

# FATIMA MATA NATIONAL COLLEGE

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# വിമുക്ത

വേദാൾഗ

# വിമുക്ത

കഥകൾ

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പരിഭാഷ

ഡോ. സുപ്രിയ ഏഓ.



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## ഉള്ളടക്കം

ആമുഖം	vii
സമാഗമം	1
ഭൂമിയുടെ സംഗീതം	19
മണൽക്കൂടം	50
വിമുക്ത	79
ബന്ധനസ്ഥൻ	101

## സമാഗമം

അസ്തമയ സൂര്യന്റെ ചെങ്കിരണങ്ങൾ വീണ് ജ്വലിച്ചു നിൽക്കുന്ന കാണനം. ആ ശോണിമയിലേക്ക് പടർന്നു കയറിയ അരണ്ട ഇരുട്ടിന്റെ പടലങ്ങളാൽ ആവൃതമായ വിപിനം, പുകവമിക്കുന്ന ഒരു തീക്കുണ്ഡത്തിന്റെ പ്രതീതി ജനിപ്പിച്ചു. ചേക്കേറാൻ പോകുന്ന പക്ഷികളുടെ ശബ്ദ കോലാഹലങ്ങളാൽ മുഖരിതമായ അന്തരീക്ഷം. പകൽ ചൂടിന്റെ അലസത കൂടഞ്ഞെറിഞ്ഞ് നിലാവെളിച്ചത്തിൽ തുള്ളിക്കളിക്കാൻ തയ്യാറെടുക്കുന്ന മാൻകൂട്ടങ്ങൾ. ഏതോ ചിത്രകാരന്റെ കലാചാതുരി പോലെ അലൗകികമായ സൗന്ദര്യത്തിൽ തുടിച്ചു നിൽക്കുന്ന പ്രശാന്ത സുന്ദരമായ ആശ്രമം.

അസ്തമന പുജയ്ക്കുള്ള ഒരുക്കങ്ങൾ ആശ്രമത്തിൽ ആരംഭിക്കുകയായി. എണ്ണം മന്ത്രധാനികൾ മുഴങ്ങി. പുന്തോട്ടത്തിൽ ചെടികൾക്ക് വെള്ളം കോരിയ ശേഷം വിശ്രമിക്കുന്ന ഒരു പറ്റം സ്ത്രീകൾ, പുജയ്ക്കാവശ്യമായ മാലകൾ കൊരുക്കുന്ന മറ്റൊരു കൂട്ടർ, വനത്തിലെ സവാരി കഴിഞ്ഞ് അക്ഷമരായി കാത്തിരുന്ന അമ്മമാരുടെ അരികത്തേക്ക് ഓടിയണയുന്ന കുട്ടികൾ. സന്ധ്യാപുജയ്ക്കായി മക്കളെ തിരക്കിട്ടൊരുക്കുന്ന മാതാക്കൾ.

അവിടെ ഒരു പർണ്ണശാലയിൽ, വനത്തിലേക്ക് പോയിരിക്കുന്ന തന്റെ പുത്രന്മാർ മടങ്ങിവരുന്നതും നോക്കി ഒരമ്മ

വാൽമീകിയുടെ രാമായണം രാമന്റെ ധീരതയുടെയും  
 ത്യാഗത്തിന്റെയും കഥയാണ്. പ്രജകൾക്ക്  
 മുന്നിൽ നന്മയുടെയും നീതിയുടെയും മുർത്തിമത്  
 ഭാവമായ രാജാവ്. എന്നാൽ വോൾഗയുടെ വിമുക്ത  
 മര്യാദാപുരുഷനായ രാമനാൽ ഉപേക്ഷിക്കപ്പെട്ട  
 സീതയുടെ ആത്മസാക്ഷാത്കാരത്തിന്റെ ദുഷ്കരമായ  
 പ്രയാണത്തിന്റെ കഥയാണ്. പാതിവ്രത്യം, മാതൃത്വം  
 എന്നീ സങ്കല്പങ്ങളിൽ അധിഷ്ഠിതമായ കുടുംബം,  
 ഭർത്താവ്, മക്കൾ എന്നീ ബന്ധനങ്ങളിൽ  
 നിന്നും ആത്മബലത്തിലൂടെ മോചനം നേടിയ  
 അസാധാരണരായ സ്ത്രീകളുമായുള്ള സീതയുടെ  
 കൂടിക്കാഴ്ചയാണ് ആ പ്രയാണത്തിന്റെ പ്രചോദനം.  
 ഇതിഹാസത്തിലെ അപ്രധാന സ്ത്രീകഥാപാത്ര  
 ങ്ങളായി നിലകൊള്ളുന്ന ശൂർപ്പണഖ, രേണുക,  
 ഊർമ്മിള, അഹല്യ എന്നിവർ സീതയെ അപ്രതീക്ഷിത  
 മായൊരു തീരുമാനത്തിലേക്കു നയിക്കുന്നു.  
 സീതാപരിത്യക്തനായ രാമനാവട്ടെ, തന്റെ  
 രാജധർമ്മം, ഭർതൃധർമ്മം എന്നീ ദന്ധാത്മക  
 കർത്തവ്യങ്ങളെ പുനരാലോചനയ്ക്കു  
 വിധേയമാക്കാൻ നിർബന്ധിതനാകുന്നു.

എല്ലാ ബന്ധങ്ങളും ഉപേക്ഷിച്ച് മാതാവായ  
 ഭൃമീദേവിയുടെ മടിത്തട്ടിൽ അഭയംപ്രാപിച്ച്  
 മുക്തിനേടുന്ന സീത എന്ന ഐതിഹാസിക  
 കഥാപാത്രം ജീവിതബന്ധങ്ങളുടെ ചങ്ങലയിൽ  
 വരിഞ്ഞുമുറുകുന്ന ഏതൊരു സ്ത്രീയുടെയും  
 പ്രതിരൂപമായി മാറുന്നു. വിമുക്തയിൽ സ്ത്രീ  
 വിമോചനത്തിനായുള്ള പോർവിളികളോ,  
 യുദ്ധകാഹളമോ മുഴങ്ങുന്നില്ല. ശാശ്വതമായ  
 ആത്മജ്ഞാനത്തിലൂടെ ലഭ്യമാകുന്ന  
 ശാന്തിമന്ത്രത്തിന്റെ ധ്വനികൾ മാത്രം.

പരിഭാഷ: ഡോ.സുപ്രിയ എം.



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# 31<sup>st</sup>

# KERALA SCIENCE CONGRESS



Our environment  
Our future  
Science and technology for  
**Rebuilding Kerala**

02-03 February, 2019  
Fatima Mata National College, Kollam

## Abstracts







The background features a grid of light blue squares. Overlaid on this grid are various hexagonal shapes in different shades of blue and white, some appearing as outlines and others as solid or semi-transparent forms. The overall aesthetic is clean, modern, and scientific.

# **ABSTRACTS**





# 31<sup>ST</sup> KERALA SCIENCE CONGRESS

02-03 February, 2019 Fatima Mata National College, Kollam

## ABSTRACTS

*Editor -in- Chief*  
Dr. S. Pradeep Kumar

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*Organized by*

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## 31<sup>ST</sup> KERALA SCIENCE CONGRESS - ABSTRACTS

### *Focal Theme*

*Our Environment – Our Future: Science and Technology for Rebuilding Kerala*

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**PINARAYI VIJAYAN**  
CHIEF MINISTER



GOVERNMENT OF KERALA

Secretariat  
Thiruvananthapuram-695 001

No.115/Press/CMO/19

29<sup>th</sup> January, 2019.

**MESSAGE**

I am extremely happy to note that the 31<sup>st</sup> Kerala Science Congress will discuss the theme "Our Environment-Our Future: Science and Technology for Rebuilding Kerala". I hope that it will serve as a game changer, paving the way for Kerala's scientists to present scientific and technological interventions which will help in rebuilding a sustainable and futuristic Kerala.

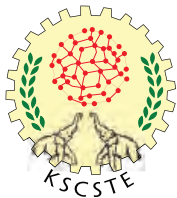
It is heartening that the Kerala Science Congress is acknowledging the budding scientists of the state, by enabling them to showcase their talents in a major platform like the KSC. I hope that the upcoming researchers will benefit by interacting with eminent scientists and academicians through the PG students' interactive session of KSC.

My best wishes to the 31<sup>st</sup> Kerala Science Congress. I hope that serious discussions will evolve out of the two-day conference. The state of Kerala looks forward to your recommendations regarding the same.

**Pinarayi Vijayan**

The Member Secretary  
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## Kerala State Council for Science, Technology and Environment



### FOREWARD

Kerala State Council for Science, Technology and Environment is organising the 31<sup>st</sup> Kerala Science Congress at Fatima Mata National College, Kollam during 2<sup>nd</sup> and 3<sup>rd</sup> February 2019. Kerala Science Congress, an annual event that has been organised for the last 30 years at different districts across the state, is an academic platform for young researchers and senior researchers alike, for sharing and exchanging their scientific achievements and knowledge. As in every year, this year's Kerala Science Congress is organised based on a focal theme "Our environment- Our future: Science and Technology for Rebuilding Kerala". The theme is utmost relevant considering the difficult phase that the State faced a few months ago. Many experts in this theme subject will deliver talk, discuss and share their expertise on various aspects of the theme.

Science Congress will also have paper and poster presentations in 12 different subject areas which include: Agriculture & Food Sciences, Biotechnology, Chemical Sciences, Earth & Planetary Sciences, Engineering & Technology, Environmental Sciences, Forestry & Wild Life, Fisheries & Veterinary Sciences, Health Science, Life Sciences, Mathematical & Statistical Sciences, Physical Sciences and Science Education, Communication & Society. There will be a leading talk by eminent scientists before the beginning of the presentation in each subject area. In addition to these other attractions of Science Congress are: Children's Science Congress and Post Graduate students' interactive session. While children's science congress gives a platform for the budding scientists to showcase their talents, the post graduate students' interactive session gives upcoming researchers a great opportunity to interact with eminent scientists in various disciplines.

I have great pleasure in presenting the abstract volume of the 31<sup>st</sup> Kerala Science Congress to the scientific community. I take this opportunity to thank all those who contributed scientific papers as well as the Chairmen and experts for their sincere effort in reviewing and selecting the papers for presentation.

This year KSCSTE is organising the Kerala Science Congress jointly with KSCSTE-Jawaharlal Nehru Tropical Botanical Garden & Research Institute and Fatima Mata National College, Kollam. I wish to congratulate and express my deep sense of gratitude to all the people involved in making Kerala Science Congress a great event.

Dr. S. Pradeep Kumar  
Member Secretary, KSCSTE





# CONTENTS

Code No.	Title	Page No.
<b>01. AGRICULTURE &amp; FOOD SCIENCE</b>		
<b>Best Paper</b>		
01-01	MANAGEMENT OF PAPAYA RINGSPOT VIRUS: THE DEADLIEST PATHOGEN EMERGING IN KERALA	1
01-02	MULTIMECHANISTIC PLANT PROBIOTIC FEATURES OF <i>BACILLUS</i> SPP. ISOLATED FROM RHIZOSPHERE OF <i>CLERODENDRUM INFORTUNATUM</i> L.	2
01-03	MICROBIAL QUALITY ANALYSIS AND STANDARDIZATION OF FRUIT ENRICHED RICE BASED PROBIOTIC YOGURT	2
01-04	BIOEFFICACY AND SOIL HEALTH IMPACT OF FLUCETOSULFURON IN WET SEEDED RICE	2
01-05	GENE PYRAMIDING FOR BACTERIAL BLIGHT RESISTANCE IN RICE VARIETY UMA	3
<b>Oral Presentation</b>		
01-06	EFFECT OF MICRONUTRIENT APPLICATION ON GROWTH AND YIELD OF OKRA IN TYPIC USTIPSAMMENTS OF KERALA	4
01-07	IN VITRO EVALUATION OF PLANT BENEFICIAL ATTRIBUTES OF TOMATO - ASSOCIATED RHIZOBACTERIA	4
01-08	NUTRIENT STICK – A COMPLETE CROP FERTILIZER FOR FUTURE	5
01-09	IMPACT OF PROJECTED CLIMATE CHANGES ON WATER BALANCE AND WATER REQUIREMENTS OF MAJOR CROPPING SYSTEMS IN KOLE LANDS	5
01-10	EFFECT OF ORGANIC MANURES AND BIOFERTILIZERS ON PLANT AND SOIL NUTRIENT STATUS UNDER PAPAYA CULTIVATION ( <i>CARICA PAPAYA</i> L.)	6
01-11	ECO-FRIENDLY MANAGEMENT OF ROOT-KNOT NEMATODE IN PEPPER USING <i>ANDROGRAPHIS PANICULATA</i> DRY POWDER	6
01-12	YIELD STABILITY ANALYSIS OF HEDGE LUCERNE GENOTYPES ( <i>DESMANTHUS VIRGATUS</i> L. WILLD)	7
01-13	CROP NUTRITIONAL RESILIENCE AS AN INTEGRAL PART OF SOIL AMELIORATION FOR ENHANCED FRUIT YIELD AND QUALITY IN PAPAYA ( <i>CARICA PAPAYA</i> L.) : AN EMERGING NUTRACEUTICALLY IMPORTANT FRUIT CROP OF KERALA	7
01-14	HYPERSPPECTRAL SIGNATURES FOR MODELING PLANT PIGMENTS AND VEGETATIVE INDICES OF DIFFERENT PADDY CULTIVARS AS A TOOL IN PRECISION FARMING	8
01-15	STANDARDISATION OF PROCESS PROTOCOL FOR OSMO-CONVECTIVE DRIED PINEAPPLE	8
01-16	PATHOGENICITY OF <i>RHABDITIS</i> , A NATIVE ENTOMOPATHOGENIC NEMATODE AGAINST TERMITE	9
01-17	NON-WOVEN FABRIC WRAP: A NEW INTERVENTION TO SUPPRESS WHITE STEM BORER ( <i>XYLOTRECHUS QUADRIPIPES</i> , CHEV.) POPULATION IN COFFEE PLANTATIONS	10
01-18	COMPARATIVE ANALYSIS OF DIOSGENIN CONTENT IN TWO SELECTED VARIETIES OF <i>DIOSCOREA</i> SP.	10
01-19	GREEN SYNTHESIZED ZINC OXIDE NANOPARTICLES AS NUTRIENT SOURCE FOR MAIZE ( <i>ZEA MAYS</i> L.)	11
01-20	CALLUS REGENERATION FROM LEAF SHEATH EXPLANTS OF SILK BANANA ‘POOVAN’ (AAB)	11
01-21	GOOD AGRICULTURAL PRACTICES FOR QUALITY RAW DRUG PRODUCTION IN BRAHMI ( <i>BACOPA MONNIERI</i> )	12
01-22	<i>IN VITRO</i> SCREENING OF SELECTED ZINGIBERALES FOR ANTIOXIDANT, ANTIFUNGAL, ANTHELMINTIC AND CYTOTOXIC ACTIVITIES	12
01-23	MOLECULAR CHARACTERIZATION OF BANANA BUNCHY TOP VIRUS IN KERALA ISOLATES	13
<b>Poster presentation</b>		
01-24	CHARACTERIZATION AND COMPARISON OF NANOBIOSENSOR FOR THE DETECTION OF BANANA BUNCHY TOP VIRUS	13
01-25	ANTIOXIDANT POTENTIAL IN RELATION TO PHENOLICS AND PIGMENTS ISOLATED FROM SOME SELECTED LANDRACES OF <i>DIOSCOREA ALATA</i> L.	14
01-26	STABILITY AND COLOR CHARACTERISTICS OF ANTHOCYANINS, ISOLATED FROM <i>DIOSCOREA ALATA</i> L., AS A NATURAL FOOD COLOURANT	14

01-27	EVALUATION OF RED <i>AMARANTHUS</i> GENOTYPES ( <i>AMARANTHUS TRICOLOR</i> L.) UNDER WATER STRESS CONDITION	15
01-28	EVALUATION OF ROS CYCLE AND TOLERANCE MECHANISM IN <i>SESAMUM ORIENTALE</i> L. AGAINST <i>ALTERNARIA SESAMI</i>	15
01-29	PROFITABILITY OF LOWLAND CASSAVA CULTIVATION AS INFLUENCED BY SOURCES OF ORGANIC MANURE AND N AND P LEVELS	16
01-30	PROFITABILITY OF TANNIA CULTIVATION AS INFLUENCED BY TILLAGE SYSTEM SOIL CONDITIONER AND NUTRIENT MANAGEMENT	16
01-31	VEGETABLE INTERCROPPING SYSTEM UNDER FERTIGATION	17
01-32	A STUDY ON THE ENTREPRENEURIAL BEHAVIOUR OF LEASE LAND VEGETABLE GROWERS IN THIRUVANANTHAPURAM DISTRICT	17
01-33	NUTRIENT ANALYSIS OF <i>PSIDIUM GUINEENSE</i> SW. (MYRTACEAE) - AN UNDERUTILIZED EDIBLE FRUIT FOUND IN KERALA.	18
01-34	VALUE - ADDED PRODUCTS FROM JACKFRUIT AND PAPAYA FOR FOOD SECURITY AND SUSTAINABLE DEVELOPMENT	19
01-35	PHYSICOCHEMICAL EVALUATION OF THE FRUITS OF CULINARY MELON AND SNAP MELON	19
01-36	PERFORMANCE EVALUATION OF GINGER ( <i>ZINGIBER OFFICINALE</i> ROSC.) VARIETIES UNDER ORGANIC NUTRITION : AN ECO FRIENDLY APPROACH TO AMELIORATE SOIL NUTRITION AND MAINTAIN SOIL SUSTAINABILITY	20
01-37	POST HARVEST TREATMENT WITH SALICYLIC ACID TO IMPROVE PHYSICAL QUALITIES OF NENDRAN BANANA DURING STORAGE	20
01-38	SEED PRIMING AND PGPR MIX-1 NUTRITION ON THE YIELD OF UPLAND RICE	21
01-39	ANTIOXIDANT POTENTIAL IN RELATION TO PHENOLICS AND PIGMENTS ISOLATED FROM SOME SELECTED LANDRACES OF <i>DIOSCOREA ALATA</i> L.	21
01-40	BACTERIAL BROOD DISEASE MANAGEMENT OF HONEY BEES ( <i>APIS CERANA INDICA</i> FAB.) USING BOTANICALS	22
01-41	ENHANCING SEED LONGEVITY IN VEGETABLE SEEDS USING FILM COAT TECHNIQUE	22
01-42	PROCESS OPTIMISATION OF A PROBIOTIC CEREAL BASED FERMENTED PRODUCT USING L. CASEI ISOLATED FROM PROBIOTIC MILK DRINK	23
01-43	A REFINED MEDIUM FOR RAPID MULTIPLICATION OF <i>DENDROBIUM</i> HYBRIDS	23
01-44	ENHANCEMENT OF RICE YIELD IN KUTTANAD THROUGH SOIL AMELIORATION AND SUPPLEMENTARY FOLIAR NUTRITION	24
01-45	COMPARATIVE PHYTOCHEMICAL ANALYSIS OF SEED OILS IN FOUR ANNONA SPECIES	24
01-46	IMPACT OF AGRICULTURAL PRACTICES IN TRIGGERING FLOOD DAMAGE AND ITS POTENTIAL SCOPE IN REDUCING THE SAME	25
01-47	GENE ACTION FOR SEED SHATTERING IN RICE ( <i>ORYZA SATIVA</i> L.)	25
01-48	IMPACT OF PRE - STORAGE SEED INVIGORATION AND PERIOD OF THAWING ON SEED LONGEVITY IN ASH GOURD ( <i>BENINCASA HISPIDA</i> (THUNB.) COGN.) SEEDS.	26
<b>02. BIOTECHNOLOGY</b>		
<b>Best Paper</b>		
02-01	GENETIC AND BIOCHEMICAL BASIS OF PEST RESISTANCE BY A DIPLOID <i>MUSA</i> CULTIVAR AGAINST BANANA PSEUDOSTEM BORER AND PROSPECTS FOR PEST MANAGEMENT	26
02-02	ECO-FRIENDLY GREEN INHIBITION OF MILD STEEL CORROSION IN ACIDIC ENVIRONMENT BY <i>TAMARINDUS INDICA</i> LEAF EXTRACT	27
02-03	CHARACTERIZATION OF BIOTIC AND ABIOTIC STRESS TOLERANT ENDOPHYTE BY PHENOMIC AND GENOMIC APPROACH FOR PLANT PROBIOTIC FUNCTION AND ENHANCED AGRICULTURAL PRODUCTIVITY	27
<b>Oral presentation</b>		
02-04	DEVELOPMENT OF AN EFFECTIVE SYSTEM FOR OVER EXPRESSION AND MOLECULAR CHARACTERIZATION OF EFFICIENT EXO-B-1,4-GLUCANASE AND ENDO - B - 1, 3 - GLUCANASE ISOLATED FROM STREPTOMYCES SPP.	28
02-05	POLYSACCHARIDE - GOLD NANOCCLUSERS AS PROFICIENT GREEN SIGNALING AGENT IN SOLID TUMOR DETECTION	29

02-06	PRODUCTION OF POLYHYDROXYBUTYRATE BY <i>BACILLUS MEGATERIUM</i> TBGSP1	29
02-07	MECHANISTIC EVALUATION OF CHITOSAN / BIOGENIC SILVER NANOPARTICLE CONJUGATE ON TUMOUR CELL LINES BY <i>IN VITRO</i> METHODS	30
02-08	PHYTOCHEMICAL AND BIOLOGICAL EVALUATION OF TROPICAL GREEN SEAWEEDS	31
02-09	PRODUCTION OF BIOPLASTIC - POLY (3 - HYDROXYBUTYRATE) IN RECOMBINANT <i>ESCHERICHIA COLI</i>	31
02-10	ANTIMICROBIAL ACTIVITY OF A NEW ENTOMOPATHOGENIC BACTERIA <i>ACINETOBACTER</i>	32
02-11	EVALUATION OF THE ROLE OF PAX6 IN RETINAL AXONAL GUIDANCE	32
02-12	BIO - INSPIRED ZNS QUANTUM DOT AS EFFICIENT PHOTO CATALYSTS FOR THE DEGRADATION OF METHYLENE BLUE IN AQUEOUS PHASE	33
02-13	A SPLICING FACTOR RBM10 CONTROLS 3'UTR PROCESSING TO REGULATE CARDIAC HYPERTROPHY	33
02-14	THE HIPPO PATHWAY EFFECTOR, YAP REGULATES CELL PROLIFERATION AND SURVIVAL IN BREAST CANCER CELLS.	34
02-15	MICROBIAL PRODUCTION OF BIOPOLYMERS FROM COIR WASTE USING <i>BACILLUS SUBTILIS</i>	34
<b>Poster presentation</b>		
02-16	ISOLATION OF PEPTIDES WITH ANTIMICROBIAL ACTIVITY FROM BLACK FIN SEA CAT FISH, <i>ARIUS JELLA</i>	35
02-17	NEXT GENERATION SEQUENCING AND ANALYSIS OF VIRAL DIVERSITY AT THE INNER ZONE OF KONGSFJORDEN, ARCTIC	36
02-18	PRELIMINARY STUDY ON THE SCREENING AND IDENTIFICATION OF DEHP DEGRADING BACTERIA ISOLATED FROM KOLLAM	36
02-19	IDENTIFICATION AND CHARACTERIZATION OF AN ANTILIPOLYPSACCHARIDE FACTOR AND CRUSTIN FROM SPECKLED SHRIMP <i>METAPENAEUS MONOCEROS</i>	37
02-20	NMR BASED METABOLITE PROFILING OF ELICITOR TREATED CALLUS CULTURES OF <i>MUCUNA PRURIENS</i> . L ON CATECHOLAMINE BIOSYNTHESIS PATHWAY WITH EMPHASIS ON L - DOPA PRODUCTION	37
02-21	ANTICANCER AND ANTIBIOTIC EXTRACTS FROM INTERTIDAL MACROALGAE ASSOCIATED HETEROTROPHS	38
02-22	STATISTICAL EVALUATION OF MEDIUM COMPONENTS FOR EXTRACELLULAR PROTEASE PRODUCTION BY <i>PENICILLIUM GOETZII</i> MF151170 USING RESPONSE SURFACE METHODOLOGY	38
02-23	MICROPROPAGATION, SYNSEED PRODUCTION AND CYTOCHEMICAL ANALYSIS OF <i>AERVA LANATA</i> JUSS.	39
02-24	DEVELOPMENT OF SSR MARKERS FOR DASHEEN MOSAIC DISEASE RESISTANCE USING BIOINFORMATICS TOOLS.	39
02-25	EXTRACTION OF ANTIMICROBIAL PIGMENT FROM <i>PSEUDOMONAS AERUGINOSA</i> ISOLATED FROM SEA WATER	40
02-26	MOLECULAR CHARACTERIZATION OF A HISTONE DERIVED PEPTIDE FROM THE MALABAR TREVALLY, <i>CARANGOIDES MALABARICUS</i>	41
02-27	TARGETED DISRUPTION OF SURVIVAL SIGNALING: AN EFFICIENT INTERVENTIONAL APPROACH TO REVERSE TUMOR RESISTANCE AND RECURRENCE	41
02-28	PRE CLINICAL EVALUATION OF THE CHEMOTHERAPEUTIC EFFECT OF KAEMPFERIDE AGAINST CERVICAL CANCER	42
<b>03 - CHEMICAL SCIENCES</b>		
<b>Best Paper</b>		
03-01	A NOVEL ZINC-CATALYZED SUZUKI-TYPE CROSS-COUPPLING REACTION OF ARYL BORONIC ACIDS WITH ALKYNYL BROMIDES	43
03-02	PREPARATION AND CHARACTERIZATION OF NOVEL POLYMER SUPPORTED METAL CATALYSTS AND ITS APPLICATIONS IN COUPLING REACTIONS	43
03-03	N - RICH ZEOLITE LIKE METAL ORGANIC FRAMEWORK ( <i>SOD</i> -ZMOF): REVERSIBLE THERMOCHROMISM AND ANION TRIGGERED METALLOGELATION	44
03-04	PHOTOLUMINESCENCE PROPERTIES OF PARA - AMINOBENZOIC ACID COMPLEXES OF EU <sup>3+</sup> AND TB <sup>3+</sup> ENCAPSULATED IN ZEOLITE Y	44

03-05	NIR - II MOLECULAR PROBE AS CONTRAST AGENT FOR PHOTOACOUSTIC IMAGING	45
<b>Oral Presentation</b>		
03-06	GRAPHENE QUANTUM DOT - PORPHYRIN NANOCONJUGATES FOR PHOTODYNAMIC THERAPY	45
03-07	A CATALYST-FREE, ECO-FRIENDLY PROTOCOL FOR THE SYNTHESIS OF 2, 3 - DIHYDRO - 1H - PERIMIDINES "ON WATER"	46
03-08	CHITIN NANO WHISKER - NATURAL RUBBER NOVEL COMPOSITES FOR GREEN TIRES: SYNTHESIS, CHARACTERIZATION AND PROPERTY EVALUATION	47
03-09	ISOLATION OF CELLULOSE NANO WHISKERS (CNW) FROM COUNTRY ALMOND SHELL (CAS) AND DEVELOPMENT OF THEIR BIOCOSCOMPOSITES.	47
03-10	MOLECULARLY IMPRINTED CONDUCTING POLYMER FOR ELECTROCHEMICAL SENSING OF CHLORPYRIFOS	48
03-11	A COMPETENT ZN (II) - BINOL CATALYTIC SYSTEM FOR C - S CROSS-COUPPLING REACTIONS	49
03-12	RECOGNITION OF AL <sup>3+</sup> ION VIA TRANSMETALATION OF NI (II) BASED BICOMPARTMENTAL SALEN SCHIFF BASE COMPOUNDS	49
03-13	STRUCTURAL INSIGHTS, SPECTRAL ASPECTS AND <i>IN VITRO</i> CYTOTOXICITY OF A ONE DIMENSIONAL COPPER(II) COORDINATION POLYMER	50
03-14	CONDUCTIVITY STUDIES OF POLYBUTYL METHACRYLATE (PBMA) BASED NANOCOMPOSITES USING CeO <sub>2</sub> NANOPARTICLES	50
03-15	SOLVENT FREE SYNTHESIS OF SPIROPYRROLIDINONES	51
03-16	A COST EFFECTIVE AND FACILE METHOD TO SYNTHESIZE BEADLESS POLYCARBONATE NANOFIBERS AND FURTHER MODIFICATION USING SURFACE COATED SEMICONDUCTOR NANOPARTICLES	51
03-17	STUDIES ON OIL RESISTANCE AND BIODEGRADABILITY OF COMPOSITES FROM CHICKEN FEATHER FIBRE AND ACRYLONITRILE BUTADIENE RUBBER	52
03-18	LUMINESCENT POLY (VINYL ALCOHOL) COMPOSITES CONTAINING SULPHUR - DOPED GRAPHENE QUANTUM DOTS FOR ULTRA SENSITIVE DETECTION OF ENVIRONMENTAL POLLUTANTS	52
03-19	SYNTHESIS, SPECTRAL STUDIES, CRYSTAL STRUCTURE AND <i>IN SILICO</i> MOLECULAR DOCKING OF THIOSEMICARBAZONE CU(II) COMPLEX	53
03-20	DEVELOPMENT OF COBALT NICKEL BASED METAL ORGANIC FRAMEWORK FOR PHOTOCATALYTIC HYDROGEN EVOLUTION	54
03-21	POLY(P-AMINO HYDROXYL NAPHTHALENE SULPHONIC ACID) MODIFIED ELECTROCHEMICAL SENSOR FOR THE SIMULTANEOUS DETERMINATION OF XANTHENE AND HYPOXANTHENE	54
03-22	SYNTHESES, SPECTRAL ASPECTS AND BIOLOGICAL STUDIES OF BROMIDE AND AZIDE BRIDGED BOX DIMER COPPER (II) COMPLEXES OF NNO DONOR AROYLHYDRAZONE	55
03-23	SYNTHESIS OF NOVEL MECHANORESPONSIVE AND SELF - HEALABLE POLY(METHYL METHACRYLATE) INCORPORATING STRATEGICALLY POSITIONED ANTHRACENE-BISMALEIMIDE DIELS - ALDER ADDUCT DERIVED MECHANOPHORE THROUGH SINGLE ELECTRON TRANSFER - LIVING RADICAL POLYMERIZATION (SET - LRP) UNDER AMBIENT CONDITIONS.	55
<b>Poster Presentation</b>		
03-24	METAL FREE MODIFICATION ON Ag <sub>3</sub> VO <sub>4</sub> PHOTOCATALYST FOR AUGMENTED SUNLIGHT INDUCED DEGRADATION OF ORGANIC POLLUTANTS IN WATER	56
03-25	NOVEL SYNTHESIS OF IMIDAZO [1,2-a] PYRIDINES <i>via</i> Fe(III)-IODIDE CATALYZED ORTOLEVA-KING - TYPE REACTION	57
03-26	A NOVEL LIGAND - FREE MANGANESE-CATALYZED C-O COUPLING PROTOCOL FOR THE SYNTHESIS OF BIARYL ETHERS	57
03-27	MICROWAVE ASSISTED SYNTHESIS OF INTERNAL ALKYNES USING COPPER - CATALYZED SUZUKI TYPE COUPLING REACTIONS	58
03-28	FABRICATION OF SOLID STATE DYE SENSITIZED SOLAR CELL WITH CARBAZOLE BASED HOLE TRANSPORTING MATERIAL	59
03-29	DESIGN AND EVALUATION OF STRUCTURAL AND <i>IN VITRO</i> CHARACTERIZATION OF CHITOSAN FUNCTIONALIZED LAYERED DOUBLE HYDROXIDE NANOCOMPOSITE: A VERSATILE NANOCOMPOSITE FOR DUAL RESPONSIVE ANTICANCER DRUG DELIVERY	63

03-30	NEW MOLYBDENUM DIOXIDE COMPLEX INCORPORATING N(4) - (3 - METHOXYPHENYL) THIOSEMICARBAZONE: SYNTHESIS, CRYSTAL STRUCTURE, OXO TRANSFER PROPERTIES AND CATALYTIC USE IN THE OXIDATION OF STYRENE THROUGH OXIDO - PEROXO MOLYBDENUM INTERMEDIATE	63
03-31	SYNTHESIS AND EVALUATION OF PHOTOPHYSICAL PROPERTIES OF AN OXADIAZOLE-PHENOTHIAZINE HYBRID DONOR - ACCEPTOR SYSTEM	64
03-32	PLANARITY CONTROLS THE ULTRAFAST INTRA MOLECULAR SINGLET FISSION DYNAMICS IN PENTACENE DIMMERS	65
03-33	IRON - LOADED BIOCHAR AS A SUPER CAPACITORS	65
03-34	BIO-SYNTHESIS OF CALCIUM OXIDE NANOPARTICLE AND ITS ANTIBACTERIAL ACTIVITY	65
03-35	THE CONTROLLED RELEASE STUDY OF THE ANTI-CANCEROUS DRUG 5 - FLUOROURACIL FROM MODIFIED NATURAL CLAY	66
03-36	A NOVEL ELECTROCHEMICAL SENSOR FOR THE DETERMINATION OF MORPHINE BASED ON THE CONDUCTING POLYMER POLY (CTAB) / GRAPHENE OXIDE NANOCOMPOSITE.	66
03-37	POST-SYNTHETIC MODIFICATION OF KETONE BASED AROMATIC MICROPOROUS ORGANIC FRAMEWORKS FOR CARBON DIOXIDE CAPTURE	67
03-38	ANTIMICROBIAL LEUKOCYTE REMOVAL FILTER BASED ON ELECTROSPUN POLYMER HYBRID FIBRE FUNCTIONALIZED WITH NANOPARTICLES	67
03-39	DNA CONDENSATION THROUGH ORDERED ASSEMBLY OF FULLERENE AMPHIPHILE	68
03-40	CONVENIENT SYNTHESIS OF PYRIDINE AND PYRIMIDINE DERIVATIVES USING PORPHYRIN CORED G1 PAMAM DENDRIMER AS HOMOGENEOUS CATALYST	68
03-41	A NOVEL NEUROTRANSMITTER SENSOR BASED ON METAL DOPED GRAPHENE - CHITOSAN COMPOSITE	69
03-42	CRYSTAL STRUCTURE AND SUPRAMOLECULAR INTERACTIONS IN NITRATE COMPLEXES OF SM(III) AND CE(III) WITH 5, 5' - DIMETHYL 2, 2' - BIPYRIDINE.	69
03-43	SILVER BASED NANOHYBRID AS AN EFFICIENT ELECTROCHEMICAL SENSOR AND PHOTOCATALYST	70
03-44	SYNTHESIS OF NOVEL ISOCHROMANS – PROMISING MOLECULES TO SHOW PLANT GROWTH REGULATING PROPERTIES	70
03-45	HPTLC QUANTIFICATION OF A NEUROTOXIC ACETOGENIN ANNONACIN IN DIFFERENT PARTS OF <i>ANNONA MURICATA</i>	71
03-46	FLUORESCENCE TURN ON SENSOR FOR CARBOFUAN BASED ON GRAPHENE QUANTUM DOT- MANGOSTEEN INTERACTIONS	71
03-47	ENHANCED FLUORESCENCE USING HOST-GUEST FORMATION ON SOLID SURFACES	72
03-48	WASTE HEAT TO ENERGY: THIOPHENE BASED SEMICONDUCTING OLIGOMERS FOR THERMOELECTRIC APPLICATIONS	72
03-49	THERMALLY INDUCED DYNAMIC SWITCHING OF SOLID - STATE LUMINESCENCE FOR SMART OPTOELECTRONIC DEVICE APPLICATIONS	73
03-50	YELLOW PHASE $\Delta$ -FAPBI <sub>3</sub> NANORODS – AN INSIGNIFICANT MATERIAL RENOVATES INTO VALUABLE RESISTIVE SWITCHING MEMORY DEVICE	73
<b>04-EARTH &amp; PLANETARY SCIENCES</b>		
<b>Best Paper</b>		
04-01	CRUSTAL STRUCTURE ACROSS AND ALONG THE WESTERN GHATS: INSIGHTS FROM PS CONVERTED PHASES	74
04-02	SUBMERGENCE OF MUNROE ISLAND: QUANTIFIABLE INSIGHTS FROM SATELLITE BASED DINSAR TIME SERIES	74
04-03	INTENSIFICATION OF SOUTHWEST MONSOON OVER KERALA IN 2018: QUANTIFICATION AND MECHANISMS	75
04-04	GROUNDWATER-SEAWATER INTERACTION ALONG THIRUVANANTHAPURAM COAST, KERALA	76
<b>Oral Presentation</b>		
04-05	ROLE OF CHANGING DYNAMIC PARAMETERS IN CONTROLLING THE EXTREME EVENTS OVER PENINSULAR INDIA IN THE RECENT DECADES	76
04-06	MAJOR ION CONCENTRATION IN THE GROUNDWATER SOURCES OF BHAVANI RIVER BASIN (KERALA) - ITS IMPLICATIONS ON SILICATE WEATHERING	77

04-07	HYDROBIOLOGICAL CHARACTERISTICS AND COMMUNITY STRUCTURE OF MICROPHYTOPLANKTON ALONG THE SOUTH EASTERN ARABIAN SEA DURING EARLY SUMMER MONSOON	78
04-08	SOLUTE TRANSPORT THROUGH THE RIVERS DRAINING SILENT VALLEY AND ADJOINING REGIONS OF SOUTHERN WESTERN GHATS, INDIA	78
04-09	SPATIAL VARIATION OF RAINFALL $\Delta 18O$ OVER PENINSULAR INDIA REFLECTING THE MOISTURE TRANSPORT MECHANISM DURING NORTHEAST MONSOON RAINFALL	79
04-10	IMPACT OF PENETRATING ELECTRIC FIELDS TO THE EQUATORIAL THERMOSPHERE-IONOSPHERE SYSTEM	79
04-11	<i>IN - SITU</i> AND MODELING INVESTIGATION OF LIGHT ABSORBING AEROSOLS OVER THE HIMALAYAS	80
04-12	RESPONSE OF EQUATORIAL AND LOW LATITUDE IONOSPHERE OVER INDIAN REGION TO A LONG DURATION MIDNIGHT M1.4 CLASS SOLAR FLARE	80
04-13	REGIONAL VARIABILITY OF SUMMER MONSOON RAINFALL OVER INDIA AND ITS ASSOCIATION WITH LOWER TROPOSPHERIC STABILITY	81
04-14	VOLUME ESTIMATION OF TILE/BRICK CLAY FROM IDENTIFIED SUITABLE SITES FOR MINING IN THRISSUR DISTRICT USING GEOSPATIAL TECHNIQUES	81
04-15	COMPUTATION OF SUBMARINE GROUNDWATER DISCHARGE USING RADON MASS BALANCE MODEL	82
04-16	SPATIAL DISTRIBUTION OF MESOZOOPLANKTON ALONG THE SOUTH EASTERN ARABIAN SEA DURING EARLY SUMMER MONSOON	82
04-17	GEOSPATIAL AND ANALYTICAL NETWORK PROCESS TOOL MIX FOR LANDSLIDE VULNERABILITY MAPPING IN KUTTIYADI RIVER BASIN, NORTHERN KERALA	83
04-18	A STUDY OF THE URBAN HEAT ISLAND IN A COASTAL CITY INTERLACED BY WETLANDS	84
04-19	MAPPING FLOOD AFFECTED AREAS ON GROUND IN ERNAKULAM, THRISSUR AND PALAKKAD DISTRICTS IN KERALA, INDIA	84
04-20	AN OPERATIONAL FRAMEWORK FOR MONITORING WEATHER AND CLIMATE FOR KERALA: DATA SOURCES, PROCESSING AND OUTCOME SHARING	85
04-21	MONITORING FLOOD AREAS USING MICROWAVE SATELLITE DATA - A CASE STUDY OF ALUVA TALUK - KERALA	85
<b>Poster Presentation</b>		
04-22	SUBSURFACE DIURNAL TEMPERATURE FLUCTUATIONS AND THERMAL CONDUCTIVITY AT A TROPICAL STATION	86
04-23	DIURNAL AND SEASONAL VARIABILITY OF SUBSURFACE HEAT FLUX AT A TROPICAL STATION	86
<b>05-ENGINEERING &amp; TECHNOLOGY</b>		
<b>Best Paper</b>		
05-01	GROWTH AND CHARACTERIZATION OF MOLYBDENUM OXIDE NANORODS BY PULSED LASER ABLATION: ANNEALING INDUCED PHASE TRANSITION	87
05-02	COBALT PHTHALOCYANINE-BASED ORGANIC FIELD EFFECT TRANSISTORS FOR ULTRAVIOLET SENSOR APPLICATIONS	88
05-03	ULTRA FAST HEAT DISSIPATING AEROGELS DERIVED FROM POLYANILINE ANCHORED CELLULOSE NANOFIBERS AS EFFICIENT MICROWAVE ABSORBERS IN THE X BAND	88
05-04	AUTOMATION OF BANDWIDTH REDESIGN AND ITS APPLICATIONS IN AMPLIFIER TUNED OSCILLATORS BASED ON NULLORS	89
05-05	PVA / POLYPHOSPHORIC ACID MODIFIED MMT COMPOSITE: AN EFFECTIVE SOLUTION FOR WATER PURIFICATION	90
<b>Oral Presentation</b>		
05-06	EXPERIMENTAL STUDIES ON MECHANICAL PROPERTIES OF FIBER REINFORCED BITUMINOUS MIXES	90
05-07	DEVELOPMENT OF RING ROAD AND NMT CORRIDOR FOR AN EMERGING TOWN IN KERALA	91
05-08	PERFORMANCE ANALYSIS OF KSRTC DEPOTS IN THIRUVANANTHAPURAM CITY USING ANALYTICAL HIERARCHICAL PROCESS	92
05-09	IDENTIFICATION OF MAJOR FACTORS INFLUENCING WORK TRIPS IN THIRUVANANTHAPURAM CITY	92

05-10	IMPROVEMENT PROPOSAL FOR RECTIFICATION OF TRAFFIC PROBLEMS IN CONGESTED JUNCTIONS USING RING ROAD CONCEPT – A CASE STUDY OF KUNNAMKULAM JUNCTION IN THRISSUR DISTRICT	93
05-11	HOLOGRAPHIC RECORDING OF MICROSCOPIC IMAGES USING PHASE SHIFT INTERFEROMETRY	94
05-12	ENHANCED PEDESTRIAN DETECTOR USING FIRST ORDER AND SECOND ORDER AGGREGATED CHANNEL FEATURES	94
05-13	MODE CHOICE ANALYSIS OF WORKERS: A CASE STUDY FROM KOCHI CITY	95
05-14	STUDY OF USE OF INDUSTRIAL WASTE MATERIALS FOR DEVELOPMENT OF AERATED MASONRY BLOCKS	96
05-15	PARAMETRIC RESPONSE ESTIMATION OF DIAPHRAGM WALL BEHAVIOURS FOR OPTIMAL SYSTEM CONFIGURATIONS	96
05-16	MECHANICAL PROPERTIES OF CHICKEN FEATHER FIBRE REINFORCED NATURAL RUBBER BIOCOMPOSITES	97
05-17	ROBUST HAND POSTURE RECOGNITION USING SVM CLASSIFIER WITH GABOR AND DWT FEATURES	97
05-18	A COMPARISON OF PERFORMANCE OF MARGIN INFUSED RELAXED ALGORITHM AND SUPPORT VECTOR MACHINE ON THE TASK OF WORD SENSE DISAMBIGUATION FOR MALAYALAM	98
05-19	EVALUATION OF GROUNDWATER QUALITY AT CHAVARA, KOLLAM DISTRICT, KERALA USING GIS AND MODFLOW	98
05-20	SYNCHRONOUS GENERATOR EMULATION IN POWER ELECTRONIC CONVERTERS FOR IMPROVING THE GRID INERTIA	99
05-21	CHARACTERIZATION OF DC MAGNETRON SPUTTERED COPPER THIN FILM ON ALUMINIUM TOUCH SURFACE	99
<b>Poster Presentation</b>		
05-22	WHEN NATURE MEETS TECH: AUGMENTED REALITY FOR REBUILDING TOURISM AND HOSPITALITY	100
05-23	HIGHLY TOUGHENED NANOSTRUCTURED SELF ASSEMBLED THERMOSETS - AEROSPACE AND AUTOMOBILE APPLICATIONS	100
05-24	GEPOLYMER: A SUBSTITUTE FOR PORTLAND CEMENT AND SOLUTION FOR DURABILITY ISSUES OF CONCRETE	101
05-25	DESIGN, CONSTRUCTION AND APPLICATION OF VARIABLE DUTY CYCLE OPTICAL CHOPPER	102
05-26	STRUCTURAL AND OPTICAL CHARACTERIZATION OF SOL - GEL SPIN COATED ZNO THIN FILMS	102
05-27	MECHANICAL, DIELECTRIC AND MORPHOLOGICAL CHARACTERIZATION OF HDPE-CHITOSAN - HYDROXYAPATITE COMPOSITES FOR ORTHOTIC APPLICATIONS	103
05-28	FABRICATION OF FLEXIBLE, DISPOSABLE NANOCELLULOSE BASED SERS SUBSTRATES FOR TRACE LEVEL SENSING OF ENVIRONMENTAL CONTAMINANTS	103
05-29	A STUDY ON DRIVING BEHAVIOURAL ASPECTS OF GOODS VEHICLE DRIVERS	104
05-30	PHOTONIC CRYSTALS OF CORE-SHELL COLLOIDAL PARTICLES AS APTASENSOR FOR ENVIRONMENTAL MONITORING	104
05-31	STUDY OF SEASONAL VARIATIONS IN OPTICAL SIGNAL ATTENUATION DUE TO TROPOSPHERIC EXTINCTION	105
05-32	COMPARISON OF DIFFERENT CONTROL STRATEGIES AND ITERATIVE METHODS USED FOR IMPLEMENTATIONS OF A PHOTOVOLTAIC EMULATOR FOR MICROGRID APPLICATIONS	106
05-33	DATA DRIVEN DEPENDENCY PARSING OF MALAYALAM LANGUAGE	106
05-34	SAFE AND SECURE HOMES FOR KERALA	107
05-35	COMPARITIVE STUDY OF 3D - PRINTING AND CONVENTIONAL CONSTRUCTION PRACTICES	107
05-36	MALAYALAM PARTS OF SPEECH Tagger	108
<b>06 - ENVIRONMENTAL SCIENCE, FORESTRY &amp; WILDLIFE</b>		
<b>Best Paper</b>		
06-01	REDISCRPTION OF THE BAGWORM MOTH <i>EUMETA CRAMERI</i> WESTWOOD (LEPIDOPTERA: PSYCHIDAE) WITH MORPHOLOGICAL AND MOLECULAR DATA FROM KERALA, INDIA	108



06-02	THREE - DIMENSIONAL RECONSTRUCTION OF TREES AND DIRECT ESTIMATION OF LEAF AREA INDEX OF A TROPICAL FOREST USING TERRESTRIAL LASER SCANNER LiDAR POINT CLOUD	108
06-03	UHLA PROCESS FOR THE EFFECTIVE UTILISATION OF IRON OXIDE WASTE FROM TITANIUM INDUSTRY	109
06-04	NAKED-EYE COLORIMETRIC SENSOR FOR THE DETECTION OF CYANIDE IONS IN AQUEOUS MEDIA USING GREEN SYNTHESIZED SILVER NANOPARTICLES	110
06-05	LINEAR INTRUSIONS AND NATURAL DISASTERS INCREASE SPREAD OF INVASIVE ALIEN SPECIES - A CASE STUDY FROM THE FORESTED LANDSCAPES OF CENTRAL KERALA.	110
<b>Oral Presentation</b>		
06-06	BIOREMEDIATION STUDY OF BIOSURFACTANT PRODUCING BACTERIAL BLOOM FROM OIL CONTAMINATED SITES AFTER FLOOD IN KERALA	111
06-07	THE IMPACT OF FLOOD ON MICROALGAE ALONG THE LOWER REACHES OF PERIYAR AND CHALAKKUDY RIVERS	111
06-08	AQUATIC BUGS (ORDER: HEMIPTERA) AS POTENTIAL BIOINDICATOR OF TWO DIFFERENT POND ECOSYSTEMS: A CASE STUDY	112
06-09	FOREST DEPENDENCE AND COMMUNITY WELL BEING IN PARAMBIKULAM TIGER RESERVE, KERALA	112
06-10	BIODEGRADATION OF CHLORPYRIFOS PESTICIDE USING AUTOCHTHONOUS <i>BACILLUS</i> CONSORTIUM	113
06-11	AN ALL KERALA STUDY CONDUCTED ON THE EFFECTS OF MOBILE TOWER AND MOBILE PHONE RADIATIONS ON HUMAN	113
06-12	APPLICATION OF UP - FLOW ANAEROBIC BIOFILTER AND HORIZONTAL FLOW SUBSURFACE CONSTRUCTED WETLAND IN KITCHEN GREYWATER TREATMENT	114
06-13	EFFECT OF PHYTOSYNTHESISED SILVEROXIDE NANOPARTICLES ON THE DEGRADATION OF AN ANIONIC DYE – COOMASSIE BRILLIANT BLUE	115
06-14	A DETAILED REDESCRIPTION OF <i>JAMIDES CELENO</i> (LYCAENIDAE, INSECTA) FROM A MORPHOLOGICAL, ANATOMICAL AND MOLECULAR PERSPECTIVE	115
06-15	A PRELIMINARY QUANTIFICATION OF THE MOTH ASSEMBLAGES IN HUMAN HABITATIONS IN AN URBAN AND RURAL AREA OF THRISSUR DISTRICT WITH EMPHASIS ON POST, PRE AND FLOOD SEASON	116
06-16	FATE OF PHOSPHORUS FRACTIONATION IN CORE SEDIMENTS OF MANGROVE ECOSYSTEM- MALIPPURAM, COCHIN, SOUTHWEST COAST OF INDIA.	116
06-17	AN ANALYSIS OF FUNCTIONAL FEEDING GROUPS OF BENTHIC MACROINVERTEBRATES IN BIOMONITORING OF PAMPA RIVER	117
06-18	ENVIRONMENTAL IMPACT OF MINING AND QUARRYING IN NETRAVATI-GURPUR RIVER BASINS: A GEO - ENVIRONMENTAL APPRAISAL	117
06-19	IMPACT OF FORESTRY PRACTICES ON PRIMARY NATURAL FORESTS IN THE WESTERN GHATS: A CASE STUDY FROM VAZHACHAL FOREST DIVISION, KERALA	118
06-20	ROLE OF TERMITES IN LIGNOCELLULOSIC WASTE MANAGEMENT	118
06-21	AN INTEGRATED APPROACH FOR RAW DRUG AUTHENTICATION IN <i>SARACA ASOCA</i>	119
06-22	ADAPTIVE PRIVATE ALLELES IN THE GEOGRAPHICALLY DISTINCT NATURAL TEAK POPULATIONS OF KERALA	119
06-23	SYNTHESIS AND CHARACTERIZATION OF NANO HYDROXY APATITE DECORATED CARBOXYL FUNCTIONALIZED GRAPHENE OXIDE / ZINC OXIDE NANOROD COMPOSITE FOR THE EFFECTIVE DEGRADATION OF CHLORPYRIFOS FROM AQUEOUS SOLUTIONS	120
06-24	PARMELIOID LICHENS OF KERALA, CURRENT STATUS AND NEED OF TAXONOMIC AND PHYLOGENETIC UPDATION OF THE FAMILY PARMELIACEAE	120
<b>Poster Presentation</b>		
06-25	ARECANUT AND COCONUT TREES, THE UNIQUE HOSTS PREFERRED BY EPIPHYTIC LICHENS IN LOWER ALTITUDE: A CASE STUDY FROM ERNAKULAM DISTRICT, KERALA	121
06-26	ANALYSIS OF ECO-PHYSIOLOGICAL AND ALLELOPATHIC EFFECTS OF TWO SPECIES OF REED BAMBOOS IN THE RESERVE FORESTS IN THIRUVANANTHAPURAM DISTRICT, KERALA.	121

06-27	ANALYSIS OF HEAVY METAL POLLUTION ON PARVATHY PUTHANAR, AN ARTIFICIAL RIVER CANAL IN THIRUVANANTHAPURAM DISTRICT, SOUTH KERALA	122
06-28	TRACKING BIODIVERSITY WITH CITIZEN SCIENCE - A CASE STUDY OF eBird IN KERALA	122
06-29	LOGISTIC REGRESSION MODEL AND TEMPORAL ACTIVITY PATTERN OF STRIPE - NECKED MONGOOSE OF SILENT VALLEY NATIONAL PARK	123
06-30	DEVELOPMENT OF AN INDEX FOR SOIL QUALITY ASSESSMENT OF MANGROVES IN KERALA	123
06-31	ZOOPLANKTONS AS INDICATORS IN THE SEASONAL ECOLOGY OF THREE PONDS OF ERNAKULUM DISTRICT OF KERALA	124
06-32	ECO-PHYSIOLOGICAL STUDIES IN RELATION TO HEAVY METAL CONTENT IN DIFFERENT STRATEGIC AREAS/PLANTS OF KADALUNDI VALLIKKUNNU COMMUNITY RESERVE	124
06-33	NOVELTIES FROM MATHIKETTAN SHOLA NATIONAL PARK, KERALA, INDIA	125
06-34	EVALUATION OF WATER QUALITY STATUS OF PARVATHY PUTHANAR CANAL, THIRUVANANTHAPURAM, KERALA, SOUTH INDIA	125
06-35	DETECTION OF WATER POLLUTION INDICATORS AND OTHER MULTIDRUG RESISTANT PATHOGENIC BACTERIA IN THE DRINKING WATER SOURCES OF CHENGANNUR AFTER FLOOD- A MAJOR THREAT	126
06-36	SOIL HEALTH STATUS OF SELECTED LAND USE SYSTEMS IN A REGION OF ACHENKOVEL WATERSHED, KOLLAM DISTRICT: A STUDY ON THE IMPACTS OF LAND USE AND MANAGEMENT	127
06-37	DIVERSITY AND DISTRIBUTION OF BIRDS IN MIDLAND LATERITIC BIOTOPES OF NORTHERN KERALA, INDIA	127
06-38	MACRO - PROLIFERATION OF THE BLACK BAMBOO, <i>GIGANTOCHLOA ATROVIOLACEA</i> WIDJAJA	128
06-39	TIO <sub>2</sub> - REDUCED GRAPHENE OXIDE NANOCOMPOSITE: A NOVEL CATALYST FOR SOLAR DECONTAMINATION OF WATER FROM DRUG POLLUTANTS	128
06-40	FOOD AND FEEDING HABITS OF SCHNEIDERS LEAF - NOSED BAT, <i>HIPPOSIDEROS SPEORIS</i> (SCHNEIDER, 1800) FROM PEECHI - VAZHANI WILDLIFE SANCTUARY	129
06-41	PHYCOREMEDIATION OF PULP AND PAPER MILL EFFLUENT USING <i>PLANKTOCHLORERLLA NUREKIS</i>	129
06-42	FLOOD INUNDATION ANALYSIS USING DEM AND LAND COVER MAP	130
<b>07-FISHERIES &amp; VETERINARY SCIENCES</b>		
<b>Best Paper</b>		
07-01	SUPPLEMENTATION OF PROBIOTIC <i>PAENIBACILLUS POLYMYXA</i> HGA4C INDUCES MORPHOMETRIC, ENZYMATIC AND GENE EXPRESSION CHANGES IN A TELEOST FISH <i>OREOCHROMIS NILOTICUS</i>	130
07-02	NATURAL ANTIOXIDATIVE EXTRACTS FROM FRUIT PEEL WASTES FOR SEAFOOD PRESERVATION	131
07-03	EVALUATION OF RUMEN METAGENOME AND METHANE EMISSION LEVELS BETWEEN VECHUR AND CROSSBRED CATTLE OF KERALA	132
07-04	VALIDATION AND ASSOCIATION STUDIES OF SINGLE NUCLEOTIDE POLYMORPHISMS IDENTIFIED IN PROLIFICACY RELATED GENES OF GOATS USING DOUBLE DIGEST RESTRICTION ASSOCIATED DNA SEQUENCING	132
07-05	A COMPREHENSIVE APPROACH FOR DIAGNOSIS OF PORCINE LEPTOSPIROSIS: AN UNDER-REPORTED THREAT TO HUMANS	133
<b>Oral Presentation</b>		
07-06	BIODIVERSITY OF <i>PLAKOBRANCHIIDS</i> (GASTROPODA: PLAKOBRANCHIDAE) FROM SOUTH-WEST COAST OF INDIA	133
07-07	EFFECT OF VARYING DIETARY PROTEIN AND LIPID LEVELS ON GROWTH AND REPRODUCTIVE PERFORMANCE OF ORANGE CHROMIDE <i>ETROPLUS MACULATUS</i> (1795)	134
07-08	ANTIBIOTIC RESISTANCE AND VIRULENCE FACTORS OF <i>AEROMONAS</i> SPP. ISOLATED FROM DISEASED <i>XIPHOPHORUS HELLERII</i>	134
07-09	MOLECULAR PHYLOGENY OF PORCINE REPRODUCTIVE AND RESPIRATORY SYNDROME VIRUS CIRCULATING IN KERALA	135

07-10	WHOLE MITOGENOME SCANS PROVIDE EVIDENCE FOR LOCALLY ADAPTED POPULATIONS OF INDIAN OIL SARDINE, <i>SARDINELLA LONGICEPS</i> IN THE INDIAN OCEAN	135
07-11	MOLECULAR CHARACTERIZATION OF ANTIVIRAL RADICAL-SAM PROTEIN VIPERIN HOMOLOGUE IN ASIAN SEA BASS ( <i>LATES CALCARIFER</i> )	136
07-12	INFLUENCE OF TOMATO, LADIES FINGER AND SPINACH ON THE UTILIZATION OF INORGANIC NITROGEN IN MEDIA BASED EBB - AND - FLOW AQUAPONICS SYSTEM	137
07-13	EVALUATION OF TOTAL MIXED RATIONS CONTAINING UNCONVENTIONAL FEED INGREDIENTS IN CROSSBRED CATTLE	137
07-14	DEVELOPMENT OF SYNBIOTIC ICE CREAM FROM GOAT MILK	138
07-15	SEROPREVALENCE OF LEPTOSPIROSIS IN THRISSUR DISTRICT OF KERALA – A RETROSPECTIVE STUDY	138
07-16	MOLECULAR DETECTION OF INFECTIOUS BURSAL DISEASE VIRUS (IBDV) IN KERALA	139
07-17	MOLECULAR DETECTION OF ROTAVIRUS OF PIGS IN KERALA	140
07-18	A PRELIMINARY EVALUATION OF <i>SAUROPLUS ANDROGYNOUS</i> (L.) MERRILL LEAF MEAL AS A PARTIAL REPLACEMENT OF FISH MEAL IN THE DIETS FOR PACIFIC WHITE SHRIMP, <i>LITOPENAEUS VANNAMEI</i> (BOONE, 1931)	140
07-19	EFFECT OF PHYTOADDITIVE COMBINATIONS ON CONTROL OF <i>MUSCA DOMESTICA</i> POPULATION IN POULTRY SHED	141
<b>Poster presentation</b>		
07-20	OCCURRENCE OF INTESTINAL LESIONS IN CHICKENS – A ONE - YEAR PROSPECTIVE STUDY IN PURE LINE CHICKENS	141
07-21	OCCURRENCE OF ESBL <i>ESCHERICHIA COLI</i> FROM LAYER BIRDS OF ORGANIZED POULTRY FARM IN WAYANAD DISTRICT, KERALA	142
07-22	MICROPLASTIC STATUS IN THE GUT CONTENT OF <i>MUGIL CEPHALUS</i> LINNAEUS, 1758 FROM POONTHURA ESTUARY, THIRUVANANTHAPURAM: BEFORE AND AFTER THE CYCLONE OCKHI	143
07-23	IMPACT OF FREQUENCY OF TRANS - VAGINAL OOCYTE RECOVERY AND REPEAT BREEDING ON YIELD AND QUALITY OF OOCYTES	143
07-24	OCCURRENCE OF <i>CAMPYLOBACTER</i> SPP. IN A PIG FARM IN THRISSUR DISTRICT	144
07-25	VACCINATION FAILURE AND OUTBREAK OF INFECTIOUS BURSAL DISEASE IN AN ORGANIZED POULTRY FARM	145
07-26	A MORPHOMETRIC STUDY OF SPECIES OF <i>AMBLYPHARYNGODON</i> BLEEKER, 1860 (TELEOSTEI: CYPRINIFORMES: CYPRINIDAE) FROM THE RIVERS OF WESTERN GHATS, KERALA.	145
07-27	BIOFILM DEVELOPMENT ON MUNDACKAL BEACH, KOLLAM, KERALA	146
07-28	LEPTOSPIROSIS IN CATTLE IN FLOOD AFFECTED AREA IN THRISSUR DISTRICT – A CASE REPORT	146
07-29	EFFECTS OF SALINITY AND WATER QUALITY PARAMETERS ON THE BREEDING AND LARVA REARING OF BLACK MOLLY <i>POECILIA SPHENOPS</i>	147
07-30	CANINE MAMMARY TUMOUR: HISTOPATHOLOGICAL VARIANTS	147
<b>008 - HEALTH SCIENCE</b>		
<b>Best Paper</b>		
08-01	DECIPHERING THE MOLECULAR EVENTS REGULATED BY TRYPTANTHRIN IN MELANOMA	148
08-02	ALGINATE DIALDEHYDE - GELATIN HYDROGEL SUBSTITUTE FOR MENISCAL REPAIR – A BOON TO ATHLETES AND LABOURERS	148
08-03	DEVELOPMENT OF A NOVEL HUMAN TISSUE DERIVED SKIN SUBSTITUTE AND PRECLINICAL EVALUATION IN ANIMAL WOUND MODELS	149
08-04	MYOCARDIAL CALCIUM - CALMODULIN - DEPENDENT PROTEIN KINASE II - DELTA (CAMKII- $\Delta$ ) SIGNALING REGULATION THROUGH NRF2/HO-1 SIGNALING PATHWAY BY CLOVE OIL, EUGENOL	150
08-05	EXPLORATION OF NEW PHYTOCHEMICAL ENTITIES FROM <i>HYDNOCARPUS WIGHTIANA</i> BLUME EVOLVED AS POTENT ANTICANCER HITS INDUCING MITOCHONDRIA MEDIATED APOPTOSIS THROUGH CYT C RELEASE	150

<b>Oral Presentation</b>		
08-06	WHERE DO WE LAG? : ACHIEVING ELIMINATION OF MOTHER TO CHILD TRANSMISSION (EMTCT) OF HIV IN INDIA	151
08-07	PHENOLIC CHARACTERIZATION OF HOT PRESSED AND FERMENTED VIRGIN COCONUT OIL AND COMPARATIVE ASSESSMENT OF THEIR ANTI - INFLAMMATORY POTENTIAL	152
08-08	ELECTROCHEMICAL SENSING OF METHYLMALONIC ACID: FUNCTIONAL BIOMARKER OF VITAMIN B-12 STATUS	152
08-09	A HIGH THROUGHPUT SCREENING METHOD USING PBMC FOR DETECTING T CELL IMMUNE RESPONSE INTRODUCTION	153
08-10	<i>HIBISCUS ROSA SINENSIS</i> L. ANTHOCYANINS MODULATES DIABETIC DYSLIPIDEMIA IN STREPTOZOTOCIN INDUCED DIABETIC RATS	153
08-11	PROFILE OF GUT MICROBIAL DIVERSITY FROM HUMAN SUBJECTS IN KERALA - HEALTHY VERSUS DIABETIC	154
08-12	AN "EX VIVO" ENGINEERED HUMAN TUMOR MODEL FOR RAPID AND REAL - TIME CANCER DRUG DISCOVERY	154
08-13	STAR FRUIT AS A POTENTIAL ANTIOXIDANT	155
08-14	ENGINEERED BONE FOR LOAD BEARING APPLICATIONS	156
08-15	HEART MURMUR FOR DEFECT IDENTIFICATION – A FFT AND WAVELET STUDY	156
08-16	CHEMOTHERAPEUTIC LOADED POLYSACCHARIDE - METAL NANOFORMULATION FOR ANTI-GLIOMA THERAPY	157
08-17	EXPRESSION OF PD-L1 IN TRIPLE NEGATIVE BREAST CANCER: A POTENTIAL BIOMARKER FOR IMMUNOTHERAPY	157
08-18	THREE DIMENSIONAL CELL CULTURE SYSTEMS FOR IN SITU CYTOCOMPATIBILITY EVALUATION OF SELECT PHYTOCHEMICALS FOR NEURAL TISSUE ENGINEERING APPLICATIONS	158
08-19	EVALUATION OF ANTI INFLAMMATORY ACTIVITY OF KOKILAKSHAM KASHAYAM ON RAW MACROPHAGE CELL LINE	158
08-20	SEX HORMONES INFLUENCE PAD4 ENZYME ACTIVITY	159
<b>Poster Presentation</b>		
08-21	ENHANCEMENT OF THE ANGIOGENENIC POTENTIAL OF A PORCINE CHOLECYST DERIVED SCAFFOLD BY COATING WITH CELL ADHESION MOLECULES FOR DIABETIC WOUND HEALING APPLICATION	159
08-22	A NEW INSIGHT ON EARLY DIAGNOSIS OF ALZHEIMER'S DISEASE BIOMARKERS BY LABEL BASED SERS IMMUNOSENSOR	160
08-23	STUDIES ON EMBELIN FLUORO DERIVATIVE AS POTENT B-RAF INHIBITOR IN MELANOMA	160
08-24	EFFECT OF <i>ROTULA AQUATICA</i> LOUR. IN AMELIORATION OF INFLAMMATION, OXIDATIVE STRESS AND RENAL DAMAGE ASSOCIATED WITH ACUTE PYELONEPHRITIS IN WISTAR RATS	161
08-25	A STUDY TO EVALUATE THE ASSOCIATION OF LIPID PEROXIDATION LEVELS AND OTHER RISK FACTORS IN THE DEVELOPMENT OF CORONARY ARTERY DISEASE (CAD)	161
08-26	CHOLECYST - DERIVED - GRAFT ASSISTED HEALING OF EXPERIMENTAL MYOCARDIAL INFARCTION IN A RAT MODEL	162
08-27	CATECHIN MODULATES AUTOPHAGY AND APOPTOSIS IN MIN6 CELLS EXPOSED TO HIGH GLUCOSE CONCENTRATION	162
08-28	AN EVALUATION OF DRINKING WATER QUALITY OF DUG WELLS IN KOLLAM DISTRICT	163
08-29	COGNITIVE EFFECTS OF ENDEMIC FLUOROSIS - A COMPARATIVE STUDY	163
08-30	CYTOPROTECTIVE ACTIVITY OF AMALAKI RASAYANA IN UV IRRADIATED HUMAN DERMAL FIBROBLASTS	164
08-31	A TRIO MODEL NANOTECHNOLOGICAL APPROACH FOR CANCER MANAGEMENT: GRAPHENE BASED PLASMONIC POLYMER ASSEMBLIES FOR MULTIMODAL IMAGING AND THERAPY	164
08-32	BIMODAL FLUORESCENCE-SERS ENCODED NANOCOCTAIL FOR THE MULTIPLEX DETECTION OF LUNG CANCER BIOMARKERS	165
08-33	PROGNOSTIC SIGNIFICANCE OF ADDITIONAL CHROMOSOMAL ABNORMALITIES IN CML PATIENTS	165
08-34	IMPORTANCE OF COVENTIONAL CYTOGENETICS IN PEDIATRIC B LYMPHOCYTIC LEUKEMIA	166

08-35	IN SILICO PREDICTION AND THREADING BASED EPI TOPE MAPPING OF LEPTOSPIRAL SURFACE ADHESION PROTEIN LSA46	166
08-36	PREVALENCE AND ANTIBIOTIC SUSCEPTIBILITY OF TRADITIONAL MEDICINAL PLANTS ON PATHOGENIC BACTERIA USING AGAR WELL DIFFUSION METHOD	167
08-37	REPRODUCTIVE HEALTH OF WOMEN IN COASTAL AREAS OF THIRUVANANTHAPURAM	167
08-38	ASSESSMENT OF ANTIOXIDANT, ANTIMUTAGENIC AND ANTIHEMOLYTIC POTENTIAL OF <i>CYNOMETRA TRAVANCORICA</i> , A SUBSTITUTE OF <i>SARACA ASOCA</i> IN ASOKARISHTA	168
08-39	CLINICO - EPIDEMIOLOGIC AND ENVIRONMENTAL FACTORS IN YOUNG ONSET PARKINSON'S DISEASE: A PROSPECTIVE STUDY	169
08-40	EGFR MUTATION ANALYSIS IN NSCLC: EXON 20 Q787Q POLYMORPHISM	169
08-41	HESPERIDINE NANOPARTICLE INCORPORATED ELECTROSPUN SCAFFOLDS FOR WOUND HEALING APPLICATIONS	170
<b>09 - LIFE SCIENCES</b>		
<b>Best Paper</b>		
09-01	IN VITRO CYTOTOXIC AND APOPTOTIC POTENTIAL OF PURIFIED TERPENOID OF <i>BRACHYTHECIUM BUCHANANII</i> (HOOK.) A. JAEGER IN MG63 OSTEOSARCOMA CELL LINES: A SEARCH	170
09-02	EFFECTIVE AMELIORATION OF LIVER FIBROSIS BY <i>TETRACERA AKARA</i> (BURM. F.) MERR., AN ETHNOMEDICINAL PLANT VIA. INHIBITING NF - KB SIGNALING PATHWAY AND HSC ACTIVATION - A NOVEL THERAPEUTIC APPROACH	171
09-03	POLYPHENOLS RICH <i>MURRAYA KOENIGII</i> LEAF EXTRACT EXERTS CARDIAC PROTECTION IN STREPTOZOTOCIN INDUCED DIABETIC RATS	171
09-04	SCREENING AND IDENTIFICATION OF CAMPTOTHECIN PRODUCING ENDOPHYTIC FUNGI FROM <i>OPHIORRHIZA MUNGOS</i>	172
09-05	A HIGH THROUGHPUT APPROACH FOR CANCER DRUG SCREENING USING REDOX GFP AND FRET BASED PROBES OF CELL DEATH	172
<b>Oral presentation</b>		
09-06	LARVICIDAL EFFICACY AND MODE OF ACTION OF 22 - HYDROXYHOPANE FROM <i>ADIANTUM LATIFOLIUM</i> AGAINST <i>ORYCTES RHINOCEROS</i> (COLEOPTERA: SCARABAEIDAE)	173
09-07	PURIFICATION AND FRACTIONATION OF ANTHOCYANINS FROM SUSPENSION CULTURES OF <i>OSBECKIA ASPERA</i> L. AND <i>OSBECKIA RETICULATA</i> BEDD.	173
09-08	DOCUMENTATION AND QR CODE ENABLED DIGITIZATION OF TREE AND GARDEN FLORA OF KANAKAKUNNU PALACE, THIRUVANANTHAPURAM -INDIA'S FIRST DIGITAL GARDEN IN PUBLIC PLACE	174
09-09	IRRIGATION REQUIREMENT USING CROPWAT MODEL AND ASSESSING THE INFLUENCE OF NUTRIENT MANAGEMENT AND METHOD OF PLANTING ON CROP AND WATER PRODUCTIVITY OF AEROBIC RICE	174
09-10	EFFECT OF BISPHENOL A ON THE PROTEIN TURNOVER REGULATING ENZYMES AND PROTEIN PROFILE IN THE MALE <i>DROSOPHILA ANANASSAE</i> (DOLESCHALL)	175
09-11	ANALYSIS OF GENETIC DIVERSITY IN <i>ANANAS COMOSUS</i> (L.) MERR HYBRIDS USING ISSR MARKER	175
09-12	POLYPHENOLIC COMPOUND AND ITS FREE RADICAL SCAVENGING POTENTIALITY OF WILD AND CULTIVARS OF <i>IMPATIENS BALSAMINA</i>	176
09-13	THE EFFECT OF RHEUMATOID ARTHRITIS SYNOVIAL FLUID ON THE TH17 / TREG RATIO IN A HEALTHY BLOOD SAMPLE	176
09-14	THE HISTOPATHOLOGICAL CHANGES IN THE GILL AND LIVER TISSUES OF FRESHWATER FISH, <i>LABEO ROHITA</i> EXPOSED TO MALATHION: PROTECTIVE ROLE OF CURCUMIN	177
09-15	ISOLATION AND CHARACTERIZATION OF AMENTOFLAVONE FROM TWO SPECIES OF <i>BIOPHYTUM</i> DC. (OXALIDACEAE)	177
09-16	GUT CONTENT ANALYSIS OF <i>PILA GLOBOSA</i> WITH DIGESTIVE ENZYMES - A COMPARATIVE STUDY	178
09-17	METAGENOMIC PROFILING OF MICROBIAL COMMUNITIES IN FLOOD - AFFECTED AREAS OF KUTTANAD	178
09-18	A STUDY ON THE INECTICIDAL POTENTIAL OF <i>ASPARAGUS RACEMOSUS</i> AGAINST RED PALM WEEVIL	179

09-19	PURIFICATION AND CHARACTERISATION OF AGARASE ENZYME FROM AGAROLYTIC BACTERIA ISOLATED FROM CORAL REEF ECOSYSTEMS	179
09-20	<i>IN VITRO</i> SHOOT MULTIPLICATION IN <i>BRUGUERA CYLINDRICA</i> W&A	180
09-21	BACTERIAL ISOLATION, HYDROLYTIC ENZYMES PRODUCTION AND ITS RELATION TO ORGANIC MATTER OF MANGROVE SEDIMENTS FROM NORTHERN KERALA	181
09-22	EFFECT OF ANTI - ETHYLENE COMPOUNDS ON HYPERHYDRICITY REVERSION AND MULTIPLICATION IN <i>DIANTHUS CHINENSIS</i> L	181
09-23	ROS DEPENDENT ENZYMATIC AND NON-ENZYMATIC ACTIVITIES DURING FLORAL MORPHOGENESIS IN <i>COCCINIA GRANDIS</i> (L). VOIGT (CUCURBITACEAE)	182
09-24	DROUGHT STRESS INDUCED CHANGES IN METABOLITE PRODUCTION AND ANTIOXIDANT ENZYME ACTIVITY IN <i>MOMORDICA CHARANTIA</i>	182
<b>Poster presentation</b>		
09-25	TWO NEW RECORDS OF BROWN ROT POLYPORES (AGARICOMYCETES, BASIDIOMYCOTA) FROM INDIA	183
09-26	BIOCHEMICAL ANALYSIS AND <i>IN SITU</i> LOCALIZATION OF REACTIVE OXYGEN SPECIES IN MULBERRY GENOTYPES	183
09-27	FIRST RECORD OF THE HALOPHILIC FUNGUS, <i>PENICILLIOPSIS CLAVARIIFORMIS</i> SOLMS (EUROTIOMYCETES, ASCOMYCOTA) ON <i>DIOSPYROS PANICULATA</i> DALZ. FROM INDIA	184
09-28	PURIFICATION, FRACTIONATION OF TERPENOIDS FROM <i>HYPNEA USCIFORMIS</i> BY GC - MS AND ANALYSIS OF ITS ANTIOXIDANT AND ANTI - INFLAMMATORY POTENTIALITIES	185
09-29	<i>IN VITRO</i> EVALUATION OF ANTI - INFLAMMATORY EFFECTS OF VARANADI KASHAYAM, A POLY HERBAL DECOCTION IN THP - 1 DERIVED MACROPHAGES	185
09-30	MOLECULAR DETECTION OF PATHOGENIC BACTERIA <i>PROTEUS MIRABILIS</i> CONTAMINATION IN CHICKEN MEAT	186
09-31	BISPHENOL A, A PLASTIC RESIDUE OF THE ECOSYSTEM INTENSIFIES MOSQUITO MENACE BY SHORTENING THE LIFE CYCLE SPAN	186
09-32	COMPARISON OF THE EXPRESSION PROFILE OF mRNA FROM YOUNG AND MATURE LEAVES OF <i>TECTONA GRANDIS</i> L.F. BY DDRT ANALYSIS	187
09-33	ANATOMICAL STUDIES OF TWO <i>CALOTROPIS</i> L. (APOCYNACEAE) SPECIES	187
09-34	COMPARATIVE STUDY ON ANTIOXIDANT AND ANTIMICROBIAL ACTIVITY OF ESSENTIAL OIL FROM <i>POGOSTEMON BENGHALENSIS</i> (BURM.F.) KUNTZE. AND <i>P. CABLIN</i> (BLANCO) BENTH	188
09-35	CONNECTOME REGULATES ODOR ADAPTATION AT DIFFERENT THRESHOLDS IN <i>CAENORHABDITIS ELEGANS</i>	188
09-36	MOLECULAR CHARACTERIZATION OF HISTONE H2A - DERIVED ANTIMICROBIAL PEPTIDE, HIPPOSIN FROM INDIAN MAJOR CARP <i>CATLA CATLA</i>	189
09-37	ANTIBACTERIAL ACTIVITY OF THE ENDOPHYTIC FUNGI FROM THE MANGROVE PLANT, <i>AEGICERAS CORNICULATUM</i>	189
09-38	DNA BARCODING AND PHYLOGENETIC INFERENCE OF <i>CAREBARA DIVERSA</i> (HYMENOPTERA: FORMICIDAE) USING MITOCHONDRIAL CYTOCHROME OXIDASE I GENE SEQUENCE	190
09-39	MARINE ACTINOMYCETES AS ANTIVIBRIO AGENTS FOR APPLICATION IN SHRIMP CULTURE SYSTEM	190
09-40	THE EVOLUTION OF <i>ATROPHANEURA ARISTOLOCHIAE</i> AND <i>TROIDES MINOS</i> TWO <i>ARISTOLOCHIA INDICA</i> FEEDING BUTTERFLIES AND THEIR HOST PLANT FROM THE NUCLEOTIDE SUBSTITUTION RATES OF THEIR CYTOCHROME OXIDASE SUBUNIT I (COI) GENE AND RIBULOSE BISPHOSPHATE CARBOXYLASE (RBCL) GENE	191
09-41	PROBIOTIC CHARACTERIZATION OF LACTIC ACID BACTERIA ISOLATED FROM BREAST MILK AND INFANT FECES	191
09-42	PHARMACOLOGICAL EFFICACY OF LEAVES OF <i>SYZYGIUM PALGHATENSE</i> GAMBLE (MYRTACEAE) ENDEMIC TO PALAKKAD DISTRICT, KERALA	192
09-43	INFRAGENERIC RELATIONSHIP AMONG THE INDIAN <i>ARISAEMA</i> (ARACEAE) BASED ON ITS SEQUENCES	192
09-44	COMPARATIVE PHENOLOGY OF <i>TRICHOPUS ZEYLANICUS</i> GAERTN. SUBSP. <i>TRAVANCORICUS</i> (BEDD.) BURKILL EX K. NARAYANAN: AN ETHNOMEDICINAL PLANT	193
09-45	ANTICANCER EFFICACY OF PETROLEUM ETHER FRACTION OF METHANOLIC EXTRACT OF <i>LEUCAS ASPERA</i> ON HELA CELLS	193

09-46	INTERACTION STUDIES OF PLANT FLAVANOID ISORHAMNETIN WITH CALF THYMUS DNA: <i>IN SILCO</i> AND BIOPHYSICAL EVALUATION	194
09-47	ANATOMICAL STUDIES OF <i>HILDEGARDIA POPULIFOLIA</i> (ROXB. & WALL.) SCHOTT & ENDL. [= <i>STERCULIA POPULIFOLIA</i> ROXB. & WALL.] AND <i>THESPESIA POPULNEA</i> (L.) SOLAND EX CORREA (MALVACEAE) LEAVES	194
09-48	ROLE OF INSULIN PATHWAY IN MEMORY RETENTION OF <i>CAENORHABDITIS ELEGANS</i>	195
09-49	ROLE OF SURFACE MICRO FLORA IN ENHANCING THE ANTI CANCEROUS POTENTIAL OF NONI	195
09-50	ANTI - OBESITY EFFECTS OF <i>GARCINIA GUMMI - GUTTA</i> (L.) ROBS. SEED OIL IN 3T3 - L1 ADIPOCYTES	196
09-51	ETHNOBIOLOGICAL SURVEY IN THE COASTAL AREAS OF THRISSUR DISTRICT, KERALA	196
09-52	STUDY OF THE EPIPHYTIC ALGAL BIOMASS FROM PNEUMATOPHORES OF <i>AVICENNIA OFFICINALIS</i> L.	197
09-53	ASSESSMENT OF ANTI - INSECT PROPERTIES OF <i>ANAMRITA COCCULUS</i> , <i>STRYCHNOS NUXVOMICA</i> AND <i>CARDIOSPERMUM HALICACABUM</i> AGAINST <i>OLEPA RICINI</i> (LEPIDOPTERA: NOCTUIDAE).	197
09-54	DIVERSITY OF BUTTERFLY WING SCALES AND THEIR ROLE IN COLOUR PATTERN AND OTHER	198
09-55	ON GERMPLASM CONSERVATION OF SOME ENDEMIC WILD ORNAMENTAL PLANTS IN JNTBGRI FIELD GENE BANK	198
09-56	MICROPROPAGATION AND SYNTHETIC SEED PRODUCTION OF <i>EUPATORIUM TRIPLINERVA</i> VAHL	199
09-57	A SYSTEMATIC ACCOUNT OF FRESH WATER DIATOMS - POTENTIAL SOURCE AS LIVE FEEDS IN AQUACULTURE AND BIODIESEL PRODUCTION	199
09-58	EFFECT OF DROUGHT STRESS IN GROWTH AND QUALITY OF <i>CENTELLA ASIATICA</i> (L.) URB	200
09-59	STUDY ON PESTS AND PREDATORS OF <i>APIS CERANA INDICA</i> F.IN SELECTED APIARIES OF THRISSUR DISTRICT	200
09-60	CHEMOPROSPECTING OF <i>PSILANTHUS TRAVANCORENSIS</i> (WT. & ARN.) LEROY – A MEDICINAL SPECIES OF RUBIACEAE.	201
09-61	LARVICIDAL EFFICACIES OF TWO PLANT EXTRACTS AGAINST <i>Aedes albopictus</i>	201
09-62	MICROBIAL DIVERSITY AND RESISTOME STRUCTURE OF POLLUTED AND NON - POLLUTED ENVIRONMENTS IN SOUTH INDIA	202
09-63	EFFECTIVE AND SUSTAINABLE ALTERNATIVE FOR USING CITRUS PEEL WASTE	202
09-64	DIVERSITY OF PLANKTONIC ROTIFERS IN AYIRAMTHENGU MANGROVE KOLLAM	203
09-65	STUDIES ON THE VARIATIONS IN SECONDARY METABOLITES AND ANTIOXIDANT ACTIVITY OF <i>ZINGIBER ZERUMBET</i> (L) SM. RHIZOME	203
09-66	NUTRITIONAL AND ANTI NUTRITIONAL ANALYSIS IN <i>ARTOCARPUS HIRSUTUS</i> LAM	204
09-67	SCREENING OF BIOACTIVE COMPOUNDS IN <i>PREMNA WIGHTIANA</i> SCHAUER (LAMIACEAE)	204
<b>10 - MATHEMATICAL &amp; STATISTICAL SCIENCES</b>		
<b>Best paper</b>		
10-01	CHARACTERIZATION OF DISTANCE HEREDITARY GRAPHS USING DISTANCE SPECTRUM	205
10-02	ANALYSIS OF A QUEUE WITH JOINING STRATEGY AND INTERRUPTION REPEAT OR RESUMPTION OF SERVICE	205
10-03	ESTIMATION OF STRESS-STRENGTH RELIABILITY USING A GENERALIZATION OF POWER TRANSFORMED HALF-LOGISTIC DISTRIBUTION	206
<b>Oral presentation</b>		
10-04	AN APPLICATION OF INTERIOR EXTERIOR AND BOUNDARY OF FUZZY SOFT MULTI TOPOLOGY IN FLOOD	206
10-05	MINIMAL IMMERSIONS OF STATISTICAL MANIFOLDS	207
10-06	SPIKING NEURAL P SYSTEMS WITH STRUCTURAL PLASTICITY AND MEMORY	207
10-07	ON A QUEUEING-INVENTORY SUPPLY CHAIN SYSTEM WITH IMPATIENCE OF CUSTOMERS	207
<b>Poster presentation</b>		
10-08	A NEW FAMILY OF ALPHA POWER TRANSFORMED FRÉCHET DISTRIBUTION AND ITS APPLICATIONS IN RAINFALL DATA ANALYSIS	208

<b>11-PHYSICAL SCIENCES</b>		
<b>Best paper</b>		
11-01	GRAPHENE INCORPORATED TITANIUM DIOXIDE CO-EXPOSED WITH HIGH ENERGY {001} AND {010/100} FACETS FOR SELF - CLEANING NANOCOATINGS	209
11-02	DEVELOPMENT OF AN IONOGEL MEMBRANE FOR CO <sub>2</sub> SENSING APPLICATION	209
11-03	ENHANCEMENT OF MICROWAVE DIELECTRIC PROPERTIES OF CA <sub>3</sub> TE <sub>2</sub> ZN <sub>3</sub> O <sub>12</sub> GARNET CERAMICS BY COLD SINTERING PROCESS	210
11-04	SPR INDUCED Au@Ag CORE SHELL DOPED SiO <sub>2</sub> -TiO <sub>2</sub> -ZrO <sub>2</sub> FIBER OPTIC SENSOR FOR VITAMIN A DETECTION	210
<b>Oral Presentation</b>		
11-05	RICE STRAW BASED COPPER OXIDE NANOCOMPOSITE AS ANTIBACTERIAL AGENT	211
11-06	BEAUTY MEASUREMENT: AN ATTEMPT TO DERIVE AN EQUATION OF BEAUTY	211
11-07	ENHANCED ELECTROMAGNETIC ABSORPTION OF CB AND RGO INCORPORATED SILICON RUBBER IN X AND KU BAND	211
11-08	OPTIMIZATION OF ELECTROCHEMICAL PERFORMANCE, AND OPERATION VOLTAGE OF SUPER CAPACITOR	212
11-09	INSIGHT INTO INTERPLAY BETWEEN CRYSTAL STRUCTURE AND LUMINESCENT PROPERTIES OF GARNET PHOSPHORS	213
11-10	ANTIOXIDANT PROPERTIES OF LANTHANUM OXIDE NANOPARTICLES SYNTHESIZED USING ORGANIC AND BIOLOGICAL CAPPING AGENTS	213
11-11	INVESTIGATING THE ELECTROMAGNETIC AND CHEMICAL ENHANCEMENTS IN G - SERS WITH THERMALLY EVAPORATED SILVER.	214
11-12	STRUCTURAL STUDIES OF ZINC OXIDE THIN FILM BY SOL - GEL DIP COATING METHOD	214
11-13	RESPONSE OF BHINDI ( <i>ABELMOSCHUS ESCULENTUS</i> L.) TO FERTIGATION AND FOLIAR NUTRITION OF MICRONUTRIENTS ON THE GROWTH, YIELD AND QUALITY OF BHINDI	215
11-14	WETTING MECHANISM OF BIMODAL POROUS TiO <sub>2</sub> - ZrO <sub>2</sub> TRANSPARENT COATINGS	215
11-15	A FLEXIBLE, POROUS, ENVIRONMENT FRIENDLY, INTEGRATED SUPER CAPACITOR USING RGO-MODIFIED FILTER PAPER	216
11-16	INFLUENCE OF EU <sup>3+</sup> SUBSTITUTION ON CRYSTAL STRUCTURE AND OPTICAL PROPERTIES OF SRBILITEO <sub>6</sub> DOUBLE PEROVSKITE	216
11-17	ENHANCED LIGHT EXTRACTION FROM ORGANIC LIGHT EMITTING DIODES USING A NANOPARTICLE SCATTERING LAYER	217
11-18	ULTRAVIOLET PHOTO DETECTORS BASED ON ZINC OXIDE: DEPENDENCE ON MORPHOLOGY	217
11-19	INFLUENCE OF GATE DIELECTRIC PROCESSING ON THE PERFORMANCE OF OF ETS: EFFECT OF SOLVENT POLARITY	218
11-20	GREEN FLOURESCENT CARBON NANOPARTICLES FROM THE PITH OF <i>MANIHOT ESCULENTA</i> (TAPIOCA) STEM FOR FE (III) DETECTION	219
<b>Poster Presentation</b>		
11-21	THERMODYNAMICS OF QUARK GLUON PLASMA USING CLUSTER EXPANSION	219
11-22	ENHANCEMENT OF PROPERTIES IN BIFEO <sub>3</sub> DUE TO PHASE TRANSITION BY EUROPIUM DOPING	220
11-23	SPECTROSCOPIC STUDIES OF CERIUM BASED NANOPHOSPHORS	220
11-24	DIELECTRIC RELAXATION AND THERMAL STUDIES IN SUPER COOLED AND GLASSY STATES OF ANTI CANCEROUS ALKALOID BRUCINE	221
11-25	GREEN SYNTHESIS OF SILVER NANOPARTICLES AND THEIR APPLICATION AS SERS SUBSTRATES	221
11-26	UTILIZATION OF PERLITE AND VERMICULITE IN CEMENT COMPOSITES FOR GAMMA RAY SHIELDING APPLICATIONS	222
11-27	THE STRUCTURAL AND MORPHOLOGICAL STUDY OF VERTICALLY ALIGNED ZNO NANORODS PREPARED BY CHEMICAL ROUTE	222
11-28	SPECTROSCOPIC FT - IR, FT - RAMAN, MOLECULAR DOCKING STUDIES, THERMAL STABILITY ANALYSIS, COMPUTATIONAL INVESTIGATION AND CONFORMATIONAL ANALYSIS OF DIURON	223



11-29	EFFECT OF ELECTROLYTE TEMPERATURE ON ALUMINIUM DOPING OF TiO <sub>2</sub> NANOTUBES BY ELECTROCHEMICAL ANODISATION	224
11-30	BIOCOMPATIBLE LUMINESCENT EUROPIUM DOPED FLUORAPATITE FOR IMAGING APPLICATIONS	224
11-31	EFFECT OF NICKEL DOPING ON THE STRUCTURAL, MORPHOLOGICAL AND OPTICAL PROPERTIES OF PULSED LASER ABLATED BaSnO <sub>3</sub> FILMS	225
11-32	CADMIUM OXIDE AND STRONTIUM OXIDE-NOVEL NANOPARTICLES WITH EFFECTIVE BANDGAPS FOR TECHNOLOGICAL APPLICATIONS	225
11-33	HYDROTHERMAL SYNTHESIS OF MOLYBDENUM DISULPHIDE (MoS <sub>2</sub> ) NANOPARTICLES FOR ENERGY STORAGE APPLICATIONS	227
11-34	CRYSTAL STRUCTURE, MICROSTRUCTURE AND MICROWAVE DIELECTRIC PROPERTIES OF NOVEL GLASS FREE NaPb <sub>2</sub> B <sub>2</sub> V <sub>3</sub> O <sub>12</sub> (B=Mg, Zn) CERAMICS	228
11-35	BIOSYNTHESIZED, MAGNETICALLY RETAINABLE BINARY TRANSITION METAL OXIDE FeO / MnO NANOCOMPOSITES FOR ENVIRONMENTAL REMEDIATION	228
11-36	STUDY ON YTRIA / ALUMINA NANOCOMPOSITE SYSTEM FOR THEIR APPLICATIONS AS INFRARED TRANSPARENT CERAMIC WINDOW MATERIAL	229
11-37	INVESTIGATION OF NON-MONOTONIC VARIATION OF SECOND MAGNETIZATION PEAK IN A LOW T <sub>c</sub> SUPERCONDUCTOR, Ca <sub>3</sub> Rh <sub>4</sub> Sn <sub>13</sub>	229
11-38	ANTIOXIDANT ACTIVITY OF BIOSYNTHESISED NANOSTRUCTURED Ce <sub>3+</sub> USING ONION JUICE EXTRACT	230
11-39	DECIPHERING THE CRYSTAL STRUCTURE AND PHOTOLUMINESCENCE PROPERTIES OF B SITE ORDERED DOUBLE PEROVSKITES Ba <sub>3</sub> Ln <sub>2/3</sub> TeO <sub>6</sub> (Ln = Y, Gd-Lu)	230
11-40	<i>IN VITRO</i> CYTOTOXICITY ANALYSIS OF CALCIUM SULFIDE NANOPARTICLES	231
11-41	OPTICAL BANDGAP ANALYSIS OF COPPER OXIDE AND MANGANESE OXIDE NANOPARTICLES - A COMPARATIVE STUDY	232
11-42	PHOTOLUMINESCENT PROPERTIES OF TERBIUM DOPED FLUOROBORATE GLASSES FOR GREEN EMISSION APPLICATIONS	232
11-43	VIBRATIONAL SPECTRAL INVESTIGATION OF ORGANIC NLO CRYSTAL MORPHOLINIUM HYDROGEN TARTRATE: A DFT APPROACH	232
11-44	ANALYSIS ON CRYSTALLOGRAPHIC STRUCTURE, SIZE AND BAND GAP VARIATIONS IN ANNEALED CuFe <sub>2</sub> O <sub>4</sub> SPINELS	233
<b>12 - SCIENCE EDUCATION, COMMUNICATION &amp; SOCIETY</b>		
<b>Best Paper</b>		
12-01	NUTRITIONAL PROFILE AND THE EFFECT OF DIETARY INTERVENTIONS IN TYPE II DIABETES PATIENTS	234
12-02	BIBLIOMETRIC ANALYSIS OF CYCLOTIDE RESEARCH	234
12-03	ENHANCING SEED LONGEVITY IN VEGETABLE SEEDS USING FILM COAT TECHNIQUE	235
12-04	E - LESSON TEMPLATE GENERATION IN SCIENCE BASED ON TAXONOMY OF INGENUITY AND CONNECTEDNESS	235
<b>Oral Presentation</b>		
12-05	INFORMATION BEHAVIOUR OF VETERINARIANS IN KERALA	236
12-06	DETERMINANTS OF CONSUMPTION OF LIVESTOCK PRODUCTS AMONG SCHOOL GOING ADOLESCENTS IN KERALA	236
12-07	ROLE OF HAEMOGLOBIN LEVELS IN THE COGNITIVE PERFORMANCES OF PRESCHOOL CHILDREN	236
12-08	INTERNET ADDICTION ON CAMPUS	237
<b>Poster Presentation</b>		
12-09	MARKETING DYNAMICS OF VALUE ADDED COCONUT PRODUCTS IN KERALA - A CASE STUDY ON VIRGIN COCONUT OIL	237
12-10	AN ETHNOBOTANICAL INVESTIGATION ON ZINGIBERALES OF KERALA	238
12-11	COMPARATIVE EVALUATION OF SALAD CUCUMBER CULTIVATION UNDER DIFFERENT DESIGNS OF POLY HOUSE STRUCTURES	239
12-12	SOCIAL INTERVENTIONS ON IMPROVING THE QUALITY OF LIFE OF WOMEN LIVING IN SC SETTLEMENTS IN KAVUMKAL DESOM, KOLLAM	239

## 01 - AGRICULTURE & FOOD SCIENCE

01-01

### MANAGEMENT OF PAPAYA RINGSPOT VIRUS: THE DEADLIEST PATHOGEN EMERGING IN KERALA

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**Background:** Papaya is an important fruit crop that is widely grown in tropics and subtropics. However, papaya plants are prone to several viral diseases. During the last decade, the incidence of papaya ringspot disease caused by *Papaya ringspot virus* (PRSV) has become a major threat in profitable cultivation of papaya across Kerala. The disease incidence was found to cause 100 per cent yield loss in papaya. The present study was taken up to find the efficacy of environmental friendly defense inducers, plant products, micronutrients and microbial inoculants in reducing the severity of papaya ringspot disease.

**Method:** A pot culture experiment laid out in Completely Randomised Design was conducted under insect-proof net house conditions to evaluate the pre and post- inoculation activity of several treatments. The test plant used was three week old papaya seedlings (Variety: Red Lady). The treatments included foliar spraying and soil drenching of salicylic acid ( $0.15 \text{ g L}^{-1}$ ), acetyl salicylic acid ( $0.15 \text{ g L}^{-1}$ ), *Pseudomonas fluorescens*, KAU formulation (2%), PGPR mix II, KAU formulation (2%), *Lecanicillium lecanii*, KAU formulation (2%), leaf extract of *Mirabilis jalapa* (10%), leaf extract of *Bougainvillea spectabilis* (10%), Perfekt, a commercial viricide (0.1%), Sampoorana, a micronutrient formulation (1%), Solubor (1%), Humic acid (0.2%), Potassium silicate (0.3%) and Solubor (0.1%) along with untreated control. The experiment consisted of a pre-inoculation application of treatments, followed by challenge inoculation of the virus and post- inoculation application of treatments. The per cent disease severity (PDS) was calculated two weeks after every application. The height and girth of the plant, virus titre of plants applied with each treatment and the chlorophyll content of the test plants were also recorded.

**Results:** The disease appeared in all the test plants about 14 - 15 days after inoculation (DAI). A downward trend was observed in the PDS in majority of the treatments and significant difference was noticed among the treatments at all intervals of observations. The lowest PDS was recorded in plants treated with 10 per cent leaf extract of *B. spectabilis* viz., 6.67 per cent against 97.77 per cent in untreated control. Plants treated with *B. spectabilis* leaf extract (10%) and *P. fluorescens* (2%) were found to be equally superior in terms of plant height. However, the maximum girth was recorded in *P. fluorescens* treated plants. The virus titre recorded in plants treated with leaf extract of *B. spectabilis* (10%) and *P. fluorescens* (2%) were the least and they were statistically on par. *B. spectabilis* was also superior in terms of the chlorophyll content recorded in the test plants (44.67 SPAD units).

**Conclusion:** The present study highlighted the effectiveness of foliar spraying and soil drenching of 10 % leaf extract of *Bougainvillea spectabilis* which showed maximum reduction of the disease. It was also noticed that spraying and drenching of 2 % *Pseudomonas fluorescens* (KAU formulation) equally reduced the virus concentration in test plants as *Bougainvillea* along with promoting plant growth.

**Keywords:** Papaya, ringspot, *Bougainvillea*, *Pseudomonas*

01-02

### MULTIMECHANISTIC PLANT PROBIOTIC FEATURES OF *BACILLUS* SPP. ISOLATED FROM RHIZOSPHERE OF *CLERODENDRUM INFORTUNATUM* L.

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**Background:** Plant growth promoting rhizobacteria (PGPR) are recently identified to have remarkable applications as biofertilizer and biocontrol agents. Hence there is an increasing demand to isolate indigenous rhizobacteria to explore its plant probiotic potential for agricultural applications.

**Method:** In the study, various PGPR isolated from *Clerodendrum infortunatum* (L.) were evaluated for plant growth promoting properties and *in vivo* plant probiotic performance.

**Results:** From these, two *Bacillus* spp. were identified to have both plant growth enhancement and antifungal properties. Both the *Bacillus* spp. were observed to have volatile organic compounds (VOCs) mediated plant growth enhancement and antifungal activity. Hence the isolates were subjected to metabolite profiling by GC-MS analysis.

**Conclusions:** The ability of the selected *Bacillus* spp. to promote plant growth through direct and VOC mediated mechanisms indicate its multimechanistic impact on plants, which makes the study unique and significant.

**Keywords:** Rhizobacteria, Volatile organic compounds, *Bacillus* spp., Plant probiotics

01-03

### MICROBIAL QUALITY ANALYSIS AND STANDARDIZATION OF FRUIT ENRICHED RICE BASED PROBIOTIC YOGURT

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**Background:** Yogurt is one of the most popular fermented milk products worldwide and has gained widespread consumer acceptance as a healthy food. Fermented milk products have probiotic effect that exerts benefits in the balanced intestinal micro flora and health, beyond basic nutrition. In this backdrop standardization of rice based yogurt enriched with fruit as probiotic food having medicinal importance is attempted.

**Method:** Plain yogurt and Rice based yogurt was prepared. Microbial analysis and organoleptic analysis was done and selected the best scored. Fruit enrichment was done and the best combination was selected by microbial analysis and organoleptic assessment. Cost analysis was done

**Results:** Rice based yogurt containing 25% milk and 75% rice slurry scored best in microbial analysis where as the one with 75% milk and 25% slurry scored best in organoleptic analysis. Hence the 2<sup>nd</sup> one was selected and fruit enrichment was done. The one with 20% annona fruit pulp and one with 5% papaya fruit pulp were selected as the best one. Microbial analysis shows that fruit enrichment doesn't affect the bacteria in the yogurt. Cost analysis proved that when fruits are collected from wild, we can make available these yogurts in low cost than market price.

**Conclusion:** The rice based yogurt containing 25% rice slurry and 75% milk enriched with 20% annona fruit pulp and the one with 5% papaya fruit pulp was selected as the final product. So we can make available the fruits, which are medicinally very important, in the form of probiotic yogurt to normal people in a tastier way and also in a lower cost.

**Keywords:** Yogurt, Probiotic, Annona, Papaya

01-04

### BIOEFFICACY AND SOIL HEALTH IMPACT OF FLUCETOSULFURON IN WET SEEDED RICE

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**Background:** Flucetosulfuron is a new generation, pyrimidinyl sulfonylurea, broad spectrum herbicide used for weed control in rice. Identification of its optimum dose and most ideal time of application for season long weed control in wet seeded rice under Kerala conditions require field investigation.

**Methods:** The investigation was carried out at College of Agriculture, Vellayani, Thiruvananthapuram during the peri-

of 2015-2018. Field experiment was conducted during the I and II crop seasons of 2016-'17, in a farmer's field with 12 treatments replicated thrice in Randomized Block Design. Flucetosulfuron @ 20, 25 and 30 g/ha applied at 2-3, 10-12 and 18-20 days after sowing (DAS) along with two control treatments *viz.*, hand weeding at 20 and 40 DAS and unweeded control comprised the treatments. Effect of flucetosulfuron on soil health was also studied. Pot culture experiments were conducted to find out the indicator plant of flucetosulfuron, its herbicidal residue in soil and to find out the effect of treatments on weed seed bank in soil. Laboratory experiments were conducted to evaluate the *in vitro* sensitivity of flucetosulfuron with biofertilizer organisms and biocontrol agents.

**Results:** The study revealed that application of flucetosulfuron @ 20, 25 and 30 g ha<sup>-1</sup> at 10-12 DAS was very effective in controlling the weeds and recorded significantly higher grain yield and monetary benefits in wet seeded rice. Sunflower was identified as the most sensitive indicator plant and shoot length of sunflower was adjudged as the best parameter to assess the flucetosulfuron residue in soil. Bioassay after each field experiment using sunflower revealed that there was no residual toxicity of flucetosulfuron in the post experiment soil. Flucetosulfuron applied at 10-12 and 18-20 DAS caused significant depletion of weed seed bank during both the seasons compared to its application at 2-3 DAS. Application of flucetosulfuron @ 20, 25 and 30 g ha<sup>-1</sup> at 2-3/10-12/18-20 DAS had no adverse impact on soil health and was found compatible with the tested biofertilizer organisms (*Azospirillumlipoferum*, *Azotobacterchroococcum*, *Bacillus megaterium* and *Fratureiaaurantia*) and biocontrol agents (*Trichoderma viride* and *Pseudomonas fluorescens*).

**Conclusions:** Application of flucetosulfuron @ 20, 25 and 30 g ha<sup>-1</sup> at 10-12 DAS effectively controlled the weeds and recorded significantly higher grain yield and monetary benefits in wet seeded rice. Flucetosulfuron applied @ 20, 25 and 30 g ha<sup>-1</sup> at 2-3/10-12/18-20 DAS had no adverse impact on soil health and was found compatible with the tested biofertilizer organisms and biocontrol agents.

**Keywords:** Flucetosulfuron, Indicator plant, *In vitro* sensitivity, Soil Health, Weed management, Weed seed bank, Wet seeded rice.

01-05

### GENE PYRAMIDING FOR BACTERIAL BLIGHT RESISTANCE IN RICE VARIETY UMA

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**Background:** As in other rice growing locales around the world, bacterial blight (BB) disease caused by *Xanthomonas oryzae pv. oryzae* (Xoo) assumes a huge role in deciding rice profitability among the elite rice varieties PTB 39 (Jyothi) and Mo 16 (Uma) of Kerala. Among the various management tactics, host-plant resistance is advocated as the most effective breeding strategy to combat the disease. Considering this, efforts were taken to introgress three R-genes (*xa5*, *xa13* and *Xa21*) into the variety Uma from donor parent Improved Samba Mahsuri (ISM) through Marker Assisted Selection (MAS). Further, backcrossing to Uma (recurrent parent) and advancing the resultant BC<sub>1</sub>F<sub>1</sub>s have resulted in production of BC<sub>2</sub>F<sub>1</sub> generation (21 Nos.).

**Method:** The present study aimed to identify BC<sub>2</sub>F<sub>1</sub> plants pyramided with genes (*xa5*, *xa13* and *Xa21*) conferring resistance to bacterial blight using molecular markers. Hence foreground selection of the BC<sub>2</sub>F<sub>1</sub> individuals was carried out using STS markers RG 556, RG136 and pTA248 for the genes *xa5*, *xa13* and *Xa21* respectively. Further confirmation for the presence of *xa5* and *xa13* genes were also done by using functional marker *xa5* SR and *xa13* promoter. The identified three R-gene pyramided plant is then subjected to background selection for identifying the recurrent parent genome recovery.

**Results:** Results obtained revealed that, of the 21 BC<sub>2</sub>F<sub>1</sub>s subjected to foreground selection, BC<sub>2</sub>F<sub>1</sub> Plant No. 8.3.9.10 was the only 3-R-gene introgressed pyramid (*xa5xa5* + *Xa13xa13* + *Xa21xa21*). While all other BC<sub>2</sub>F<sub>1</sub>s including the recurrent parent was confirmed to have the presence of only one R-gene (*xa5xa5*). Background profiling using 22 rice microsatellite (RM) markers revealed that the 3-R-gene introgressed BC<sub>2</sub>F<sub>1</sub> Plant No. 8.3.9.10 was more similar to recurrent parent Uma with its genome recovery of 81.82 per cent. The identified 3-R-gene pyramid plant was advanced for further evaluation.

**Conclusion:** MAS has enabled identification of a 3-R-gene introgressed BC<sub>2</sub>F<sub>1</sub> Plant No. 8.3.9.10. (*xa5xa5* + *Xa13xa13* + *Xa21xa21*), with high recovery of recurrent parent background in the early backcross generations. The novel gene combinations arising in the backcross generations of R-gene pyramids can serve as base population in future breeding programmes for BB resistance.

**Key words:** R-genes (*xa5*, *xa13* and *Xa21*), Bacterial Blight (BB), Marker-Assisted Selection (MAS), Foreground Selection, Background Selection, SSR (Simple Sequence Repeats), Rice Microsatellite (RM)

01-06

### EFFECT OF MICRONUTRIENT APPLICATION ON GROWTH AND YIELD OF OKRA IN TYPIC USTIPSAMMENTS OF KERALA

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**Background:** The sandy plain region of Kerala comprises a unique agro ecological unit designated as Onattukara sandy plain (AEU 3). These soils are very young soils and are classified under Mixed, isohyperthermic Typic Ustipsamments. Micronutrients are important for maintaining soil health and soil must supply micronutrients for desired growth and productivity of plants. Now problems due to micronutrient deficiencies have been reported from many parts of this region. The supplementation of micronutrients under such situation becomes more important to provide balanced nutrition to crops. Hence a study was undertaken at College of Agriculture, Vellayani, Kerala Agricultural University, to assess the micronutrient status of the onattukara sandy plain and to study the response of crops to micronutrient application in this sandy tract.

**Method:** Data on available nutrient status of two hundred georeferenced soil samples collected from twenty soil series covering the onattukara region was used for assessing the status of micronutrients. Based on the results a trial was undertaken in the onattukara sandy plain at eighteen different locations to study the response of the crops to micronutrient application in this sandy tract. Okra variety Varsha Uphar was taken as the test crop. Adhoc recommendation of micronutrients proposed by Kerala Agricultural University viz. ZnSO<sub>4</sub> @ 20 kg ha<sup>-1</sup>, CuSO<sub>4</sub> @ 1.5 kg ha<sup>-1</sup> and borax @ 10 kg ha<sup>-1</sup> was applied in the okra crop and it was compared with the package of practices recommendations. Observations on yield and yield attributes were recorded and analyzed statistically using paired 't' test.

**Results:** The study revealed that the Onattukara sandy plain suffers from severe micronutrient deficiencies of Zinc, Copper and Boron and Adhoc recommendation of these micronutrients proposed by Kerala Agricultural University was applied in okra to study the response of the crop to micronutrient application. The results from 18 different locations revealed that there was significant difference in yield and soil micronutrient status due to micronutrient application. Application of micronutrients significantly increased the yield of okra compared to the package of practices recommendation of NPK alone. Maximum yield recorded in POP was 5.2 t ha<sup>-1</sup> and that in package of practices recommendation of NPK + adhoc recommendation of micronutrient was 9.4 t ha<sup>-1</sup>. Micronutrient application increased the yield up to eighty percent.

**Conclusions:** Increased yield due to micronutrient confirm the need for including micronutrients in the regular fertilizer application schedule in this region. Therefore, it is very important to take necessary steps to apply the required amount of micronutrients for enhancing and sustaining crop production in the sandy plain.

**Keywords:** Micronutrients, okra, sandy plain, ustipsamments

01-07

### IN VITRO EVALUATION OF PLANT BENEFICIAL ATTRIBUTES OF TOMATO-ASSOCIATED RHIZOBACTERIA

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**Background:** The present study focuses on to the characterization of two rhizobacterial isolates; *Bacillus sp.* PKDL10 and *Bacillus sp.* PKDL14 obtained from tomato rhizosphere and analysis of their plant growth promoting ability by seedling vigour assay

**Method:** Rhizobacterial isolates were screened for IAA production, Phosphate solubilisation, Acc deaminase Production, Siderophore production, HCN production, Nitrogen fixation, Ammonia production. Moreover lytic enzyme production such as amylase, protease, lipase and pectinase. In addition seedling vigour assay was also tested.

**Result:** *Bacillus sp.* PKDL10 showed IAA (10µg/ml). And Siderophore (PSU 13.73), Nitrogen fixation, Ammonia (0.162 mg/ml) and HCN production (1.584 ppm). In addition it showed the presence of lytic enzymes such as amylase, protease, lipase, pectinase. Whereas the isolate *Bacillus sp.* PKDL14 was positive for ACC deaminase, Siderophore (PSU 22.60), Ammonia (0.10mg/ml), HCN (0.396 ppm) and amylase enzyme production. Highest germination % and

vigour index was given by isolate treated with the organism *Bacillus sp.* PKDL10. Combination of our isolates has given better germination % and vigour index compared to the uninoculated control.

**Conclusion:** Production of growth enhancing molecules, increased germination, vigour index, were shown by our isolates. This study suggests the prominence of using bacterial consortium is highlighted, as the lack of one growth promoting activity is substituted by another. Consortium biofertilizers can be more effective and can be more economical, eco-friendly and sustainable method for tomato cultivation.

**Keywords:** Rhizobacteria , Tomato, Plant growth promotion , *Bacillus*

01-08

### NUTRIENT STICK – A COMPLETE CROP FERTILIZER FOR FUTURE

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**Background:** Fertilizer stick, a slow releasing fertilizer is also referred to as fertilizer spike or stakes, is a complete fertilizer composition that is formulated in stick form and contains ten essential nutrients. The nutrients are embedded in a suitable matrix, selected after lab trials. It ensures a constant supply of nutrient, as we irrigate the plants the stick will gradually dissolve and release nutrient into the soil, from where they are taken up by the roots.

**Method:** The experiment was carried out in a randomized block design with nine treatments and three replications. Growth and yield parameters observed were days to harvest, the number of fruits per plant, average fruit weight, fruit length, total fruit yield and shelf life of the fruit. The data were subjected to analysis of variance for randomized block design.

**Results:** The present investigation indicates improvement in different characters under study with treatment application in oriental pickling melon. Days to fruit harvest in nutrient stick and the fertigated field was 59 to 62 days respectively and in the conventional method of irrigation plus fertilizer application (KAU POP recommendation) was 64 days. The number of fruits per plant and total fruit yield was increased significantly with treatment application. The highest number of fruit per plant and total fruit yield per plot were recorded with drip irrigation + nutrient stick + potassium silicate spray @ 0.25 per cent. Foliar spray of silicon recorded the maximum shelf life of more than six months.

**Conclusions:** The nutrient stick is a complete fertilizer composite that is formulated in a solid form containing ten essential nutrients. The present investigation indicates days to harvest, the number of fruits per plant, average fruit weight, fruit length; total fruit yield and shelf life of the fruit were improved with treatment application in oriental pickling melon. As it is an efficient slow releasing fertilizer, it can support plants by providing essential nutrients for its growth in a steady manner for more days.

**Keywords:** Nutrient stick, Fertigation, Oriental pickling melon, Silicon nutrition

01-09

### IMPACT OF PROJECTED CLIMATE CHANGES ON WATER BALANCE AND WATER REQUIREMENTS OF MAJOR CROPPING SYSTEMS IN KOLE LANDS

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**Background:** Climate change is an important issue that faces by the planet earth. Agriculture sector is most vulnerable to climate change because the changes in rainfall pattern and rise in temperature affect agriculture production. Changes in weather conditions can reduce the production by 67 per cent.

**Method:** The impact of projected climate changes on water balance and water requirements of major cropping systems in Kole lands were analysed using CROPWAT. The ensemble mean weather data generated from seventeen models in Representative Concentration Pathways 4.5 and 8.5 was used to analyse future climatic conditions (2030 and 2050).

**Results:** Rainfall was found to be important weather parameters that decide the crop production particularly under rain fed conditions. The monthly rainfall of Kole lands indicated an increasing trend during the months June, July and August in projected climate scenarios both RCP 4.5 and 8.5. Based on the projected climates the potential evapotranspiration would be higher than the present condition and that during the months of January to April and November to

December there would be no water surplus in Kole lands.

**Conclusions:** This work establishes importance of water balance and water requirements of major cropping systems in Kole lands for attaining the better yield throughout the production period.

**Keywords:** Climate change, CROPWAT, Kole lands, water requirement

01-10

#### EFFECT OF ORGANIC MANURES AND BIOFERTILIZERS ON PLANT AND SOIL NUTRIENT STATUS UNDER PAPAYA CULTIVATION (*CARICA PAPAYA* L.)

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**Background:** Papaya is an important tropical fruit crop which is mainly grown in the homesteads of Kerala. Papaya being heavy feeder in nature judicious fertilizer application is necessary to meet the nutrient requirement of the crop. For sustainable crop production, it is necessary to improve the soil health and maintain a healthy ecosystem. Application of large quantities of chemical fertilizers can have a negative impact on the physical properties of the soil health and productivity. Increased awareness consequent negative effect on human health has led way for the building up of organic farming within the country.

**Method:** The present experiment was conducted at College of Agriculture, Vellayani during 2016-2018, for studying the effect of organic manures and biofertilizers on plant and soil nutrient status before and after the cultivation of papaya (cv. Surya). The experiment was carried out with 11 treatments replicated three times using randomised block design. Different doses of organic manures and bio fertilizers were applied to the plant.

**Results:** Soil nutrient status was analysed before and after the experiment and the study revealed that application of 75% recommended dose of Nitrogen as organic along with AMF to papaya plants significantly increased the nitrogen, phosphorus and potassium content in the soil. The micronutrient content (Cu, Fe, Mn, Zn) and microbial count (bacteria, fungi and actinomycetes) were found to be highest with the application of 100% recommended dose of nitrogen as organic along with AMF. The statistical report on plant analysis of papaya revealed that the phosphorus, potassium and micronutrient content of the leaf petiole was found to be maximum with the application of 100% recommended dose of nitrogen as organic along with PGPR Mix-1 and AMF.

**Conclusion:** Application of 75% recommended dose of Nitrogen as organic along with AMF to papaya plants significantly increased the nitrogen, phosphorus and potassium content in the soil. Phosphorus, potassium and micronutrient content of the leaf petiole was found to be maximum with the application of 100% recommended dose of nitrogen as organic along with PGPR Mix-1 and AMF.

**Keywords:** AMF, PGPR MIX-1, biofertilizers.

01-11

#### ECO-FRIENDLY MANAGEMENT OF ROOT-KNOT NEMATODE IN PEPPER USING *ANDROGRAPHIS PANICULATA* DRY POWDER

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**Background:** Kerala accounts for a major share of area under spice cultivation. Plant parasitic nematodes are one of the constraints in spice production. Chances of presence of terminal residues in the harvested produce are more in the case of chemical interventions of nematode management especially in pepper. Therefore the present study is undertaken to document the nematodes associated with pepper and to evolve management strategies using botanical pesticides.

**Methods:** Survey was conducted to document the distribution of nematodes in the rhizosphere of pepper. Nematode population was estimated by Cobb's sieving and decanting technique followed by modified Baermann's funnel technique. *In vitro* screening studies were conducted to evaluate the nematicidal property of aqueous extracts of weed plants and selected plant materials were subjected to solvent extraction. Pot culture experiments were conducted to standardize the appropriate preparation and method of application. Micro plot studies were conducted to evaluate the efficacy of the botanical identified in comparison with bio agent, chemical and organic amendment. The data generated were subjected to analysis of variance (ANOVA) technique.

**Results:** Root-knot nematode was the most damaging nematode in the rhizosphere of pepper. Methanolic extract of *Andrographis paniculata*, *Glyricidia maculata* and *Chromolaena odorata* were effective against *M.incognita* in increasing the mortality of juveniles at 24,48 and 72 hours after treatment (72 to 97 per cent) under *in vitro* condition. Results of pot culture experiments using different plant preparations revealed that *A. paniculata* dried powder @ 25 g/kg soil suppressed the nematode population in soil (78%). Micro plot studies confirmed that the above treatment is significantly superior to bioagent, *Purpureocillium lilacinum* and neem cake treatments.

**Conclusion:** Soil amendment with dried powder of *A. paniculata* @ 25 g/plant can be recommended as a best substitute for chemical nematicides in managing root knot nematode infestation in pepper

**Keywords:** *Meloidogyne incognita*, Black pepper, *Andrographis paniculata*, management

01-12

### YIELD STABILITY ANALYSIS OF HEDGE LUCERNE GENOTYPES (*DESMANTHUS VIRGATUS L. WILLD*)

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**Background:** Livestock rearing is an integral part of the various farming systems and has been a major source of employment in rural areas for centuries. Its share is 4.4 per cent to the Gross Value Added of the agriculture and allied sector. Stagnation in the availability of green fodder and its increasing deficit over the years is a major concern. Along with productivity enhancement, it becomes all the more essential for ensuring the availability of quality feed and fodder to sustain higher productivity in animals. Hedge lucerne, being a perennial fodder legume can be also used as a protein supplement for the livestock. Multilocation trials of hedge lucerne genotypes were conducted across four locations in Kerala *viz.*, Trivandrum, Kollam, Thrissur and Wayanad for yield and quality parameters in the view of assessing the stability of genotypes.

**Method:** In this study eight hedge lucerne genotypes were evaluated. The biometric, yield and quality characters of the genotypes were recorded at the time of each harvest. Four harvests were taken in a year. Analysis of Variance (ANOVA), mean performance of genotypes, stability analysis using Eberhart and Russell model, pooled analysis of variance for the genotypes were done for different characters over four locations.

**Results:** The genotype T<sub>8</sub> (Thumburmuzhi local) recorded the maximum green fodder yield, dry matter production, crude protein and crude fibre content. Stability analysis revealed that the genotype T<sub>1</sub> (IC 345276) was stable over all locations for different characters such as plant height, number of branches, green fodder yield, dry matter production and crude fibre. The genotype T<sub>8</sub> (Thumburmuzhi local) was stable in favourable environment for length of branches, green fodder yield, dry fodder yield and dry matter production.

**Conclusions:** Genotype-environment interaction is one of the basic reasons for the difference in high performance in genotype for the yield and other essential agronomic traits.

**Keywords:** Hedge lucerne, Stability, Biometric characters, Yield

01-13

### CROP NUTRITIONAL RESILIENCE AS AN INTEGRAL PART OF SOIL AMELIORATION FOR ENHANCED FRUIT YIELD AND QUALITY IN PAPAYA (*CARICA PAPAYA L.*) : AN EMERGING NUTRACEUTICALLY IMPORTANT FRUIT CROP OF KERALA

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**Background:** Papaya is one of the most commonly cultivated tropical fruit crops, which gained popularity due to its nutraceutical properties. It is slowly emerging from the status of a homestead crop to that of commercial crop in Kerala. Major production constraint encountered in papaya is difficulty in maximizing yield with in unit time. Due to the increasing popularity of the crop, a progressive farmer has started its commercial cultivation in Kerala. Reluctance in giving proper care and scientific management has resulted in decrease in fruit size, quality and yield. Balanced nutrition plays a vital role on plant growth, yield and fruit quality. One of the reasons for low production in papaya is inadequate



nourishment. As the export of papaya from India is rapidly increasing in the recent past, there is a pressing need to enhance its productivity and improve the fruit quality. The present experiment was undertaken to study the response of major plant nutrients *viz* nitrogen, phosphorus and potassium on growth, yield and quality of papaya and also to find out the optimum dose of NPK for commercial cultivation under Kerala conditions.

**Method:** The trial was conducted in 3<sup>3</sup> confounded factorial RBD, confounding NPK in replication-1 and NP<sup>2</sup>K<sup>2</sup> in replication-2. Different levels of nitrogen, phosphorus and potassium (200, 250 and 300) gram plant<sup>-1</sup> year<sup>-1</sup> were tried in six equal splits. Papaya variety CO-2 was used for the experimental purpose.

**Results:** NPK interaction had significant influence on plant height, girth, leaf number at all stages of growth. The study revealed that application of nitrogen, phosphorus and potassium at the rate of 250:250:500 grams per plant per year increased fruit yield and quality of papaya.

**Conclusions:** The overall assessment of crop nutritional resilience of papaya indicated that the application of nitrogen, phosphorus and potassium at the rate of 250 : 250 : 500 g plant<sup>-1</sup> year<sup>-1</sup> in six equal splits at two months interval was economically viable and improved growth and yield of papaya under Kerala conditions.

**Keywords:** Papaya, nutrition, Nitrogen, Phosphorus, Potassium

01-14

### HYPERSPECTRAL SIGNATURES FOR MODELING PLANT PIGMENTS AND VEGETATIVE INDICES OF DIFFERENT PADDY CULTIVARS AS A TOOL IN PRECISION FARMING

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Hyperspectral remote sensing provide detailed information about physical status and photo synthetic variable of the plant, based on seasonal or continues observation of the plant. The study was concentrated on estimating plant chlorophyll content and monitor leaf water status of three rice varieties commonly cultivated in Kerala called as Uma, Aishwarya and Jyothi during different growing period and to asses relationship of different pigments during growing stage of the plant. The study investigated a wide range of pigment content and its relationship by using spectral reflectance range 400 to 900nm of the maple. Nitrogen and chlorophyll estimated with help of vegetation index (VI), ratio vegetation index (RVI), red chlorophyll index, and green chlorophyll index. Plant health status and leaf water content was evaluated using NDVI (Normalized Difference Vegetation Index) and NDWI (Normalized Difference Water Index). Even though a slight variation was observed between the indices, in general the indices increased up to flowering stage after planting and later decreased at maturity stages. Spectral information related to the pigments at 400 to 900 nm region help to derive maximum data about the specimen's physiological status. 870 and 1260 nm offers maximum probability for obtaining water content in plant. Linear regression, showed that Chlorophyll and nitrogen content were positively correlated and statistically significant with spectroradiometer measured and calculated indices of NDVI. To conclude, this developed spectral signature library can be potentially used to understand the area of different varieties in specific location, current growth stage in the field, the influence by water or nutrient stress and for precisemanagement under precision agriculture.

**Keyword:** Spectroradiometer, NDVI (Normalized Difference Vegetation Index), Vegetation Indices, Chlorophyll, Correlation.

01-15

### STANDARDISATION OF PROCESS PROTOCOL FOR OSMO-CONVECTIVE DRIED PINEAPPLE

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**Background:** Pineapple is non-climacteric in nature and has characteristic pleasant flavour, distinct aroma, exquisite taste and absence of seeds qualifies it act as one of the choicest fruits. Though pineapple is having a better post-harvest life during the glut season but the growers are forced to sell the produce at meager price since the small farmers cannot afford to produce processed forms either canned slices or juice due to higher in processing cost. Osmotic dehydration is a simpler preservation technique that does not require any sophisticated equipments. In the osmotic dehydration process, the drying acts as an important role in which only hot air is used for removal of moisture and considerable energy

is saved as compared to other methods such as osmo-convective drying. In recognition of the above facts, the investigation was proposed to standardise the syrup concentration, soaking time and drying temperature of osmo-convective dried pineapple to evaluate their acceptability and quality.

**Method:** The treatments were carried out under atmospheric conditions. Fresh cut pineapples were subjected to blanching in water for 3 minutes and kept in sugar solution of 50, 60, 70% with various soaking times (12, 18 and 24h). Soaked samples were dried at 65°C for 10 h using a combo convective drier developed under Centre of Excellence in Post-harvest Technology, Kerala Agricultural University, Thrissur. Quality parameters such as moisture content, colour, water activity and texture were analysed.

**Results:** The sample treated with 60% sugar solution with 18 h of soaking time was selected as the best treatment combination. Moisture content of standardized sample was 16.34% with water activity of 0.587. Selected sample also maintained good colour ( $L^*$ -52.44,  $a^*$ -8.18,  $b^*$ -35.97) and textural properties (Hardness-68.48 N).

**Conclusion:** The study concluded that osmo-convective dried pineapple titbits showed good sensory and quality properties, the pineapple growers can use this technique and convert the excess production into dehydrated form. This method prolongs the post-harvest life of pineapple and growers can get better return even in off seasons.

**Keywords:** Osmo-convective drying, pineapple, quality parameters

01-16

### PATHOGENICITY OF *RHABDITIS*, A NATIVE ENTOMOPATHOGENIC NEMATODE AGAINST TERMITE

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**Background:** Naturally occurring entomopathogens are important biotic factors for suppressing the population of insects. Exploitation of the mutualistic association of entomopathogenic nematodes (EPN) belonging to families Steinernematidae and Heterorhabditidae with insect pathogenic bacteria in the genera *Photorhabdus*/*Xenorhabdus* is gaining momentum. Termites are becoming a major menace in crop production. It is reported that 190 species of termites attack a wide variety of crops like cereals, annuals, shrubs, living trees and timber. Hence the present study was conducted to isolate and evaluate the pathogenicity of indigenous entomopathogenic nematodes against termites.

**Method:** Native isolates of entomopathogenic nematodes isolated from soil by using *Galleria melonella* larvae as trap were used for the study. One among these was identified as *Rhabditis* sp. and multiplied *in vivo* in *Galleria melonella* larvae. Active dauer juveniles (DJ) stored for 15 days in sterile tap water were used for inoculation following petriplate method described by Woodring and Kaya (1988). Four levels of *Rhabditis* isolate (10, 50, 100 and 200 DJ) were inoculated in petriplates containing 50 termites. The experiment is conducted in completely randomized design with four replications. Mortality of termites was recorded at 24, 36, 48, 60 and 72 hours after treatment. Control was also maintained for recording natural mortality of termites. The corrected mortality percentage was worked out using Abbott's formula.

**Results:** Maximum mortality of termites was noticed at an inoculum level of 200 DJ of *Rhabditis* isolate with 78 per cent mortality and it was statistically on par with 100 DJ with percentage mortality of 69. At lower doses of 50 and 10 DJs significantly lower percentage mortality was recorded. Cent percent mortality was recorded at inoculum levels of 100 and 200 DJs at 48 hours after treatment. Cent percent mortality of termites for 10 and 50 IJs was observed at 60 and 72 hours respectively.

**Conclusion:** This work clearly infers the effective use of *Rhabditis* for the control of termites. Most of the EPN parasitizing dipteran and coleopteran pests belong to Rhabditidae. Hence the new indigenous isolate can be effectively used in the integrated pest management strategy of maggot and grub stage of many dipteran and coleopteran pests which have life stages in soil.

**Keywords:** Entomopathogenic Nematodes (EPN), Termites, Dauer Juveniles (DJs), Mortality

01-17

**NON-WOVEN FABRIC WRAP: A NEW INTERVENTION TO SUPPRESS WHITE STEM BORER (*XYLOTRECHUS QUADRIPE* CHEV.) POPULATION IN COFFEE PLANTATIONS**

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Coffee White Stem Borer (WSB) *Xylotrechus quadripes* (Coleoptera: Cerambycidae) is the most serious pest of arabica coffee in India. Plants in the age group of 6-10 years are most vulnerable to WSB. Ten grubs may be sufficient to kill a 5-7 year old plant.

Last few months our scientists are crazy over a material, “Non-woven fabric” which helps to reduce White Stem Borer (dreaded pest) infestation in coffee plantation without any herculean task. This revolutionary technique has been featured in several platforms and plantation field during last year. Planters are using all recommended IPM strategies to avoid WSB attack and in addition to that the impregnated non-woven wrapping to infested plants will be additional armoury to planters. As the method is effectively kill the beetles which are about to emerge and reducing the inoculum. Which provide the planters an ample time to harvest the standing crop and retain plant population without any further spread of the pest. Meantime, grower will get sufficient time to take proper decision of the infested plant viz., collar pruning/uprooting/supply planting. In the present study reveals that there is no disease were noticed in any of the wrapped plants. From the data, the recovery per cent of the plants ranges from 88% to 100 %. In control eight percent only observed. Four beetles were escaped from the total emergence of 421 adults. Which itself is a clear indication that 99 % of the adult beetles were found dead before emergence. Few stems were split opened and no mortality of larvae or pupae observed, which reveals that, there was no significant against larval mortality and pupal mortality. The plant which are having limited infestation due to WSB, wrapping with nonwoven fabric will promote the plant to repair the tissues damaged by the stem borer larvae and will rejuvenate within a short time. The results indicated that, impregnated non-woven wrapping with insecticide has observed no phyto-toxicity for the plant and only targeted to White Stem Borer.

01-18

**COMPARATIVE ANALYSIS OF DIOSGENIN CONTENT IN TWO SELECTED VARIETIES OF *DIOSCOREA* SP.**

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*Dioscorea* species are traditionally dominant source of diosgenin and is widely used in synthesis of sex hormones, oral contraceptives and other steroidal drugs. *Dioscorea zingiberensis* is the main raw material for industrial diosgenin preparation because of its steep saponin concentration in the tubers. The supply of diosgenin cannot currently satisfy the demands of the ever flourishing steroid industry. Therefore it is crucial to search new plant source for diosgenin production. We selected *Dioscorea floribunda* (Mexican kachil) and *Dioscorea esculanta* (Nanakizhangu) for the study, in which *floribunda* is noncultivated species. Whereas *Dioscorea esculanta* produces edible roots. The specimens were collected from different regions of Western Ghats and CTCRI Thiruvananthapuram in flowering and fruiting conditions preferably in quadruplicate. The taxonomic identities of the collected materials were confirmed with the help of various regional and adjacent countries floras and also by consulting with authentic specimen depositories in various National Herbarium like CAL, BLAT, BSI, BSD, BSIM, NBG, MH, CALI etc. Different chemical components (moisture, starch, reducing, hemicellulose, cellulose, and Ash) were also analyzed. Diosgenin concentration was determined by high pressure liquid chromatography (HPLC) Shimadzu Japan using methanol extract of tubers. Diosgenin concentration in *floribunda* and *esculanta* were 1.6% and 0.66% respectively. *Dioscorea floribunda* is selected for further studies due to high diosgenin concentration.

01-19

**GREEN SYNTHESIZED ZINC OXIDE NANOPARTICLES AS NUTRIENT SOURCE FOR MAIZE  
(ZEA MAYS L.)**

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**Background:** Plant mediated synthesis or green synthesis of zinc oxide nanoparticles (ZnO NPs) is gaining importance due to the disadvantages associated with chemical synthesis. The chemical synthesis followed by stabilization of synthesized ZnO NPs cause release of toxic by-products which are harmful to the ecosystem. Green synthesis has emerged as the best alternative to chemical synthesis of nanoparticles due to its simplicity, rapid rate of synthesis, cheapness and eco-friendly nature. Zinc is an essential element and has become the fourth important yield limiting nutrient after NPK. Zinc application to crop plants in the form of nanoparticles will serve as an efficient nutrient source which reduces the quantity of nutrient required and increase the effectiveness of applied nutrients

**Method:** ZnO NPs were green synthesized using calotropis leaf extract and characterized for its size and shape using scanning electron microscopy (SEM). The chemical composition of green synthesized nanoparticles were determined using energy dispersive atomic X-ray analysis (EDAX). This was followed by a pot culture study with maize plants in calcareous black soil, supplying with different concentrations of green synthesized ZnO nanoparticles (50 ppm to 2000 ppm) to study its effect as a nutrient source.

**Result:** Plant received nano ZnO @ 250 ppm showed enhanced growth and at higher concentrations (> 1000 ppm) plant growth decreased due to zinc toxicity

**Conclusion:** ZnO NPs at lower concentrations are very effective in enhancing growth as well as nutrients uptake of maize plants than the conventional zinc sulphate spray. But at higher concentrations, nano ZnO caused toxicity in plants due the higher bioavailability of zinc nutrient.

**Key words:** Green synthesis, calotropis, maize, nanoparticles, zinc oxide

01-20

**CALLUS REGENERATION FROM LEAF SHEATH EXPLANTS OF SILK BANANA 'POOVAN' (AAB)**

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*In vitro* regeneration through indirect organogenesis of a triploid banana, *Musa paradisiaca* cv. Poovan (AAB) was achieved from leaf sheath explants of sucker origin. Calli were induced on Murashige and Skoog (MS) medium supplemented with 2, 4-dichloro phenoxy acetic acid 0.3 mg/L in complete dark condition. The off white friable calli so obtained have more shoot organogenic potential. These calli grown on MS medium supplemented with 1 mg/L benzyl adenine and 0.1 mg/L  $\alpha$ -naphthalene acetic acid gave rise to white protuberances which developed into 2-3 prominent shoot buds in the dark in 8 weeks. The buds along with callus regenerated more shoots and obtained average 5.62 shoots upon transfer to benzyl adenine 4 mg/L and  $\alpha$ -naphthalene acetic acid 0.1 mg/L in 16 hrs light. Good rooting was achieved on ½ MS + 3% sucrose + 150 mg/L activated charcoal + 0.7 mg/L indole-3-butyric acid within 15 days and plantlets exhibited 83 % survival in greenhouse conditions.

**Key words:** Banana, Callus, Leaf sheath, *Musa*, Poovan, Tissue Culture.

01-21

### GOOD AGRICULTURAL PRACTICES FOR QUALITY RAW DRUG PRODUCTION IN BRAHMI (*BACOPA MONNIERI*)

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**Background:** *Bacopa monnieri* is a traditional medicinal plant in ayurveda used for enhancement of intelligence and memory and revitalization of vital organs. Standardization of good agricultural practices is essential for organised cultivation of the plant to ensure availability of sufficient quantity of good quality raw drug for medicine manufacturers.

**Methods:** Natural habitats of the plant in Kerala were explored and accessions collected from different agro ecological situations were evaluated. Field and laboratory experiments were carried out to standardise water management, nutrient requirement, harvest interval and storage methods. Quality evaluation of the raw drug was carried out by estimation of the pharmacologically active glycoside Bacoside A.

**Results:** Survey of the natural habitats showed that brahmi is found naturally in ill drained soils. Analysis of plant and soil samples revealed the presence of excessive levels of toxic heavy metals in certain locations. The accessions collected from different locations showed wide variation in vine yield and Bacoside A content. Yield varied from 132.2 g/pot to 260.5 g/pot; Accession 39 from Kakkenchery, Kozhikode registered highest yield. Wide variation (0.87 to 4.71%) was noticed in Bacoside A content. Accession 11 from Vellanikkara and Accession 42 from Alappuzha showed exceptionally high Bacoside A content of 3.88% and 4.71% respectively.

Shallow submergence of 1cm was found to favour growth and yield of brahmi. The plant was found to respond well to organic manuring. Basal application of FYM-10 t/ha followed by groundnut cake slurry application @ 2 t/ha after each cut was found to give higher yield. The best harvesting interval for higher vine yield of brahmi is 60- 80 days. Among the containers tested for storage of dried brahmi, sealed polythene cover was found superior to cloth bag or gunny bag. Quality of the crude drug was found to decline after six months of storage. It is also observed that Bacoside A content is 2.14% in shade dried samples, whereas it is 1.83% in sundried condition.

**Conclusion:** Brahmi accessions collected from different locations showed variations in yield and Bacoside A content. Agricultural practices on water management, manuring, harvesting interval and storage of brahmi were standardised. Study also showed that quality of raw drug is influenced by growing situations, drying and storage methods.

**Keywords:** Brahmi, *Bacopa monnieri*, Bacoside, Good Agricultural Practices, Medicinal plant

01-22

### IN VITRO SCREENING OF SELECTED ZINGIBERALES FOR ANTIOXIDANT, ANTIFUNGAL, ANTHELMINTIC AND CYTOTOXIC ACTIVITIES

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**Background:** Zingiberales is a vital group of rhizomatous plants distributed widely in Southeast Asia and many of them are being used for treatment of various ailments. Though their free radical scavenging activity and general toxicity in different test organisms and activity against human pathogens have been widely reported, exploration of tropical Zingiberales for plant protection has not been endeavored.

**Methods:** Aqueous methanolic extracts of rhizomes of selected Zingiberales were evaluated for *in-vitro* antioxidant activity by DPPH assay and total phenol content was also determined using standard protocol. Antifungal activity of extract was studied by poison food technique using phytopathogenic fungi *Rhizoctonia solani*, *Fusarium oxysporum* and *Phytophthora capsici*. Cytotoxicity of extract was studied by Brine shrimp lethality assay and anthelmintic activity by using African earth worm *Eudrilus eugeniae*.

**Results:** *Alpinia calcarata* showed highest DPPH scavenging power with lowest IC 50 value of 14.73 ppm. The extracts of *Curcuma caesia*(58.375 ppm), *Curcuma zedoria* (61.147 ppm) and *Curcuma longa* (61.87ppm) exhibited moderate free radical scavenging capacity. Aqueous methanolic extractives of *Alpinia calcarata*, *Curcuma zedoaria*, *Curcuma longa*, *Hedychium coronarium*, *Kaempferia galanga* showed 30-77% inhibition against *Rhizoctonia solani*, *Fusarium oxysporum* and *Phytophthora capsici* at 500 ppm concentration. Among these, extracts of *Curcuma zedoaria*, *Kaempferia galanga* and *Hedychium coronarium* showed significant broad spectrum antifungal activity against all the

three fungi tested. In brine shrimp lethality assay, *Kaempferia galanga* and *curcuma longa* showed highest cytotoxicity with an  $IC_{50}$  value of 8.26  $\mu\text{g/ml}$  and 1.06  $\mu\text{g/ml}$  respectively. *Hedychium coronarium* exhibited moderate anthelmintic activity with an  $LC_{50}$  of 271.63  $\mu\text{g/ml}$  followed by *Curcuma caesia* ( $LC_{50}$  330.36  $\mu\text{g/ml}$ ) with 100 % death within 2 hours.

**Conclusions:** This work identifies *Alpinia calcarata* as a grander source of antioxidant activity and *Curcuma zedoaria*, *Kaempferia galanga* and *Hedychium coronarium* offer wide scope for their exploration in crop protection against pests and diseases.

**Keywords:** Brine shrimp lethality assay, *Eudrilus eugeniae*, Total phenol content, Cytotoxicity, Antifungal, DPPH, antioxidant, Zingiberales

01-23

### MOLECULAR CHARACTERIZATION OF BANANA BUNCHY TOP VIRUS IN KERALA ISOLATES

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**Background:** Although BBTV is a DNA virus, it shows genetic reassortment and variability. The BBTV isolates from various parts of the world has been clustered into two subgroups Pacific Indian Oceans (PIO) group and South East Asian (SEA) group. Hence a study was conducted in phylogenetic analysis, comparative analysis of genomic components of BBTV and recombination analysis of BBTV isolates.

**Methods:** The BBTV infected plant samples were collected from Kannara and various districts of Kerala, was amplified by primers specific to DNA-S (Coat protein), DNA-R (Replicase), DNA-M (Movement protein) and DNA-C (Cell cycle link protein) by polymerase chain reaction. The sequenced data was analyzed using NCBI Blastn (<http://www.ncbi.nlm.nih.gov>) for homology search. Multiple alignments for sequence comparison were conducted with reported isolates using ClustalW (<http://clustalw.ddbj.nig.ac.jp>) and percent identity was calculated. Phylogenetic trees were constructed using neighbor-joining methods with MEGA version 6.0 software. DnaSP 5.10 was used to estimate Tajima's D test for each components of BBTV isolates. The recombination analysis in the aligned BBTV gene segments were carried out using RDP v.4.96 software.

**Result:** The result of *in silico* analysis showed that, size of the genome components DNA-R, DNA-S, DNA-C and DNA-M of BBTV genome were 900bp, 1042bp, 1018bp and 1043bp respectively. The sequenced data was analyzed in NCBI Blastn suite and deposited in NCBI Genebank. The phylogenetic analysis of Kerala isolates and other deposited sequences of DNA-R and DNA-S showed that Kerala isolates clustered within the PIO group. To evaluate the importance of natural selection in BBTV isolates, Tajima's D statistics was used. These statistics were significantly negative (-1.00) suggesting a negative selection. Recombination in the aligned BBTV sequences were also implemented using RDP v.4.97 software and the results shows that in the DNA-M segment minimum four recombination events has been reported between the sites (128,153) (153,160) (160,170) and (986,1015). But in case of DNA-C and DNA-S segments no recombination events were detected

**Keywords:** *Banana bunchy top virus*, Recombination, Coat protein gene, Tajima's D test.

01-24

### CHARACTERIZATION AND COMPARISON OF NANOBIOSENSOR FOR THE DETECTION OF BANANA BUNCHY TOP VIRUS

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**Background:** Banana bunchy virus is an economically destructive pathogen that affect banana. Stunted growth and bunched appearance of the plant are the major symptoms of the disease. Nano-sized particles exhibit unique characteristics different from microscopic/macrosopic particles and are utilized to detect wide variety of biological molecules with different sizes from smaller molecules to larger complex structures such as proteins, nucleotides, viruses and peptides. The study was conducted to detect BBTV using gold nanobiosensor.

**Methods:** Preparation of gold nanobiosensor includes functionalization of gold nanorod with *Banana bunchy top virus* antibody. Seed mediated growth method was followed for synthesis gold nanorod (GNR). The characterization of GNR was done by recording the absorption spectrum at the wavelength of 200nm-1100nm. The GNR biosensor for BBTV detection was tested by direct interaction with antigen and in TAS- ELISA.

**Results:** Development of pink color indicates the formation of GNR. The absorption spectrum of synthesized GNR was taken consecutively for seven days. Two peaks viz., longitudinal plasmon band (LPB) and transverse plasmon band (TPB) were observed in the absorption spectrum and it remained stable for seven days which shows the stability of the synthesized GNR. The GNR biosensor in direct addition could detect antigen dilution up to 1:100. It is an effective simple technique for field level detection of BBTV. In TAS- ELISA, addition of GNR probe gave positive reaction up to 1:1000 antigen dilutions where as monoclonal antibody gave only up to 1:100 antibody dilution. This shows the enhanced sensitivity by the use of GNR biosensor in TAS-ELISA.

**Keywords:** Banana bunchy top virus, TAS-ELISA, Gold nanobiosensor, Virus detection

01-25

### ANTIOXIDANT POTENTIAL IN RELATION TO PHENOLICS AND PIGMENTS ISOLATED FROM SOME SELECTED LANDRACES OF *DIOSCOREA ALATA* L.

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**Background:** *Dioscoreaalata* L. is an underutilized and poorly studied tuber crop cultivated by local farmers of Kerala. The present study dealt with the nutritional and antioxidant property of four selected land races of *D. alata* whose flesh color ranges from white to yellow, pink and purple.

**Methodology:** The total phenol, flavonoid, anthocyanins and carotenoids were estimated from the tuber flesh as per standardized protocols. DPPH and FRAP assay were performed to evaluate the antioxidant property of the tubers. The results obtained were statistically tested using correlation coefficient analysis.

**Results:** Yellow and purple fleshed tubers contained higher amount of phenols and flavonoids compared to white and pink colored tubers. In the case of anthocyanins purple fleshed tubers showed significantly higher amounts when compared to all other tubers. Yellow tubers contained maximum carotenoids and that contributes to its characteristic colour. Purple and yellow fleshed tubers showed significantly higher antioxidant activity than all other tubers. Phenol and flavonoids revealed very high positive correlation with antioxidant properties.

**Conclusion:** The present investigation revealed that yellow and purple landraces of *D. alata* are nutritionally more superior to the commonly used white fleshed yams.

**Key words:** Antioxidant, *D. alata*, land races, phenol

01-26

### STABILITY AND COLOR CHARACTERISTICS OF ANTHOCYANINS, ISOLATED FROM *DIOSCOREA ALATA* L., AS A NATURAL FOOD COLOURANT

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**Background:** Kerala is a rich repository of yams diversity and purple fleshed *Dioscoreaalata* L. is one among them which faces gradual loss of diversity due to underutilization. Different landraces of purple yams with distinct gradation in purple colour are available in Kerala. Being a source of acylated anthocyanin they can be considered as a potential alternative source of natural food colourant.

**Methodology:** Total anthocyanin content of purple yams and their colour characteristics were quantified by spectroscopy. Identification of anthocyanins in purple yam was done by LC-MS analysis. Influence of temperature and pH on anthocyanin stability was also studied. Colour characteristics of food products with purple yam anthocyanin were quantified using CIE L a\* b\* coordinates.

**Results:** An efficient solvent system was standardized for the isolation of anthocyanins from purple yams. Among three landraces of purple yams 'Chorakachil' showed higher total anthocyanin content and five distinct acylated anthocyanins were identified from it. At boiling temperatures purple yam anthocyanin showed higher pigment retention percentage. According to the shift in pH, colour characteristics of yam anthocyanins changes from red to yellow. Colour

characteristics of food products coloured with yam anthocyanin was comparable to the synthetic food colourant.

**Conclusions:** The present investigation established isolation, colour characteristics and applications of an anthocyanin rich food colourant equivalent to FD&C Red No. 3, from purple yam landrace 'Chorakachil'.

**Keywords:** Purple yam, Anthocyanin, colour quantification, food colorant

01-27

### EVALUATION OF RED AMARANTHUS GENOTYPES (*AMARANTHUS TRICOLOR* L.) UNDER WATER STRESS CONDITION

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**Background:** Drought is one of the major limiting factors in crop production, and will become increasingly important due to the global climate changes. Water greatly influences the yield and quality of vegetables, which are more sensitive to water stress as compared to other crops. Production of water stress tolerant crops becomes more important to sustain the food security in the world. The main objectives of the experiment are to evaluate performance of amaranthus genotypes under water stress and its adaptation mechanisms.

**Method:** The ten red amaranthus (*Amaranthus tricolor* L.) genotypes were used for the study. The biometric characters and physiological characters of the genotypes were recorded at the time of harvest. Analysis of Variance (ANOVA) was done for different characters to know the variation between the characters.

**Results:** The genotype A22 (Madhur local) also recorded the maximum yield, stem girth, number of branches, length of leaf lamina, leaf to stem ratio, membrane integrity, relative water content and proline content of leaves. Presence of proline in the leaves might be considered as an important water stress tolerance mechanism.

**Conclusions:** high yielding genotype showed maximum membrane integrity, relative water content and proline content of leaves which might be the yield contributing characters under water stressed condition in red amaranthus.

**Keywords:** Red amaranthus, Water stress, Biometric characters, Physiological characters, Yield

01-28

### EVALUATION OF ROS CYCLE AND TOLERANCE MECHANISM IN *SESAMUM ORIENTALE* L. AGAINST *ALTERNARIA SESAMI*

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**Background:** Plants and pathogens communicate with each other through reactive oxygen species (ROS) signalling network. Induction of ROS is one of the earliest observable manifestations of a plant defence strategy orchestrated by ROS gene network. So the ROS cycle seems to have an increasing importance. The leaf spot disease caused by *Alternariasesami* is one of the major single threat to sesame. In this scenario, the present study aims to unravel the biochemistry of ROS cycle and to formulate an eco-friendly control measure against the disease.

**Methods:** Leaf tissues of sesame from 1, 3, 5, 7, 9, 11 and 13 days after infection were subjected to biochemical studies and compared with respective controls and also evaluate the tolerance mechanism using plant based fungicide and bio-control agent.

**Results:** The superoxide anion and hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) concentrations remarkably increased in diseased plants compared with the control. H<sub>2</sub>O<sub>2</sub> can be detoxified via the ascorbate-glutathione cycle. Ascorbate, glutathione content and the related key enzymes of ascorbate-glutathione cycle showed high activities up to 9<sup>th</sup> day followed by a decrease. A lower induction of antioxidant defense system in turn leads to oxidative damage in sesame. The application of plant extract or microbial antagonists to sesame initiated a series of biochemical changes in the plants as part of the plant defense response.

**Conclusion:** The present study outlines defense mechanisms of sesame Thilarani against *A. sesami* by activating antioxidant enzymes to an extent and the disease management strategies are tried by antagonistic microorganisms and plant extract based control.

**Keywords:** Sesame, *Alternariasesami*, ROS Cycle, Ascorbate-Glutathione cycle



01-29

### PROFITABILITY OF LOWLAND CASSAVA CULTIVATION AS INFLUENCED BY SOURCES OF ORGANIC MANURE AND N AND P LEVELS

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A present study was conducted at College of Agriculture, Vellayani, Thiruvananthapuram, Kerala University to standardize the nutrient management involving farmyard manure, poultry manure, green manuring *in situ* and chemical fertilizers for higher profitability of cassava cultivation in lowlands. The field experiment was conducted in the lowlands at Integrated Farming System Research Station, Karamana, Thiruvananthapuram from September 2017 to February 2018. The treatments consisted of three sources of organic manure ( $m_1$  - FYM @ 12.5 t ha<sup>-1</sup>,  $m_2$  - FYM @ 6.25 t ha<sup>-1</sup> + green manuring *in situ* and  $m_3$  - poultry manure (PM) @ 2.5 t ha<sup>-1</sup> + green manuring *in situ*), two levels of N (50 and 75 kg ha<sup>-1</sup>) and two levels of P (25 and 50 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup>) along with a uniform dose of 100 kg K<sub>2</sub>O ha<sup>-1</sup>. The experiment was laid out as 3 x 2 x 2 factorial experiment with three replications in randomized block design. Application of PM @ 2.5 t ha<sup>-1</sup> + green manuring *in situ* ( $m_3$ ) recorded the highest net income of ₹ 336874 ha<sup>-1</sup> and BCR of 2.97 followed by the application of FYM @ 6.25 t ha<sup>-1</sup> + green manuring *in situ* ( $m_2$ ). Significantly higher net income of ₹ 314306 ha<sup>-1</sup> and BCR of 2.87 could be obtained due to application of 75 kg N ha<sup>-1</sup> ( $n_2$ ). However, higher net income and BCR were registered with lower level of P ( $p_1$  - 25 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup>). ROI also followed the same trend due to treatments. Higher productivity and profitability could be obtained from the cultivation of cassava in lowlands with var. Vellayani Hraswa by the application of poultry manure @ 2.5 t ha<sup>-1</sup> + green manuring *in situ* with cowpea + 75: 25: 100 kg N P K ha<sup>-1</sup>.

**Keywords:** Lowland Cassava, Farmyard manure, Poultry manure, Green manuring *in situ*, Tuber Yield, Net income, Benefit cost ratio, Returns on investment

01-30

### PROFITABILITY OF TANNIA CULTIVATION AS INFLUENCED BY TILLAGE SYSTEM SOIL CONDITIONER AND NUTRIENT MANAGEMENT

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The present study was conducted at College of Agriculture (KAU), Vellayani, Thiruvananthapuram to identify ideal Tillage system, Soil conditioner and Nutrient management for profitable tannia cultivation during 2015 -2016. The field experiment was laid out in split plot design with 24 treatment combinations and four replications. The main plot treatments consisted of four tillage systems ( $I_1$ - conventional tillage followed by pit system,  $I_2$ - conventional tillage followed by mound system,  $I_3$ - deep tillage followed by pit system and  $I_4$ - deep tillage followed by mound system) and sub plot treatments were combinations of two soil conditioners along with a control ( $s_1$ - control,  $s_2$ - coir pith @ 500 g plant<sup>-1</sup> and  $s_3$ - rice husk @ 500 g plant<sup>-1</sup>) and two nutrient management practices ( $n_1$ - integrated nutrient management (INM) - FYM @ 25 t ha<sup>-1</sup> + 80:50:150 kg NPK ha<sup>-1</sup> and  $n_2$ - organic nutrition- FYM @ 37.5 t ha<sup>-1</sup> + wood ash @ 2 t ha<sup>-1</sup>). Deep tillage followed by pit system, produced the highest cormel yield, corm yield, net income and BCR. Coir pith as soil conditioner recorded significantly higher cormel yield and corm yield, however, the highest net income and BCR were obtained without soil conditioner. Compared to INM, organic nutrition resulted in the highest cormel yield, corm yield, net income and BCR. Deep tillage (to depth of 30 cm) followed by pit system (size of 45 cm x 45 cm x 15 cm) and organic nutrition (FYM @ 37.5 t ha<sup>-1</sup> + wood ash @ 2 t ha<sup>-1</sup>) can be recommended for profitable tannia cultivation. Wherever coir pith or rice husk is available at a cheaper rate, it can be applied as soil conditioner @ 500 g plant<sup>-1</sup> for enhanced productivity of tannia.

**Key words:** Tania, Tillage, Soil Conditioner, Corm Yield, Cormel Yield, Net Income, Benefit Cost Ratio

01-31

### VEGETABLE INTERCROPPING SYSTEM UNDER FERTIGATION

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Intercropping is a way to augment production through intensifying cropping by combining different crops thereby utilizing the available resources more efficiently. The productivity of intercropping system can be enhanced by adopting suitable planting geometry and by proper nutrient and water management. Information on planting geometry and schedules of fertigation and drip irrigation can help in further increasing the productivity of the system. The present study was undertaken to assess the bio economic suitability of chilli- amaranth intercropping system under different nutrient and water regime.

The experiment entitled “Chilli- Amaranth intercropping system under fertigation” was conducted at Water Management Research Unit, Vellanikkara during January to July 2017. The trial was laid out in randomized block design replicated thrice. The treatments consisted of chilli- amaranth intercropping system planted at two different planting geometries viz., normal row planting and paired row planting, three nutrient levels viz., 100, 75 and 50 per cent of NPK recommendation for both crops as fertigation and two irrigation levels viz., 100 per cent Epan and 75 per cent Epan.

Performance of crops under intercropping and pure crop system revealed that the yield of intercropped chilli was 41 per cent lower than chilli pure crop. However for amaranth, the yield was 17 per cent higher under intercropping compared to pure crop.

Planting geometry had no significant influence on the yield performance of intercropped chilli and amaranth. Paired row pattern was adopted to accommodate more intercrops. However, paired row planting had no significant effect on the yield of chilli and amaranth.

The nutrient levels showed no significant difference on the yield of intercropped chilli, whereas yield of intercropped amaranth was significantly influenced. Intercrop yield of amaranth at 100 per cent of nutrient dose (26,227 kg/ha) was significantly higher than intercrop yield of amaranth at 75 (21,824 kg/ha) and 50 per cent of nutrient dose (24,050 kg/ha) and pure crop yield (20,559 kg/ha).

Intercropped chilli receiving irrigation at 100 per cent Epan recorded 37 per cent higher yield compared to lower level of irrigation. However, the performance of intercropped amaranth was not significantly influenced by the irrigation levels.

LER (Land Equivalent Ratio), LEC (Land Equivalent Coefficient), ATER (Area Time Equivalent Ratio), RCC (Relative Crowding Coefficient) and CEY (Crop Equivalent Yield) were worked out for assessing biological efficiency of intercropping system. LER more than 1.0, LEC more than 0.25 and high values of ATER and CEY revealed the biological efficiency of chilli- amaranth intercropping system compared to pure crop system. Intercropping system under normal row planting produced significantly higher LER (2.84) compared to paired row planting. In addition, nutrient level of 100 per cent NPK recommendation showed higher LER (2.81) compared to lower doses. Irrigation at 100 per cent Epan recorded significantly higher value of LEC and ATER.

Economic benefit of intercropping system was assessed using gross return, net return and B:C ratio. The net return of chilli-amaranth intercropping system (Rs.428212) was 116 per cent higher compared to pure crop chilli (Rs.197716) and 164 per cent higher to pure crop of amaranth (Rs.24548). The study indicated that there is an effective utilization of space, nutrients and water when amaranth was raised as intercrop with chilli. To get maximum biological and economic benefit from chilli-amaranth intercropping system, planting should be done at normal row with 100 per cent recommended dose of nutrients for both the crops and irrigation at 100 Epan.

01-32

### A STUDY ON THE ENTREPRENEURIAL BEHAVIOUR OF LEASE LAND VEGETABLE GROWERS IN THIRUVANANTHAPURAM DISTRICT

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The present study was carried in the Thiruvananthapuram district of Kerala. It focused on the entrepreneurial behaviour, attributes of entrepreneurial behaviour and the constraints faced by lease land vegetable farmers. Entrepreneurial

behaviour is defined as the ability of the respondent to exploit the opportunities and initiate an enterprise of his/her own for income generation.

**Methodology:** The study comprised of eighty respondents who were selected randomly from four panchayats of Thiruvananthapuram district. A structured interview schedule was used for data collection. Statistical tools such as arithmetic mean, standard deviation, frequency, ANOVA were used for the analysis. Based on the analysis of data, it was found that majority (62.5%) of the farmers were having medium entrepreneurial behaviour. On comparison of four panchayats, it was found that there was no significant difference between the panchayats which means all the respondents of four panchayats had similar level of entrepreneurial behaviour. Distribution of respondents based on their entrepreneurial attributes was done using mean and standard deviation.

**Results:** it was found that majority (72.5%) of the respondents belonged to medium category of risk taking (72.5%), hope of success (61.25%), persuasibility (61.25%), feedback usage (62.5%), self confidence (68.75%), knowledge ability (61.25%), persistence (60%), manageability (61.25%), innovativeness (60%) and achievement motivation (61.25%). Constraints faced by lease land farmers were found based on discussion with the respondents and ranking was done accordingly. Correlation analysis revealed that with respect to overall entrepreneurial behaviour, problems solving ability, creativity, deferred gratification, market orientation, credit orientation and self reliance were found to have positive and significant correlation with entrepreneurial behaviour. High lease rent and owners demanding payment of rent before the cropping season, no fixed lease rent, lack of timely and sufficient credit facilities from banks, short tenure period, no voucher for payment of rent and lack of legal structure for agreement in the order were the major constraints faced by lease land farmers.

**Conclusions:** Legalization of land leasing, creation of land bank, provide better extension agent support, timely and need specific training to farmers by developmental departments, improve marketing and transportation facilities without intermediaries, better availability of government subsidies and schemes, providing timely and sufficient credit facilities and promotion of value addition technologies were the major suggestions given by experts. The constraints experienced by the farmers need the attention of government agency, policy makers, and extension organisation of the state for their redressal to boost up vegetable production.

**Keywords:** Entrepreneurial behaviour, lease land

01-33

### NUTRIENT ANALYSIS OF *PSIDIUM GUINEENSE* SW. (MYRTACEAE) - AN UNDERUTILIZED EDIBLE FRUIT FOUND IN KERALA.

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**Background:** The present study was aimed to reveal the nutrient composition of fruits of *Psidium guineense* Sw., Myrtaceae, an underutilized wild plant commonly seen in Kerala.

**Methods:** The edible pulp portion of the fruits was used for the analysis of proximate composition, vitamin content, mineral composition and anti-nutrient content using standard procedures.

**Result:** The result obtained showed that the fruit has considerable amount of moisture (78%), carbohydrate (14.4g/100g) and fiber (4.7%). Of the vitamins examined, vitamin C (45.45mg/100g) and Vitamin A (600IU) shows highest amount. Among the mineral analysis, potassium is the main component (531mg/100g). The only anti-nutrient present was oxalate (3.70mg/100g) which was found to be much lower when compared to commonly consumed fruits.

**Conclusion:** Thus, the present investigation shows that *Psidium guineense* is a source of many nutrients, minerals and vitamins and therefore could be utilized for human consumption like other common fruits.

**Keywords:** *Psidium guineense*, Wild fruit, Nutrient analysis, Mineral composition, Anti-nutrient

01-34

### VALUE - ADDED PRODUCTS FROM JACKFRUIT AND PAPAYA FOR FOOD SECURITY AND SUSTAINABLE DEVELOPMENT

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**Background:** A survey conducted at IRTC on Jackfruit availability in Kerala revealed that around 2.5 million tons of jackfruit are produced in Kerala annually, around 30% of which is wasted due to various reasons like difficulty involved in plucking the fruit from tall trees and the time consumed in processing the same. Jackfruit is seasonal; however papaya is a perennial fruit.

**Method:** This work explores the production possibilities of value - added products from the above fruits by techniques like steam sterilization, osmotic dehydration, solar-cum-electric drying, conventional and microwave baking. Dietary fibre and calcium content of these fruits have been estimated using standard procedures (using wet chemical analysis and atomic absorption spectrophotometry)

**Results:** Procedures and flowsheets for the production of jackfruit powder, jackfruit based toffee, biscuits, pickle, osmotically dehydrated sweetened jackfruit and papaya snacks (tutti-frutti) have been standardised. Jackfruit powder can replace 'Atta' by 25% which makes chapati and poori extremely soft and palatable. Papaya tutti-frutti is a healthy snack for everybody-both children and elderly equally well.

**Conclusion:** This work established the possibility of popularising nutritive and fibre rich Jackfruit and papaya products with no added preservatives and colours.

**Keywords:** Jackfruit, Papaya, value –addition, osmotic dehydration, conventional and microwave baking.

01-35

### PHYSICOCHEMICAL EVALUATION OF THE FRUITS OF CULINARY MELON AND SNAP MELON

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*Cucumis melo* L. commonly known as melon, is a tropical plant species belongs to the family Cucurbitaceae. Morpho metric analysis of melon landraces from Kerala revealed that the varieties showed considerable variability especially with fruit characteristics . The landraces belonged to two varieties such as *Cucumis melo* var. *acidulus* . L. Naudin (Culinary melon) and *Cucumis melo* var. *momordica* (Roxb.) Duthie&Fuller (Snapmelon). Among this var. *momordica* is an underexploited cucurbitaceous crop and the ripened fruits are consumed as dessert, whereas var. *acidulus* is a commonly used cooking type vegetable. The present investigation was carried out to understand basic principles of physicochemical properties in the fruits of the two varieties of melon in order to compare quality and nutritive value of fruit at different developmental stages. Fruits were harvested at three developmental stages and evaluated for physical and chemical parameters. Biometrical characteristics and physical characteristics of the fruits in two varieties showed significant changes during ripening. Whereas chemical characteristics such as Total Soluble Solids , Titrateable acidity and Ascorbic acid concentration of the var. *acidulus* more compared to var. *momordica* at different developmental stages. Final contents of these parameters were 3.06°Brix, 0.32%, 12.95mg/g tissue in var. *acidulus* and 2.9°Brix, 0.26% and 8.25 mg/100g in var. *momordica*. This can be treated as one of the reason for different mode of consumption of these varieties.

01-36

**PERFORMANCE EVALUATION OF GINGER (*ZINGIBER OFFICINALE* ROSC.) VARIETIES UNDER ORGANIC NUTRITION: AN ECO FRIENDLY APPROACH TO AMELIORATE SOIL NUTRITION AND MAINTAIN SOIL SUSTAINABILITY**

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**Background:** Ginger, a surprisingly useful plant, noted for its economic value has an important place in the spice map of Kerala. Although many varieties of ginger are grown in different parts of the country, only those varieties grown in Kerala, which are grown with low fibre and pungency are suitable for dry ginger. Ginger is a heavy feeder and it demands nutrients in large amount and use of large quantity of chemically formulated fertilizer is not feasible as it results in progressive rise in multi-nutrients deficiency, nutrient imbalance, deteriorating soil health and productivity with time. Thus organic farming is the best known alternative.

**Method:** Krishi Vigyan Kendra, Kollam selected four ginger varieties Athira, Karthika, Aswathy and Varada for the trial. Number of replications is ten. Organic ginger production package developed by Kerala Agricultural University is followed for its cultivation.

**Results:** The trial revealed that ginger variety Varada recorded highest yield (18.5 t/ha) followed by variety Aswathy (16.7 t/ha), while local variety recorded lowest yield (10.0 t/ha). Highest B:C ratio (2.63) was obtained from Varada followed by Aswathy (2.38) and Athira (2.32). Highest disease incidence (25.0%) was reported from local variety followed by Karthika (8.0%) and lowest from Varada (5.2%). Pest incidence (15.4) was highest in local variety and lowest (4.3%) in variety Varada. The rhizomes of ginger variety Varada and Athira is bold, while that of variety Aswathy and Karthika is medium bold. Varieties Varada, Athira and Karthika can be used for fresh and dry ginger purpose while variety Aswathy is used for fresh ginger purpose.

**Conclusion:** It was concluded from the study that ginger performs well under organic farming. This farming method helps maintaining soil sustainability in long run. Ginger variety Varada reported highest yield and benefit cost ratio and less pest and disease incidence than other ginger varieties in Kollam district of Kerala under organic management practices. Ginger variety Varada reported highest yield and benefit cost ratio and less pest and disease incidence than other ginger varieties in Kollam district of Kerala under organic management practices.

**Keywords:** Ginger, Soil sustainability, Amelioration Rhizome, Organic farming

01-37

**POSTHARVEST TREATMENT WITH SALICYLIC ACID TO IMPROVE PHYSICAL QUALITIES OF NENDRAN BANANA DURING STORAGE**

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**Background:** Nendran banana is a climacteric and tropical fruit crop with short shelf life during storage as well as export purpose. Due to its rapid ripening nature, huge amount of postharvest losses occurs and which in turn affect the farmer's benefit. To slow down the ripening process of Nendran banana, it is needed to inhibit ethylene synthesis by an ethylene inhibitor like salicylic acid.

**Method:** Nendran banana bunches of uniform maturity were selected, de-handled and treated with salicylic acid (SA) at three different concentrations for 10 minutes. The treatment consists of T<sub>1</sub>- SA 1 mM, T<sub>2</sub>- SA 1.5 mM, T<sub>3</sub>- SA 2 mM, T<sub>4</sub>- Distilled water (control) and T<sub>5</sub>- Absolute control (without any treatment). Treated banana fruits were air dried and stored under room temperature in Corrugated Fiber Board Boxes till the end of shelf life. Physical parameters like pulp %, peel %, pulp to peel ratio, peel colour and fruit firmness were observed at an interval of 3 days till the end of shelf life.

**Results:** Nendran banana fruits treated with SA 2 mM recorded minimum pulp percentage, maximum peel percentage and minimum pulp to peel ratio after 15 days of storage. Maximum fruit firmness with good peel colour was also observed when compared to distilled water (control) and absolute control (without any treatment).

**Conclusions:** Postharvest treatment with SA 2 mM for 10 minutes showed better retention of physical quality attributes and delayed ripening in Nendran banana during storage period of 15 days.

**Keywords:** Salicylic acid, Banana, Postharvest, Physical properties

01-38

### SEED PRIMING AND PGPR MIX-1 NUTRITION ON THE YIELD OF UPLAND RICE

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Direct seeding of rice, without standing water, can be an attractive alternative for enhancing the production of rice. However, poor emergence and seedling establishment and weed infestation are the main hindrances in the adoption of this culture. Seed priming with micro nutrients improved the crop emergence, establishment, and subsequently enhance the growth and yield. Sufficient densities of PGPR provide a beneficial role in creating a proper rhizosphere for plant growth. With this background the present study is proposed.

The experiment was conducted at Coconut Research Station, Balaramapuram in completely randomised block design with eleven treatments in three replications. The treatments comprised of T<sub>1</sub>-seed priming with ZnSO<sub>4</sub> @2g kg<sup>-1</sup> seed +PGPR Mix-1@10 g kg<sup>-1</sup> seed, T<sub>2</sub>- seed priming with borax @ 0.5g kg<sup>-1</sup> seed + PGPR Mix-1@10g kg<sup>-1</sup> seed, T<sub>3</sub>- T<sub>1</sub>+ foliar spray of PGPR Mix-1@ 2 per cent at panicle initiation stage, T<sub>4</sub>- T<sub>2</sub>+ Foliar spray of PGPR Mix-1 @ 2 per cent at panicle initiation stage, T<sub>5</sub>- T<sub>1</sub>+ soil application of PGPR Mix-1@ 2 kg ha<sup>-1</sup> at panicle initiation stage, T<sub>6</sub>-T<sub>2</sub>+ soil application of PGPR Mix-1@ 2 kg ha<sup>-1</sup>at panicle initiation stage, T<sub>7</sub>-T<sub>1</sub>+ foliar spray of PGPR Mix-1@ 2 per cent at active tillering and panicle initiation stage, T<sub>8</sub>- T<sub>2</sub>+ foliar spray of PGPR Mix-1@ 2 per cent at active tillering and panicle initiation stage, T<sub>9</sub>- T<sub>1</sub>+ soil application of PGPR Mix-1@ 2 kg ha<sup>-1</sup> at active tillering and panicle initiation stage, T<sub>10</sub>-T<sub>2</sub>+ soil application of PGPR Mix-1@ 2 kg ha<sup>-1</sup> at active tillering and panicle initiation stage, T<sub>11</sub>-Control (NPK fertilizer alone).

Results revealed that instead of sowing dry seeds, seed priming with zinc sulphate and PGPR Mix 1 had significant effect on yield attributes, grain yield and B:C ratio. Soil and foliar application of PGPR Mix-1 also had positive effect on yield attributes and yield. Seed priming with ZnSO<sub>4</sub> @ 2 g + PGPR Mix-1 @10 g kg<sup>-1</sup> seed + soil application of PGPR-Mix @ 2 kg ha<sup>-1</sup> recorded the highest grain yield, gross returns and B: C ratio, but it was statistically comparable with seed priming with ZnSO<sub>4</sub> @ 2 g and PGPR Mix-1 @10 g kg<sup>-1</sup> seed alone and seed priming with ZnSO<sub>4</sub> @ 2 g and PGPR Mix-1 @10 g kg<sup>-1</sup> seed + foliar application of PGPR Mix-1, 2 per cent at active tillering and panicle initiation stage. These treatments also recorded comparable values for the yield attributes also. Hence it can be concluded that seed priming with ZnSO<sub>4</sub>@ 2g + PGPR Mix-1@ 10 g kg seed<sup>-1</sup> alone or seed priming with soil application of PGPR Mix-1 @ 2 kg ha<sup>-1</sup>at panicle initiation stage or foliar application of PGPR Mix-1 at active tillering and panicle initiation stage along with NPK @ 90:45:45 kg ha<sup>-1</sup> can be recommended for higher yield and returns in upland rice.

**Key words:** Borax, foliar application, PGPR Mix-1, seed priming, soil application, zinc sulphate

01-39

### ANTIOXIDANT POTENTIAL IN RELATION TO PHENOLICS AND PIGMENTS ISOLATED FROM SOME SELECTED LANDRACES OF *DIOSCOREA ALATA* L.

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**Background:** *Dioscorea alata* L. is an underutilized and poorly studied tuber crop cultivated by local farmers of Kerala. The present study dealt with the nutritional and antioxidant property of four selected landraces of *D. alata* whose flesh color ranges from white to yellow, pink and purple.

**Methodology:** The total phenol, flavonoid, anthocyanins and carotenoids were estimated from the tuber flesh as per standardized protocols. DPPH and FRAP assay were performed to evaluate the antioxidant property of the tubers. The results obtained were statistically tested using correlation coefficient analysis.

**Results:** Yellow and purple fleshed tubers contained higher amount of phenols and flavonoids compared to white and pink colored tubers. In the case of anthocyanins purple fleshed tubers showed significantly higher amounts when compared to all other tubers. Yellow tubers contained maximum carotenoids and that contributes to its characteristic colour. Purple and yellow fleshed tubers showed significantly higher antioxidant activity than all other tubers. Phenol and flavonoids revealed very high positive correlation with antioxidant properties.

**Conclusion:** The present investigation revealed that yellow and purple landraces of *D. alata* are nutritionally more superior to the commonly used white fleshed yams.

**Key words:** Antioxidant, *D. alata*, landraces, phenol

01-40

**BACTERIAL BROOD DISEASE MANAGEMENT OF HONEY BEES (*APIS CERANA INDICA* FAB.) USING BOTANICALS**

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**Background:** Honey bees are important to the mankind for the bees products and also they aid in maintaining the biodiversity *via.*, pollination. The bacterial brood diseases infecting honey bees are a serious menace to the bee keeping industry of Kerala. Use of antibiotics for the management has lead to residue problem in honey and deteriorated the quality of Indian honey in the international market. Therefore, it's high time to move to the botanical means of management of the honey bee diseases.

**Method:** Field evaluation of botanicals *viz.*, crushed garlic (0.25 % and 0.5 %), crushed leaves of *Centella asiatica* (0.05 % and 0.1 %), crushed leaves of *Ocimum* sp. (0.05 % and 0.1 %), turmeric powder 0.2 %; CaSO<sub>4</sub> (homeo medicine) along with oxytetracycline hydrochloride (40 ppm) as check and a control treatment provided through artificial feed (sugar solution 1:1). **Results:** Analysis of Co-variance study revealed a significant reduction in the disease of the colonies treated with crushed garlic 0.25 % (68.52 %) over the pre-count observation followed by the treatment with crushed leaves of *Ocimum* sp. 0.05 % with 67.57 per cent reduction in the disease in four weeks after treatment. **Conclusion:** Crushed garlic 0.25 % and crushed leaves of *Ocimum* sp. 0.05 % were found effective against the brood disease with a percentage reduction of 68.52 and 67.57 respectively.

**Keywords:** Honey bees; *Apis cerana indica*; Kerala; Botanicals.

01-41

**ENHANCING SEED LONGEVITY IN VEGETABLE SEEDS USING FILM COAT TECHNIQUE**

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**Background:** Success of any crop production program depends on the quality of seeds own. Seeds undergo deterioration over storage and hence, maintenance of seed vigour and viability from harvest until planting is vital. Seed treatment is a common practice in agriculture for effective storage and preservation of seed. Polymer film coating is one such seed invigoration technique which is associated with chemical seed treatment.

**Method:** Freshly harvested and processed seeds of okra, variety Arka Anami kaand oriental pickling melon, variety Mudicode local were separately treated with polymers. The treated seeds along with the control were packed in 700 gauge polyethylene bags and stored under ambient conditions and observations were recorded at bi monthly intervals for a period of sixteen months.

**Results:** Throughout the storage period there was a decline in the seed quality parameters like germination and vigour. Inokra and OP melon Polykote (10ml)+carbendazim-mancozeb(2g)+ bifenthrin (0.1%) were found to be superior among the treatments with respect to germination(%), seeding vigour indices and other seed quality parameters.

**Conclusions:** The results indicated that seed treatment with polymers was highly effective for enhancing the storage life of okra and OP melon. The polymers along with plant protection chemicals help to retain viability and storability of seeds. Among the treatments, polykote (10ml) +carbendazim- mancozeb (2g) + bifenthrin (0.1%) showed best results which may be recommended for pre storage seed treatment. Seed treatment with polymers therefore provides a cheaper and safe method to enhance seed viability and seedling performance under ambient storage condition

**Keywords:** Polymers, Seed coating

01-42

### PROCESS OPTIMISATION OF A PROBIOTIC CEREAL BASED FERMENTED PRODUCT USING *L. CASEI* ISOLATED FROM PROBIOTIC MILK DRINK

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**Background:** Increased interests in healthy diets that prevent diseases have led to the development of new functional foods. Probiotic products, a functional food, have always been associated with dairy foods. Innovative pairing of probiotics with plant foods and prebiotics have given way to a wider range of products with specific focus on health and environment.

**Method:** The suitability of selected indigenous plant foods as substrates for probiotic *L.casei* isolated from fermented milk beverage was explored to identify ideal substrates. Probiotic characterisation was done to assess its probiotic potential and was confirmed by DNA sequencing. A fermented probiotic beverage using indigenous plant foods was formulated by optimising the processing conditions. The nutrient content and composition of organic acids formed during fermentation was measured. The acceptability of the product was analysed in terms of physico- chemical, microbial and sensory parameters to evaluate the shelf life. Biological study was conducted on rats to evaluate its effect in altering the gut microflora.

**Results:** The isolated organism displayed good probiotic properties. DNA sequencing confirmed the culture to be *L.casei*. Plant substrates that demonstrated good prebiotic potential towards *L.casei* was chosen for preparation of the probiotic product. The beverage prepared under optimised conditions was found to have a high viability and acceptable physico chemical and sensory attributes necessary for a probiotic product. The consumption of probiotic product improved *Lactobacillus* count in the faeces of rats.

**Conclusion:** This work establishes a novel way of utilising indigenous plant foods along with the probiotic bacteria. Being plant based, such a product could greatly benefit both man and the environment.

**Key words:** probiotic, cereal based, fermentation, *L.casei*

01-43

### A REFINED MEDIUM FOR RAPID MULTIPLICATION OF *DENDROBIUM* HYBRIDS

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**Background:** Developing climate resilient varieties and timely availability of quality planting materials are need of the hour to meet the challenges of ensuing climatic changes. The sympodial orchid *Dendrobium* is of great demand in Kerala. But there is dearth of quality planting material. To tackle this problem, several indigenous *Dendrobium* hybrids have been developed under the DBT project in the Department of Plant Breeding and Genetics, College of Agriculture, Vellayani. For rapidly multiplying these hybrids attempts were made to refine the tissue culture protocol for *Dendrobium* hybrids using *in vitro* leaf.

**Method:** The young leaf segments derived from *in vitro* established *Dendrobium* hybrids were used as explant. Leaf segments of 1.5 to 2.0 mm<sup>2</sup> size were inoculated into the medium. The cultures were then incubated in a culture room with controlled conditions of light, temperature and humidity.

**Results:** Callus initiation studies were conducted with two levels of casein hydrolysate (CH) (500 mg l<sup>-1</sup> and 250 mg l<sup>-1</sup>) in half strength MS medium containing BAP 5 mg l<sup>-1</sup> + KN 5 mg l<sup>-1</sup> + CH 500 mg l<sup>-1</sup> + CW 200 ml l<sup>-1</sup> + AC 1 gl<sup>-1</sup>. Out of this CH at 500 mg l<sup>-1</sup> was found to be the best for callus initiation and subsequent development of plantlet. The callus obtained from the inoculation medium were grouped together and cultured on regeneration media with two different levels of CH, viz., CH at 250 mg l<sup>-1</sup> and no CH. Presence of CH at 250 mg l<sup>-1</sup> was found to have significant effect on shooting response.

**Conclusions:** The optimum medium combination for shoot initiation was found to be half strength MS medium with BAP 5 mg l<sup>-1</sup>+ KN 5 mg l<sup>-1</sup>+CH 250 mg l<sup>-1</sup>+CW 200 ml l<sup>-1</sup>+ AC 1 gl<sup>-1</sup>. Plantlets were ready for plant out in six months. The refined medium was proved to be successful in mass multiplying the indigenous developed *Dendrobium* hybrids.

**Keywords:** *Dendrobium*, *in vitro* leaf, casein hydrolysate, *in vitro* medium, inoculation medium, tissue culture



01-44

### ENHANCEMENT OF RICE YIELD IN KUTTANAD THROUGH SOIL AMELIORATION AND SUPPLEMENTARY FOLIAR NUTRITION

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**Background:** The soil of Kuttanad is characterised by extreme acidity and accumulation of salts and the cultivation of paddy in this area faces problems due to water logging, acidity and metal toxicities of iron and aluminium. Iron toxicity can cause nutrient disorders and deficiencies of several elements primarily affects the production of lowland rice. This study was undertaken with the objectives to evaluate the effect of soil amelioration with rice husk ash in abating iron toxicity and supplementary foliar application of a customized nutrient formulation in increasing rice yield in the low lands of Kuttanad.

**Method:** A customized nutrient formulation was developed based on the available nutrient status of the region and crop requirement and was used for supplementary foliar nutrition @ 5 kg ha<sup>-1</sup> as foliar application of 0.5% solution in two splits at maximum tillering and panicle initiation stage. The field experiment was conducted with nine treatments replicated thrice in RBD using rice variety Uma.

**Results:** Growth and yield of rice increased significantly due to soil amelioration and supplementary foliar nutrition. The treatments did not show a significant influence on number of tillers at maximum tillering and panicle initiation stages. The leaf iron content was also found to be low in treatments where soil amelioration and supplementary foliar nutrition was given.

**Conclusion:** From the investigation it can be concluded that, treatment where soil test based recommended dose of fertilizers + Rice husk ash @ lime (based on pH) + foliar spray of 0.5% solution of customized formulation at tillering and panicle initiation stage was given was the best treatment. Use of rice husk ash as soil ameliorant along with soil test based RDF and supplementary foliar nutrition improved rice yield in Kuttanad.

**Keywords:** Soil amelioration, Rice husk ash(RHA), Foliar nutrition, Customized formulation.

01-45

### COMPARATIVE PHYTOCHEMICAL ANALYSIS OF SEED OILS IN FOUR ANNONA SPECIES

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**Background:** The genus *Annona* L. is an important source of edible fruits worldwide and *A. muricata*, *A. squamosa*, *A. reticulata* and *A. glabra* are the major *Annona* species in Kerala. Though the fruit pulp is being utilised, the seeds of the *Annona* species are neglected and the present work aims a comparative prospecting of the seed oils of the *Annona* species.

**Methods:** The seeds of the *Annona* species (5 g each) were extracted using a Soxhlet extractor with n-hexane. The lipid components were studied through HPTLC and GC-MS FAME method. The phylogenetic relation based on the distribution of fatty acids among the four species has been evaluated through hierarchical cluster analysis (HCA) using SPSS.

**Results:** The oil yield of the seeds of *Annona* species varied from 15.9 % to 27.8 %. GC-MS FAME analysis revealed that oil of the four species had oleic acid (39.84-45.68) and linoleic acid (25.41-40.91) as the major fatty acids. The dendrogram based on the distribution of fatty acids showed *A. glabra* as a distinct species.

**Conclusion:** The *Annona* species seed oils were found rich in the essential fatty acid linoleic acid, that has potential utility in functional foods. *Annona glabra* was found to have a distinct lipid profile with higher concentration of linoleic acid.

**Keywords:** *Annona* species, Seed oil, HPTLC, GC-MS FAME, Linoleic acid.

01-46

### IMPACT OF AGRICULTURAL PRACTICES IN TRIGGERING FLOOD DAMAGE AND ITS POTENTIAL SCOPE IN REDUCING THE SAME

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**Background:** In August 2018, the state of Kerala experienced severe flooding in 13 out of its 14 districts that resulted from an excessive rainfall. It was the worst flood Kerala ever experienced in this century. Apart from taking about 483 lives and damaging around 56,000 ha of cropped area, the deluge also impaired the socio-economic conditions of the state. This article studies various anthropogenic factors such as intensive cultivation without proper soil management, reclamation of wetlands and paddy fields, deforestation etc., which has triggered the pace of flood damage. And also, aims at studying the scope of unleashing the potential for agriculture to become a key to reduce the impact of flood damage rather than being part of the problem.

**Method:** The study is based on the secondary data collected from various research articles, scientific publications, study reports and annual reports of various government organisations.

**Results:** Water holding capacity of the soil is highly influenced by the top soil that contains the highly adsorbent organic materials. Unscientific land use and improper drainage practices especially in the high ranges, has promoted the erosion of top soil and consequently reduced the water holding capacity of the soil. On a different note, significant reduction in the area under wetlands and paddy fields of the state, due to ever-increasing population and consequent developmental activities can be attributed as one of the major cause of this disaster. On the other hand, it is possible to reduce the impact of flood damage by adopting various strategies that includes proper land and soil management measures, conservation of the wetlands and paddy fields, etc.

**Conclusions:** In an agronomic perspective, land and soil management has got a pivotal role to play in maintaining the inherent storage capacity of the soil as well as in controlling surface and sub-surface runoff. The findings reveal that, along with relying upon agronomic and engineering measures which has got its own limitations, conservation and use of the wetlands, flood plains, paddy fields etc., to intercept and hold the precipitation where it falls, can be a much better strategy towards the sustainable flood management.

**Key words:** Flood, Kerala, Agriculture, Wetlands, and Land management

01-47

### GENE ACTION FOR SEED SHATTERING IN RICE (*ORYZA SATIVA* L.)

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**Background:** Shedding of seeds at maturity is an important factor which leads to yield loss especially in case of field crops like rice. One of the main disadvantages of Jyothi, a popular rice variety of Kerala is seed shattering at maturity.

**Method:** Twenty-five rice genotypes were screened for yield and seed shattering using augmented design and IRI (Induced Random Impact) method, and analysed for the extend of variability. Seven genotypes- three susceptible (Pavizham (L1), Jyothi (L2) and Aishwarya (L3)) and four resistant (Aathira (T1), Triveni (T2), Jaya (T3) and Manupriya (T4)) were selected and crossed in LxT mating design.

**Result:** There was significant variability among the genotypes for yield and seed shattering. Shattering was governed by high heritability and genetic gain, which indicates that selection for shattering will be highly promising. LxT analysis revealed a preponderance of non-additive and epistatic gene interaction for the same. The per se performance of the parents for yield contributing characters and shattering revealed that the genotypes L2, L3 and T2 were promising, whereas the general combining ability (*gca*) effect showed L2, T1, T2 and T3 as better combiner. When both *gca* effects and mean values were considered together L2, T1 and T2 found to be most promising parents. Studies on hybrids based on per se performance revealed that H1, H2, H3, H5, H6 and H11 as better among the twelve hybrids. When these

hybrids were evaluated based on the specific combining ability (*sca*) effect, hybrids H3, H4, H5, H6, H8, H10 and H11 were found to be better cross combination. Mean performance and *sca* effect for yield and shattering revealed that hybrids H1, H2, H3, H5, H6, and H11 were having high response and H8 with moderate response.

**Conclusion:** The top ranking hybrids involved parents with either high mean performance, high *gca* effects or combinations of both. Hence there is more chance of getting better recombinations in segregating generation through transgressive breeding.

**Keywords:** seed shattering, *gca* effect and *sca* effects.

01-48

### IMPACT OF PRE-STORAGE SEED INVIGORATION AND PERIOD OF THAWING ON SEED LONGEVITY IN ASH GOURD (*BENINCASA HISPIDA* (THUNB.) COGN.) SEEDS.

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**Background:** Environmental condition in Kerala is hot and humid for most part of the year, which is highly detrimental to seed longevity. Under this circumstance, storing of seeds under controlled environment is recommended to prolong viability. In addition to the high recurring cost to maintain the seed under ideal controlled conditions, such seeds also undergo thawing when taken out for distribution. Usually one to three months elapses before the distributed seeds are used for sowing. Several techniques to enhance seed longevity under such environment are practiced. Seed invigoration is one such treatment methodology followed. However its applicability and utility in the storage environment prevailing in the state is to be analysed.

**Method:** The seed of ash gourd variety KAU Local collected immediately after extraction were invigorated with the respective priming agents in the ratio 1:2 on volume basis for the specified period. The invigorated and untreated seeds were shade dried at room temperature to  $\leq 8$  per cent moisture prior to packing. At monthly intervals up to 10 months of storage (MAS), three replicates of seed packed separately in polyethylene bags of 700 gauge and stored under refrigerated condition were taken out and the seeds allowed to thaw under ambient conditions for a period of five months and the effect of thawing on seed quality was assessed every month, up to five months from retrieval.

**Results:** It was observed that irrespective of the thawing period, when seeds were retrieved from refrigerated storage at monthly intervals (*i.e.*, 1 to 10 MAS), the germination in seeds invigorated with  $\text{CaCl}_2$  50mM 12h was retained above MSCS throughout, except at 2 MAS and 3 MAS.

**Conclusions:** Invigoration with  $\text{CaCl}_2$  50mM for 12h ( $I_1$ ) is beneficial in instances when it is anticipated that seeds stored under refrigeration needs to be retrieved and stored under ambient storage before sowing.

**Keywords:** Ash gourd, Refrigeration, Thawing

## 02 - BIOTECHNOLOGY

02-01

### GENETIC AND BIOCHEMICAL BASIS OF PEST RESISTANCE BY A DIPLOID *MUSA* CULTIVAR AGAINST BANANA PSEUDOSTEM BORER AND PROSPECTS FOR PEST MANAGEMENT

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**Background:** Banana form a major agriculture commodity of Kerala and aggressive attack by *Odoiporus longicollis*, the banana pseudostem borer (BPB), is the major challenge. Farmers inject toxic insecticides in the pseudostem to control BPB.

**Methods:** Estimation of total phenol, flavonoids and related enzymes such as Phenyl alanine ammonia lyase (PAL), Polyphenol Oxidase (PPO) and Peroxidase (POX) in susceptible (S) and resistant (R) cultivars. Toxicity of alarvicide of R cultivar on hemocytes, gut histology and gut enzymes. Extraction of RNA and Differential display reverse transcription

(DDRT) of mRNA and gene sequencing of PAL in R and S cultivars.

**Results:** *Kappa* (AAA) is a Scultivar and *Aadinkombu* (AA) is R. Phenols, flavonoids and related enzymes PAL, PPO and POX were very high in R cultivar. Stigmasterol-3-O-glucoside of R cultivar caused lysis of hemocytes, histolysis of midgut and inhibition of gut protease and amylase. DDRT profile of mRNA and gene sequence of PAL showed sharp difference between S and R cultivars.

**Conclusion:** Stigmasterol-3-O-glucoside can be used as a natural systemic insecticide. Developing resistant cisgenic *Musa* cultivars has prime importance.

**Key words:** Stigmasterol-3-O-glucoside, BPW, Histology, DDRT, PAL, PPO, POX

02-02

### ECO-FRIENDLY GREEN INHIBITION OF MILD STEEL CORROSION IN ACIDIC ENVIRONMENT BY TAMARINDUS INDICA LEAF EXTRACT

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**Background:** In industries, synthetic corrosion inhibitors displaying toxic effects produced an urge to search for ecologically acceptable materials which are easily available, inexpensive and inexhaustible.

**Method:** In this work, inhibitive response of the ethanolic extract of *Tamarindus indica* leaves on the corrosion of mild steel in 0.1 N HCl solution has been investigated as a potent source of green, environment friendly inhibitor. To determine the inhibition efficiency, the green inhibitors with concentrations of 10 g/L, 20 g/L and 30 g/L was studied using gravimetric weight loss method for 10 days (240 hours) under room temperature.

**Results:** The results obtained showed that the inhibition efficiency was up to 85.7% with 30 g/L concentration of the leaf extract. The protection efficiency increased with the increase in concentration of the inhibitor and decreased with time. With the aid of some binding agents, like PEG, iron oxide and poly (oxy ethylene), the surface of mild steel coupons were coated with the leaf extract. The usefulness of *T. indica* leaf extract with the increase in concentration was proved from the results of potentiodynamic polarization and Electrochemical Impedance Spectroscopy (EIS). For each coated samples, the EIS measurements was performed. The change in impedance parameters with the change in leaf extract concentration indicates the development of a defensive layer for corrosion on mild steel surface. Gas Chromatography Mass spectroscopy (GCMS) method was applied for the identification of about 58 components of the leaf extract. **Conclusions:** The inhibitor activity may be posed by the active components present in the leaf extract. Experimental results reveal that *T. indica* leaf extract is a promising candidate to function as a corrosion inhibitor for mild steel in acidic environment.

**Keywords:** Corrosion, Mild Steel, HCl, *Tamarindus indica* Leaf Extract, Inhibitor, Gravimetric, Coating, EIS, GCMS

02-03

### CHARACTERIZATION OF BIOTIC AND ABIOTIC STRESS TOLERANT ENDOPHYTE BY PHENOMIC AND GENOMIC APPROACH FOR PLANT PROBIOTIC FUNCTION AND ENHANCED AGRICULTURAL PRODUCTIVITY

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**Background:** The recent flood in Kerala has alarmed about the emergence of harsh environmental conditions such as drought which can lead to decreased agricultural productivity. Also the flood has caused marked changes in normal and

beneficial microbial flora of agricultural lands. To deal with such a condition, the most suitable way is via a “nature to nature approach”. Here comes the relevance of endophytic bacteria which reside in plants by providing plant beneficial functions.

**Methods:** The current study involves the isolation and screening of promising plant growth promoting endophytic bacteria by phenomic and genomic approach.

**Results:** The isolate *Bacillus* Dcl 1 purified from the rhizome of medicinal plant *Curcuma longa* revealed it to be positive for IAA, ACC deaminase, nitrogen assimilation and phosphate solubilization. In addition, *in vivo* plant growth promotion in *Vigna unguiculata* seedlings showed its potential to promote plant growth under stressed and nonstressed conditions. Also, Dcl 1 was found to have the presence of anti-phytopathogenic bioactive molecules such as surfactin, fengycin and plipstatin as revealed by LC-M/S and LC-MS/MS along with extracellular enzymes. Whole genome sequencing of further Dcl 1 revealed the presence of specific genes for direct plant growth promoting traits, bioactive secondary metabolites, proteins involved in colonization, abiotic stress tolerance such as drought, salinity, heat shock and cold shock along with heavy metal mobilization and hydrocarbon degradation.

**Conclusion:** The existence of all these plant growth promoting properties in *Bacillus* Dcl 1 make it to have promises as biofertilizer, biocontrol agent or bioremediator to save nature from hazardous chemicals and to protect plants from harsh environmental conditions and disease for better agricultural productivity.

**Keywords:** *Bacillus* sp., Drought, LC-MS/MS, Lipopeptides, Genome sequencing

02-04

#### DEVELOPMENT OF AN EFFECTIVE SYSTEM FOR OVER EXPRESSION AND MOLECULAR CHARACTERIZATION OF EFFICIENT EXO-B-1, 4-GLUCANASE AND ENDO-B-1, 3-GLUCANASE ISOLATED FROM *STREPTOMYCES* SPP.

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**Background:** The therapeutic properties of  $\beta$ -glucan make clear the application of  $\beta$ -glucan rich cereals such as barley and oats in animal feeds, which help to improve the health of cattle and other farm animals those maliciously suffering the health problems in flood-affected areas of Kerala. Along with  $\beta$ -glucan rich food, the exogenous enzyme  $\beta$ -glucanase, as a food additive is essential for the enhancing the digestibility of the molecule. For massive and cost effective production, an effort was taken for the over production of  $\beta$ -glucanase genes isolated from *Streptomyces* spp.

**Method:** The exo- $\beta$ -1,4-glucanase and endo- $\beta$ -1,3-glucanase producing *Streptomyces* strains were isolated from Western Ghats areas of Kerala. The enzyme producing genes were isolated and codon optimized for obtaining high level expression. The pET101 D-TOPO cloned genes were expressed in BL21 StarTM (DE3) *E.coli* strain. Biochemical and kinetic parameters of nickel affinity purified proteins were determined.

**Results:** The strains *Streptomyces althoticus* TBG-MR17 and TBG-AL13 as *Streptomyces showdoensis* TBG-AL13 were identified as efficient producers of exo-1,4-  $\beta$ - glucanase and endo-1,3-  $\beta$ - glucanase respectively. The codon optimized genes produced significantly elevated levels of expression than the native ones. The purified optexo14 showed 72.0 U.mg-1 of exo  $\beta$ -1,4-glucanase activity and optendo13 protein produced 65.63 U.mg-1 of endo  $\beta$ -1,3-glucanase activity. The expressed enzymes showed broad pH stability, good thermostability, and better affinity towards barley  $\beta$ -glucan substrate. The enzyme cocktail mix showed more effective degradation of barley  $\beta$ -glucan.

**Conclusion:** Our study implies the effectiveness of the reported enzymes as animal feed additive which helps to enhancing the nutritive value of  $\beta$ -glucan rich grains along with immune-enhancing effect.

**Keywords:** exo- $\beta$ -1,4-glucanase, endo- $\beta$ -1,3-glucanase, codon optimization, over-expression, cocktail mix.

02-05

### POLYSACCHARIDE-GOLD NANOCCLUSERS AS PROFICIENT GREEN SIGNALING AGENT IN SOLID TUMOR DETECTION

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**Background:** The seminal unique position of gold nanoclusters (AuNCs) between the gold atom and gold nano particles (AuNPs) provides a surfeit of physiochemical features for many biomedical applications. Natural polysaccharides are gifted with biocompatibility and unique functionalities custom them as novel tools for harmless visible light imaging and targeted therapy in cancer. The complex polysaccharide (PSP001) isolated from the fruit rind of *Punica granatum* could be used for the effective preparation of AuNCs in a green chemistry approach. Since majority of the fluorescent compounds accounts for off-target distribution and systemic toxicity, design of a targeted biocompatible fluorescent counterpart could attract translational potential.

**Methods:** PSP001 was conjugated to the cysteine (Y) by reductive amination. This conjugate (PSP-Y) was used for the biogenic synthesis of AuNCs (PSP-Y-AuNCs) in a facile manner which was later well characterized by <sup>1</sup>H NMR, FTIR, UV-visible and fluorescence spectroscopy, HRTEM, DLS and ICP-AES. Various *in vitro* studies such as hemolysis assay, cell viability assay, lymphocytes proliferation assay, cellular uptake studies by various modalities were also conducted. Toxicity and tumor targeting potential of PSP-Y-AuNCs in a fluorescent platform were evaluated in BALB/c mice.

**Results:** Apart from the promising quantum yield and other photo-physical features, the precise designed PSP-Y-AuNCs exhibited pH sensing fluorescence emission profile with excellent biocompatibility and non-toxicity with both *in vitro* and *in vivo* studies. The maximum fluorescence intensity was around the pH of 5.5 could be beneficial for real-time imaging of tumors because of the acidic microenvironment displayed by tumor region. This fact was well appreciated with the highest fluorescence intensity obtained at the tumor site within 4 hours of administration in solid tumor bearing mice models.

**Conclusion:** Novel pH sensing polysaccharide aided AuNCs could be effectively utilized for the real time optical imaging applications in oncology.

**Keywords:** Polysaccharides, gold nanoclusters, pH sensitive, *in vivo* imaging.

02-06

### PRODUCTION OF POLYHYDROXYBUTYRATE BY *BACILLUS MEGATERIUM* TBGSP1

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**Background:** The synthetic plastic waste disposal is a major problem all over the world. The need of the hour is to find out suitable alternatives to synthetic plastics. Most of the bioplastics are biodegradable and biocompatible, which makes them very attractive from the biotechnological point of view. Polyhydroxyalkanoates (PHAs) are polymers produced by different types of microorganisms under nutrient limitation. PHAs are presently being used in many industrial purposes such as packaging materials, and medical applications, etc. Polyhydroxybutyrate (PHB) is one of the major groups among these polymers. They have almost similar physical properties with synthetic plastics. Since bioplastic production is expensive, selection of bacterial strains that are capable of producing PHB in large amount is also very important for industrial production. The present study aims at the isolation and characterization of bacteria able to produce PHB from different environments and media optimization for maximum PHB yield.

**Method:** Bacterial strains were screened for PHA accumulation based on Nile sulphate staining. The intra-cellular PHA was extracted with sodium hypochlorite and assayed. Out of the PHA positive isolates, one was selected based on its PHA production in the minimal medium. The biochemical and 16S rDNA based sequencing were done for characterization of the bacterium.

**Results:** The biochemical and 16S rDNA based sequencing analysis revealed that the isolate belonged to *Bacillus megaterium*. PHA accumulation was studied and found to produce >70% of PHB from its biomass within 48h of cultivation. Further analyses revealed the bioplastic produced was PHB.

**Conclusions:** Isolation and characterization of PHB producing bacteria from the environment was carried out and the maximum PHB production of isolated bacterial strain at different incubation period was also determined. Further studies are in progress for the commercial production of PHB using low cost substrates.

**Key words:** Biopolymer, Bacillus, PHA, Bioplastic.

02-07

## MECHANISTIC EVALUATION OF CHITOSAN/BIOGENIC SILVER NANOPARTICLE CONJUGATE ON TUMOUR CELL LINES BY *IN VITRO* METHODS

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**Background:** Nano particle-based remedial frameworks for cancer treatment have increased now a day as it is very promising field and devoid of many drawbacks that the conventional drugs possess. Cancer is a worldwide danger and the main drawback associated with the treatment of cancer is the cost of drugs and the side effects of the therapeutic agents. Nanodrugs can decrease the effect of normal cell death and can increase the rate of tumour cell death. The nano drugs for cancer have another advantage that at the same time they act as antimicrobial agent to prevent the associated infections. Recent developments in cancer research suggest that the silver nano particle conjugates have enhanced antitumour activity against multi drug resistant tumour cells.

**Methods:** Biogenic silver nanoparticles were synthesized by an endophytic *Colletotrichum gloeosporioides* isolated from the medicinal plant *Withania somnifera* (L). The biogenic silver nanoparticles were conjugated with chitosan and screened well. MDA MB cells and Si Ha cells were obtained from National Centre for Cell Sciences (NCCS), Pune, India and were used for the studies. The effect of Bio-AgNP and Chitosan conjugate of Bio-AgNP on the tumour cell lines were studied by MTT assay. IC<sub>50</sub> value was determined for both the cell lines and all the assays were preceded with the particular concentration. Acridine Orange/ethidium Bromide double staining method was used for the detection of apoptosis. *In vitro* RO production was studied using Dichloro dihydro fluorescein diacetate (DCFDA). Caspase - 7 and caspase- 9 for Si Ha cells and MDA MB cells were performed to ensure its role in apoptosis. The hallmark of apoptosis DNA fragmentation was studied. Cell cycle analysis was performed with flow cytometry (Becton Dickinson USA). Real Time PCR was used to study the gene expression analysis.

**Results:** IC<sub>50</sub> value for Bio-AgNP and Ch Bio-AgNP for MDA MB cells are 4.346 ± 0.6381 µg/ml and 0.9851 ± 0.0065 µg/ml respectively. IC<sub>50</sub> value for Bio-AgNP and Ch Bio-AgNP on Si Ha cells are 24.35 ± 1.390 µg/ml and 2.086 ± 0.319 µg/ml respectively. It showed extensive pattern of cell death according to increasing concentration. Ch Bio-AgNP showed enhanced antitumour activity in comparison with Bio-AgNP. On double staining with AO/EtBr, MDA MB cells and Si Ha cells showed early and late apoptosis. *In vitro* RO assay using DCFDA showed significant green fluorescence on both cell lines due to RO production. MDA MB and SiHa showed increase in the caspase activity compared to the untreated cells. This clearly depicted the apoptosis of cells after treatment with Ch Bio-AgNP. DNA fragmentation was noticed after treatment with Ch Bio-AgNP on both cell lines. Flow cytometry revealed that SiHa cells exhibited cell cycle arrest at G<sub>1</sub>/S phase. In Case of MDA MB cells the cell cycle arrest was at G<sub>2</sub>/M phase. For MDA MB p38 and for SiHa p53 was selected for gene expression studies and both the genes showed increase in expression fold.

**Conclusion:** Cancer is a top cause of disease and a public health problem worldwide. The main drawback coupled with the cancer treatment is the expensive drugs and dangerous side effects of the drug. To balance with the current cancer treatment progressive research in the area is required. So far many reports are available on the use of nanoparticles for anticancer activity. Silver nanoparticles are extensively studied as an anticancer agent. The toxicity of silver nanoparticles was a hindering factor associated with the research but the Bio-AgNP, which resolved the issue of toxicity. In the present study, compared to the antitumour activity of Bio-AgNP, the conjugate with chitosan showed enhanced antitumour efficacy. The cytotoxicity on normal cell lines showed no toxicity and it makes the chitosan conjugate of Bio-AgNP as a promising alternative to the world of cancer medicine.

**Keywords:** Chitosan-BioAgNP conjugate, Si Ha cells, MDA MB cells, Antitumour activity, Flowcytometry

02-08

## PHYTOCHEMICAL AND BIOLOGICAL EVALUATION OF TROPICAL GREEN SEaweEDS

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**Background:** Seaweeds are macroscopic multicellular algae, which are either attached to the bottom in shallow waters or grow in deep sea areas. In recent days, spectral fingerprinting of the crude extracts from different phyto-resources has emerged as a potential tool to understand their potential bioactive properties and to additionally corroborate the results obtained by in vitro laboratory experiments in various disease models. In this study four tropical green seaweeds namely *Ulva fasciata*, *Halimeda macroloba*, *Chaetomorpha linum* and *Chaetomorpha antennina* were analyzed for its phytochemical indicators, antioxidant and antibacterial activities combined with proton spectral studies.

**Method:** The method includes collection, processing and extraction using EA-MeOH as the solvent system. The extracts were qualitatively and quantitatively analyzed for phytochemicals using standard methods. In addition to analytical methods such as DPPH and ABTS, antibacterial activities and spectral studies were also conducted to understand the nature of compound present in the extracts green seaweeds.

**Results:** Among the seaweeds *U. fasciata* showed the presence of phytochemicals which exhibited higher levels of total phenols 59.8 mg GAE/g, saponins 1.77 %, flavanoids 2.3 % contents as well as high DPPH scavenging activity (IC<sub>50</sub> 0.86 mg/mL). *U. fasciata* and *C. antennina* were able to inhibit the gram negative bacterium *V. parahaemolyticus*. The NMR regions showed the proton integrals of *U. fasciata* were higher when compared to the rest of the seaweeds.

**Conclusion:** The phytochemical screening could be used as a baseline for isolating specific low molecular weight leads. The results suggested that *U. fasciata* has potent biological effects like antioxidant activity and antibacterial activities which can be used as a source of biomedical importance

**Keywords:** Green seaweeds, Phytochemical, antibacterial, spectral studies.

02-09

## PRODUCTION OF BIOPLASTIC- POLY (3-HYDROXYBUTYRATE) IN RECOMBINANT *ESCHERICHIA COLI*

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**Background:** Polyhydroxyalkanoates (PHAs) are a group of biodegradable and biocompatible substitutes for conventional plastics. As the demand for bioplastics is rising, new PHA production approaches are being implemented for making the industrial processes more profitable. Employing recombinant *E. coli* for PHA production is an ideal strategy for PHA production. Poly (3-hydroxybutyrate) (PHB) is the first discovered and widely studied PHA. In the present study, we have developed a recombinant *E. coli* strain for the production of PHB.

**Methods:** PHB biosynthetic genes from a *Bacillus* sp. was amplified and cloned for the construction of a recombinant system in *E. coli*. The strain was tested for PHB production and visualised through Transmission Electron Microscopy. The polymer produced by the recombinant strain was physically characterized.

**Results:** The recombinant strain accumulated the bioplastic as granules within the cytoplasm. The polymer yield was estimated as 1.163 g/L. The extracted polymer was confirmed as PHB by GC-MS and NMR analyses. The thermal characteristics of the polymer were also observed similar to that of the polymer standard.

**Conclusion:** The recombinant strain obtained in this study is accumulating biopolymer with the *phaARBC* gene cluster from the environmental isolate. The strain is a potential candidate for PHB production and has to be evaluated for its capability to make use of cheap carbon feed stocks.

**Keywords:** Polyhydroxybutyrate, Bioplastic, *E. coli*, Gas Chromatography



02-10

### ANTIMICROBIAL ACTIVITY OF A NEW ENTOMOPATHOGENIC BACTERIA *ACINETOBACTER*

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**Background:** The EPN are a nematode-bacterium complex. The symbiotic nematode-bacterial mutualism is highly specific. Novel EPN belonging to the family rhabditidae were reported for the first time from Central Tuber Crops Research Institute (Mohandas *et al.*, 2002). These new EPN belonging to the *Rhabditis* sp. and their symbionts offer great scope for their exploitation of bio separation and identification of novel bioactive molecules. The present work is mainly focused on the antimicrobial activity of a new entomopathogenic bacteria *Acinetobacter*.

**Method:** The bacteria were isolated from infective third stage dauer juveniles of the nematode isolate collected from Vellayani, Thiruvananthapuram. Incubation time of the bacteria was standardized and cell free culture filtrate was prepared. The cell free culture filtrate was then separated into organic and aqueous fraction. Antibacterial and antifungal activity of the organic fraction was tested.

**Results:** Organic fraction of 72 hr have highest anti bacterial activity against *B.subtilis* with a zone diameter of 20 mm and lowest antibacterial activity with a zone diameter of 13 mm against *P.aeruginosa* and antifungal activity (29 mm zone diameter) in case of *A. flavus* and lower in case of *F. oxysporum* (18 mm zone diameter). Antimycotic and antibacterial activity was not observed in 24 hr organic fraction.

**Conclusions:** From the study it can be concluded that the organic fraction have significant antibacterial and antifungal activity. The present study also reveals that this entomopathogenic bacteria will be useful for the production of bioactive metabolites effective against bacterial and fungal diseases of plants and animals.

**Keywords:** Entomopathogenic nematodes (EPN), *Rhabditis*, *Acinetobacter*, *B. subtilis*, *P. aeruginosa*, *A. flavus*, *F. oxysporum*, antibacterial, antifungal.

02-11

### EVALUATION OF THE ROLE OF PAX6 IN RETINAL AXONAL GUIDANCE

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**Background:** Retinal ganglion cells (RGC's) are the sole output neurons which carry visual information from the eye to brain visual centres. Our findings have shown that RGCs generated from ES-NP's can be transplanted into the adult retina but they lack the cues to guide the axons to brain visual centres (Front.Cell.Neurosci.2017; 11:295). Therefore, it is very important to first understand how the axons of RGCs are guided to brain visual centres during development and the molecules involved in it. Here, we have analysed the role of Pax6 in regulating the intra-retinal axonal guidance.

**Method:** In order to understand the role of Pax6 in intra-retinal axonal guidance, we have generated Pax6 conditional knock-out animals, and the embryos were used for immunohistochemistry, RNA isolation, qRT-PCR and Transcriptomic analysis. Other methods involved in the study are cell culture, transfection, luciferase assay and ChIP-PCR.

**Results:** To understand the role of Pax6 in axonal guidance, we perturbed Pax6 expression in retinal explant cultures and also conditionally knock out (cKO) in the mice retina during the period of axon formation. Down regulation of Pax6 with siRNA in E16 retinal explants showed a significant reduction in RGC axonal growth and fasciculation. We further substantiated our results by knocking out Pax6 in E15.5 mice retina. Here, we have observed a decrease in the number of RGCs, amacrine cells, horizontal cells and photoreceptors which were confirmed by Brn3, Ap2-alpha, calbindin, and recoverin staining, respectively. Analysis of Pax6<sup>+/+</sup> (control) and Pax6<sup>-/-</sup> (knocked out at E15.5) retinal flatmounts showed a significant alteration in the axonal guidance and fasciculation in Pax6<sup>-/-</sup> retina compared to the control. To further understand axonal guidance molecules that Pax6 could be regulating, we performed ChIP-seq with Pax6 antibody and identified a number of axonal guidance genes that are regulated by Pax6. Out of which, the prominent ones were *EphB1* and *Sema5B*. The interaction and regulation of EphB1 and Sema5B by Pax6 was further confirmed with luciferase and qRT-PCR analyses. These findings highlight a novel role for Pax6 in the intra-retinal axonal guid-

ance by regulating key guidance molecules.

**Conclusion:** These findings showed an important role of Pax6 in regulating the intra-retinal axonal guidance in the mice retina

**Keywords:** Pax6, Axon

02-12

### BIO-INSPIRED ZnS QUANTUM DOT AS EFFICIENT PHOTO CATALYSTS FOR THE DEGRADATION OF METHYLENE BLUE IN AQUEOUS PHASE

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**Background:** In the past decade, there has been an upsurge in the research initiatives aimed at the development of efficient and cost-effective waste water treatment technologies. Photo catalysis using visible light as perennial energy source is a sustainable solution to effectively tackle contaminants in industrial and domestic effluents. Among the diverse photocatalysts explored till date, semiconductor nanoparticles characterized by high photocatalytic activity and stability have gained considerable attention. The amenability of ZnS nanoparticles in initiating efficient photo-redox reactions enable their use as photocatalysts for environmental remediation.

**Methods:** Heavy metal tolerant fungi were isolated from water sample collected in proximity to effluent disposal sites. Biosynthesis of Zinc sulfide (ZnS) nanoparticles were carried out by the heavy metal tolerant fungus by a green process. Morphology and average size of the ZnS nanoparticles were analyzed using Transmission Electron Microscope, Scanning Electron Microscope, Fourier Transform Infrared Spectroscopy and X-ray powder diffractometer. The photocatalytic activity of biosynthesized ZnS nanoparticles was investigated by monitoring the efficiency of ZnS QDs in the photodegradation of Methylene Blue (MB) dye under sunlight.

**Results:** Zn tolerant *Penicillium* sp was isolated from industrial effluent samples for the successful green synthesis of ZnS nanoparticles under ambient conditions. The formation of ZnS QDs was confirmed by using spectroscopic and advanced microscopic analysis. The ZnS QDs were found to have an average diameter of 11.8 nm and were characterized with a zinc blend crystal structure. The optical and morphological characteristics were comparable to that of chemically synthesized counterparts. Further, photocatalytic degradation of Methylene Blue dye was carried out in the presence of sunlight and ZnS QDs. It was found that the green synthesized ZnS QDs exhibit good photocatalytic activity with a half-life of 4 hours. Further, the dye degradation efficiency was enhanced as the ZnS nanoparticle/dye ratio increased and reaches equilibrium within 6hrs.

**Conclusion:** This work establishes an inexpensive and scalable method to fabricate ZnS nano hybrids with practical applicability in the remediation of pollutants in textile, paper and dyeing industry.

**Keywords:** Biosynthesis, Methylene Blue, Photocatalysis, *Penicillium*, Quantum dots, ZnS nanoparticles

02-13

### A SPLICING FACTOR RBM10 CONTROLS 3'UTR PROCESSING TO REGULATE CARDIAC HYPERTROPHY

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mRNA processing at the 3'-untranslated region (3'-UTR) is an essential step in eukaryotic gene expression that involves two major steps: endonucleolytic cleavage followed by addition of a poly(A) tail (polyadenylation). Polyadenylation is carried out by enzymes called poly (A) polymerases (PAPs). Star-PAP is a non-canonical PAP that selects pre-mRNA targets for polyadenylation. A large set of Star-PAP target mRNAs encode factors that play a crucial role in heart diseases such as cardiac hypertrophy (CH), a major risk factor for heart failure (HF). We hypothesized that Star-PAP regulates CH/HF through unique associated factors.

Mass spectrometry sequencing identified RBM10 as a unique Star-PAP co-regulator. RBM10 is enriched in the heart and stimulates Star-PAP polyadenylation activity. RBM10 binds target mRNA and guides Star-PAP complex to specifi-

cally process cardiac mRNAs. Microarray analysis demonstrated that RBM10 and Star-PAP commonly regulates genes mostly down regulated during CH/HF suggesting RBM10 as a master regulator of CH. Further HITS-CLIP sequencing and qRIP analysis confirmed requirement of RBM10 for the assembly of Star-PAP complex on the overlapped targets. We extended our study to physiological relevant models of CH, cellular (rat cardiomyoblast, H9c2), and animal (Wistar rat) models for CH. We observed downregulation of both RBM10 and Star-PAP resulting in reduced expression of target anti-hypertrophic genes. In H9c2 cell line, RBM10 depletion resulted in the generation of molecular events of hypertrophic response, and ectopic re-expression of RBM10 rescued the induced-hypertrophy. Similarly, there was reduced expression of both RBM10 and Star-PAP after the compensatory hypertrophy transitioned into HF in our hypertrophic heart model.

Our results establish a novel anti-hypertrophy gene program mediated through Star-PAP-controlled selective 3'-end processing of cardiac mRNAs. We identified a splicing factor, RBM10 as unique Star-PAP co-regulator that determines Star-PAP specificity for mRNAs encoding key anti-hypertrophy regulators in heart.

**Keywords:** mRNA processing, 3'-UTR, RBM10, Star-PAP, Cardiac hypertrophy

02-14

### THE HIPPO PATHWAY EFFECTOR, YAP REGULATES CELL PROLIFERATION AND SURVIVAL IN BREAST CANCER CELLS.

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**Background:** Breast cancer is the most frequent female cancer worldwide representing nearly a quarter of all cancers with an estimated 1.67 million new cancer cases diagnosed in 2012. The burden of the disease is riotously increasing and is accounting for the largest crude incidence rate and prevalence of any cancer type. The dysregulation of Hippo pathway is found to play a critical role in tumorigenesis and cancer survival in a vast range of cancers; nevertheless, our understanding of how core components of this particular pathway regulate breast cancer survival remains incomplete.

**Method:** We have aimed at exploring the role of Hippo pathway effector YAP in progression and survival of breast cancer cells *in vitro*. The effect of YAP gene silencing by siRNA transfection in breast cancer cell proliferation, migration, apoptosis and cell cycle arrest was studied.

**Results:** siRNA silencing of YAP was confirmed in breast cancer cell line at both transcriptional and translational level. We observed increase in apoptosis in YAP silenced cells compared to the control cells. The cell cycle analysis revealed that, silencing of YAP caused a significant accumulation of cells in the sub G0 phase of cell cycle. Absence of YAP delayed wound healing process as observed in scratch assay.

**Conclusions:** Our work elucidates role of Hippo pathway effector-YAP on breast cancer cell proliferation and survival. The present study shows that YAP act as a proapoptotic gene and its transient silencing promoted apoptosis and inhibited proliferation and metastasis. Further validations in both upstream and downstream components of Hippo pathway are to be done for substantiation and characterization of YAP as a clinical marker and therapeutic target for breast cancer treatment.

**Key words:** Breast cancer, Hippo pathway, YAP, apoptosis, cell proliferation.

02-15

### MICROBIAL PRODUCTION OF BIOPOLYMERS FROM COIR WASTE USING *BACILLUS SUBTILIS*

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Coir pith, a byproduct of coconut fibers and waste material from the coir industry, is stable and not easily degradable due to its high lignin content. Hence the potential use of coir industrial wastes for production of bioplastics (Poly- $\beta$ -hydroxybutyrate - PHB) is an alternative to plastics. One of the most interested biopolymers is polyhydroxybutyrate (PHBs), which could be synthesized by numerous microorganisms as an energy reserve material when an essential nutrient such as nitrogen or phosphorus is available only in limited concentrations in the presence of excess carbon source. Due to the deficiency of nitrogen TCA cycle does not take place that is why two molecules of acetyl-CoA condense to acetoacetyl-CoA, catalyzed by a  $\beta$ -ketothiolase (PhbA), which is subsequently reduced by a stereospecific

acetoacetyl-CoA reductase (PhbB) to R(-)-3-hydroxybutyryl-CoA. The final step is the polymerization of 3-hydroxybutyryl-CoA to PHB with concomitant release of CoA which is catalyzed by the PHB synthase(phbC) .

**Methodology:** Acid hydrolysis and enzymatic hydrolysis of coir waste followed by the preparation of nitrogen deficient coir hydrolysate medium with the inoculation of *Bacillus subtilis* was carried out and the optimum pH, temperature and incubation period for the maximum yield of PHB was determined.

**Result:** The extracted PHB polymer was assayed and confirmed by Law and Slepceky's method using con.H<sub>2</sub>SO<sub>4</sub>. Production of PHB was maximum at pH 7, temperature 37 C and incubation period of 2 days.

**Conclusion:** This study provided valuable information about the coir industrial waste utilization and as an inexpensive potential substrate for the production of eco-friendly plastic.

02-16

### ISOLATION OF PEPTIDES WITH ANTIMICROBIAL ACTIVITY FROM BLACK FIN SEA CAT FISH, *ARIUS JELLA*

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**Background:** Antimicrobial peptides (AMPs), also called host defense peptides are part of the innate immune response found among all classes of life. They are small molecular weight proteins with broad spectrum antimicrobial properties against pathogenic organisms. They are evolutionarily conserved molecules, which are usually positively charged. They have the potential to act as novel therapeutic agents. The present study is focused on isolation of AMP from Black fin sea cat fish, *Arius jella*

**Methods:** The crude peptide was extracted by modified acetic acid-acetone precipitation method and its activity was tested against bacterial pathogens by disc diffusion assay. The peptide extracts were reconstituted in sterile milli Q and subjected to solid phase extraction using Sep-pak<sup>R</sup> c-18 cartridges (Waters, USA). 5%, 40% and 80% Sep-pak<sup>R</sup> fractions eluted was subjected for further purification by cation exchange chromatography employing UNO<sup>TM</sup> Q1 (Q1 BioRad) column using Fast Protein Liquid Chromatography (FPLC). FPLC active fractions were tested for antimicrobial activity by the liquid growth inhibition assay against gram positive bacteria like *Bacillus cereus*, *Staphylococcus aureus* and gram negative bacteria *Vibrio alginolyticus*.

**Results:** The crude peptide sample from *Arius jella* displayed potential activity against the tested micro organisms. FPLC of 5% Sep-pak fraction yielded 6 fractions (Aj5-1, Aj5-2, Aj5-3, Aj5-4, Aj5-5 and Aj5-6), FPLC of 40% Sep-pak fraction yielded 5 fractions (Aj40-1, Aj40-2, Aj40-3, Aj40-4 and Aj40-5), FPLC of 80% Sep-pak fraction yielded 3 fractions (Aj80-1, Aj80-2 and Aj80-3). In the liquid growth inhibition assay Aj5-3, Aj5-5, Aj5-6, Aj40-1, Aj40-2, Aj40-4, Aj40-5 and Aj80-2 showed maximum inhibition (~90%) against the tested bacterial strains( *B.cereus*, *S.aureus* and *V.alginolyticus*)

**Conclusion:** The study suggests that the Black fin Sea cat fish is a source of potent antimicrobial peptides. The array of AMPs produced by this cat fish can be utilized by pharmaceuticals to develop novel therapeutic agents.

**Keywords:** AMP, FPLC, Host Defense Peptides

02-17

## NEXT GENERATION SEQUENCING AND ANALYSIS OF VIRAL DIVERSITY AT THE INNER ZONE OF KONGSFJORDEN, ARCTIC

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**Background:** Metagenomics or the culture independent method approach enables to explore the vast diversity of microbes in marine ecosystems. This study focuses on next generation sequencing and analysis of viral diversity along the transition zone of Kongsfjorden, Arctic

**Method:** Sediment sample (2 Kg) was collected from the most inner zone of Kongsfjorden, Arctic as a part of Indian Arctic Expedition 2015-16 conducted by NCAOR, Goa. Viral population was enumerated using epifluorescence microscopy. Separation of virus from the samples was done through a series of steps such as washing, centrifugation, filtration, flocculation and resuspension. The sediment suspended in the wash buffer was subjected to low speed centrifugation followed by high speed centrifugation. Then the supernatant was subjected to multi-step filtration through a series of filter membranes followed by FeCl<sub>3</sub>-based virus flocculation and resuspension. Viral nucleic acid isolation was done using QIAamp MinElute Virus Spin Kit (QIAGEN) from the Fe-virus flocculate.

**Results:** Sediment sample from both the inner fjord region of Kongsfjorden, Arctic was subjected for NGS based detection and analysis of viral communities. A total of 49 viral communities have been identified in the inner fjord region, Kongsfjorden, Arctic. *Human endogenous retrovirus K113* (23.81%), *Spleen focus-forming virus* (19.64%) and *Cotesia congregata virus* segment Circle 9 (14.13%) were highly abundant in the sample. *Murine type C retrovirus* (9.22%), *Pseudoalteromonas Phage H103* (5.21%), *Salmonella phage E1* (4.99%), *Murine osteosarcoma virus* (4.74%), *Cellulophaga phage phi19:1* (3.93%), *Burkholderia phage AH2* (3.88%), *Clostridium phage 39-O* (2.90%), *Clostridium phage phiCP26F* (2.84%) and *Mycobacterium phage Sheen* (2.60%) were the various other groups in terms of abundance.

**Conclusions:** Present study showed the presence of various viral communities in the fjord polar environment through next generation sequencing and analysis of the viral metagenome.

**Keywords:** Kongsfjorden; Metagenomics; Marine viruses; DNA virus; RNA virus

02-18

## PRELIMINARY STUDY ON THE SCREENING AND IDENTIFICATION OF DEHP DEGRADING BACTERIA ISOLATED FROM KOLLAM

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**Introduction:** The plastic degrading bacteria are of significant importance due to their capability to utilize pollutants. The bacteria metabolizes the plastic by utilizing plastic as sole carbon source and depolymerise them.

**Materials and Method:** Soil samples were collected from waste disposal areas of Kollam. The soil samples were collected in sterile containers from a depth of 5-10cm and kept at 4°C for further analysis. The soil samples were serially diluted up to 10<sup>-6</sup> dilution and plates were incubated at 37°C. The non- identical colonies were enumerated and the colony morphology were recorded. The selected bacterial colonies were purified and sub cultured. The potential strains were identified based on 16SrRNA analysis and morphological observations for identification and screening studies

**Result:** A total of 15 different isolates were subjected to screening for their ability to degrade the plasticizer compound DEHP (di-2-ethylhexyl phthalate). Among them one potential isolate was selected for further analysis and identified as *Gordonia hongkongensis* based on morphological, biochemical and molecular phylogenetic analysis. The effect of time bound incubation on DEHP degradation, microbial biomass was demonstrated by batch fermentation method and validated by statistical analysis.

**Conclusion:** The isolation and characterization of DEHP degrading *G. hongkongensis* offers a new insight to plastic degrading bacteria from natural sources.

**Key word:** DEHP, Bacteria, biodegradation, *Gordonia hongkongensis*

02-19

### IDENTIFICATION AND CHARACTERIZATION OF AN ANTI-LIPOPOLYSACCHARIDE FACTOR AND CRUSTIN FROM SPECKLED SHRIMP *METAPENAEUS MONOCEROS*

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**Background:** Bioactive peptides which are present in all classes of life as part of their innate immune system. In the present study two antimicrobial peptides ALF and Crustin have been identified and characterized from the Speckled shrimp, *Metapenaeus monoceros*.

**Method:** RNA was extracted from hemocytes and cDNA was synthesized. The PCR amplification of cDNA done with crustacean primers ALF and crustin at an annealing temperature of 60°C. PCR product was cloned into pGEMT Easy Vector and transformed into DH5 alpha *E. coli* competent cells. The plasmid was isolated and sequenced.

**Results:** Mature peptide region of ALF consisting of 100 amino acids exhibited 96% similarity to ALF from *Macrobrachium rosenbergii*. The ORF of crustin consisted of 115 amino acid residues showing maximum similarity to crustin from *Fenneropenaeus indicus* (99%).

**Conclusion:** The present study reports two antimicrobial peptides ALF and Crustin from *Metapenaeus monoceros*. Further studies on expression profile of the AMPs might open a new avenue for the development of new drugs to fight microbial infections.

**Keywords:** Antimicrobial peptides, Antilipopolysaccharide Factor, Crustin.

02-20

### NMR BASED METABOLITE PROFILING OF ELICITOR TREATED CALLUS CULTURES OF *MUCUNA PRURIENS*. L ON CATECHOLAMINE BIOSYNTHESIS PATHWAY WITH EMPHASIS ON L-DOPA PRODUCTION

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*Mucuna pruriens*. L is a leguminous plant of Fabaceae family and is a natural source for L-Dopa (3,4-dihydroxyphenylalanine). L-Dopa is a precursor for neurotransmitter which is used against Parkinson's disease. In the present study, callus cultures of *Mucuna pruriens* were developed in modified Murashige-Skoog (MS) medium with hormonal supplementation. The study focused on NMR based metabolic profiling in catecholamine biosynthetic pathway and the effect of elicitation on L-Dopa production.

Callus cultures were established in MS medium supplemented with benzyl amino purine (BAP 1mg/mL). Abiotic elicitor namely, methyl jasmonate (MeJA) was supplemented to the callus cultures at different concentrations (0.1-2mg/L) and its effect on L-Dopa production was studied. Elicited callus was extracted and harvested using acidified aqueous extract and quantified using high performance liquid chromatography (HPLC). Quantification was also correlated with high performance- thin layer chromatography (HPTLC) using standardized solvent system n-butanol: acetic acid: water.

Callogenic response of the cultures was recorded in regular intervals and was possible to obtain full-fledged callus cultures in 20-25 days using hormone supplementation. Compared to the untreated control sample, 3-4 times increase in L-Dopa production was seen in 1mg/L concentration of MeJA. NMR based analyses of catecholamine metabolites in *Mucuna* were performed using 50% aqueous methanolic callus extracts (untreated with elicitor) using standard protocol. The callus cultures induced from nodal explants showed signals of catecholamines and the highest signal was of tyrosine followed by L-Dopa using NMR spectroscopy. These are precursors for major catecholamine and neurotransmitter dopamine, which has therapeutic potential. In this study, the metabolite content of callus cultures of *Mucuna* was estimated and studied using the powerful tool for compound identification. This work establishes the enhancement

of L-Dopa using elicitor treatment in callus culture, which can be optimized and exploited for large-scale production.

**Keywords:** *Mucuna pruriens*, MS medium, MeJA, HPLC, HPTLC, NMR

02-21

### ANTICANCER AND ANTIBIOTIC EXTRACTS FROM INTERTIDAL MACROALGAE ASSOCIATED HETEROTROPHS

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**Background:** Since the discovery of the first antibiotic with anticancer activities, numerous researches have been focused on isolation, modification, partial or total synthesis, over and above uncovering the mechanism of action, increasing the efficacy, and in the meantime reducing the toxicity of potential metabolites. The marine environment is a habitat for many unique microorganisms, for instance, marine surface associated microorganisms especially, macroalgae associated microbes have proven to be a rich source for novel bioactives because of the necessity to evolve allelochemicals capable of protecting the producer from the brutal competition that exists between microorganisms on the surfaces of marine hosts. As is the case for bioactive discovery in general, progress in the detection and characterization of marine microbial bioactives has been limited by a number of obstacles, such as unsuitable culture conditions, laborious purification processes, and a lack of de-replication.

**Method:** The work ascertain the production of antibacterial compounds from selected intertidal macroalgae associated heterotrophs collected from the Southern coast of India, in a culture-dependent method, identified as *Shewanella algae* (KX272635) and *Bacillus amyloliquefaciens* (KX272634) and their ability to inhibit infectious diseases and prevent cell proliferation in human cancerous cell lines such as Liver carcinoma cell lines (HepG2) and Breast cancer cell lines (MCF 7) without affecting the normal cells, ie, fibroblast cells (L929) by means of micro dilution method and MTT (3-(4, 5-dimethylthiazol-2-yl)-2,5- diphenyltetrazolium bromide) screening assay, respectively.

**Results:** Significant antibacterial activity of organic extracts was observed against broad spectrum pathogens including Multi Drug Resistant pathogens MRSA and VRE (minimum inhibitory concentration 6.25-12.5 µg/mL). The extracts were also exhibited anticancer activity against human carcinoma cell lines, HepG2 with the best half maximal inhibitory concentration IC<sub>50</sub> 77.64 - 82.68 µg/mL and MCF<sup>V</sup> with IC<sub>50</sub> 44.96 - 47.97 µg/mL in MTT screening assay without showing any cytotoxic effects (IC<sub>50</sub> on L929 cell lines above 100 µg/mL).

**Conclusion:** This study evaluated the antibacterial activities and cytotoxicity of the secondary metabolites of intertidal macroalgae associated heterotrophic bacteria. The secondary metabolites from the bacteria shown antibacterial activity against clinically significant pathogens and anticancer activity against human cancer cell lines without exhibiting cytotoxicity against normal cell lines.

**Keywords:** antibiotic, anticancer, heterotrophic bacteria, surface associated microorganisms, human cancerous cell lines

02-22

### STATISTICAL EVALUATION OF MEDIUM COMPONENTS FOR EXTRACELLULAR PROTEASE PRODUCTION BY *PENICILLIUM GOETZII* MF151170 USING RESPONSE SURFACE METHODOLOGY

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The main scope of this work was to optimize the process parameters, through a statistical approach, for the enhanced production of protease enzyme by *Penicillium goetzii* MF151170, a mangrove isolate, through submerged fermentation. Plackett-Burman experimental design was employed for screening and selection of critical components affecting enzyme production. Among the various variables, incubation time, zinc sulphate and tween 20 concentrations were found to be the most significant parameters. Response surface methodology employing a central composite design was adopted to further investigate the interaction effects between these three variables on protease production and determine

the optimal values of the variables. The most significant variables were determined as follows: incubation time (5 days), zinc sulphate (0.075%) and tween 20 (1.170%). Design Expert version 10.0 was used for experimental design, data analysis and quadratic model building. A second order polynomial equation was found to be useful for the development of efficient bioprocess for protease production. Under the proposed optimized conditions, the experimental protease production ( $182.32 \text{ Uml}^{-1}$ ) closely matched the yield predicted by the statistical model ( $177.17 \text{ Uml}^{-1}$ ) with an  $R^2$  of 0.735. By using the optimal fermentation medium, the protease production was enhanced upto, an approximate 1.689 fold over the previous production ( $81.60 \text{ Uml}^{-1}$ ) with un-optimized medium. The protease enzymes find commercial applications in detergent, textile, leather and food industries.

**Keywords:** *Penicillium goetzii* TBG Pay V, Protease, Plackett-Burman, Response surface methodology, Central composite

02-23

### MICROPROPAGATION, SYNSEED PRODUCTION AND CYTOCHEMICAL ANALYSIS OF *AERVA LANATA* JUSS.

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**Background:** *Aerva lanata* Juss. (Amaranthaceae) is a vital medicinal plant used in traditional medicine for the treatment of diabetes mellitus, urinary calculi, hematemesis, bronchitis, nasal bleeding, cough, scorpion stings, fractures, spermatorrhea etc. The increasing demand together with lack of cultivation of the plant necessitates efforts for its conservation. This study aims to develop a micropropagation based strategy for the conservation of *Aerva lanata* Juss.

**Method:** The present work suggests protocols for the large scale multiplication through shoot tip/nodal segment culture and indirect organogenesis. The explants were cultured on MS (Murashige and Skoog) medium fortified with different concentrations of benzyl adenine (BA) or Kinetin(KIN). Combinations of BA/ KIN along with indole 3- acetic acid (IAA) was also used to initiate cultures. Encapsulation of explants in the form of synthetic seeds and general cytochemical analysis of the callus were also done as part of the study.

**Results:** A maximum of 3 shoots were induced from nodal segments cultured on MS medium amended with 1 mg/ l BA. 3 shoots have emerged from shoot tip explants in presence of 2 mg /l BA. 3 shoots were developed from nodal segments in presence of 1 mg/l KIN. Callus was induced from stem explants cultured on MS medium supplemented with 2.5 mg/l BA alone and also in cultures containing 1 mg/l KIN and 1 mg/l BA.

**Conclusion:** Tissue culture protocols were standardized for the micropropagation of *Aerva lanata* Juss. Rapid clonal multiplication was achieved via nodal segment culture, shoot tip culture and indirect organogenesis.

**Keywords:** Micropropagation, *Aerva lanata* Juss., Murashige and Skoog medium, Encapsulation, Indirect organogenesis, Indole 3- acetic acid, Benzyl adenine, Kinetin

02-24

### DEVELOPMENT OF SSR MARKERS FOR DASHEEN MOSAIC DISEASE RESISTANCE USING BIOINFORMATICS TOOLS.

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**Background:** Molecular genetic markers represent one of the most powerful tools for the analysis of genomes and the association of heritable traits with underlying genetic variation. Simple sequence repeats, also known as microsatellites, have shown to be one of the most powerful genetic markers in plant functional genomics. The availability of large sequence data sets permits mining for these molecular markers, which may be used for applications such as genetic trait mapping, diversity analysis and marker assisted selection in agriculture. Modern agricultural breeding is dependent on molecular markers, from trait mapping to marker assisted selection. Molecular markers can also be used to select parental genotypes in breeding programs, eliminate linkage drag in back-crossing and select for traits that are difficult to characterize phenotypically. However, the revelation of SSRs and improvement utilizing conventional techniques are difficult, tedious, and expensive.



**Method:** The preliminary dataset for the work was obtained from transcriptome sequencing and profiling of mosaic infected *A. paenifolius*. About 25152 sequences were used for study. MISA and SSRIT tools were used for the identification of SSR. Micro Satellite Identification tool allows identification and localization of perfect microsatellites as well as compound microsatellites which are interrupted by certain number of bases. General syntax for running MISA is Misa.pl <FASTAfile>. The tool SSRIT (Simple Sequence Repeat Identification) uses Perl regular expressions to find perfect SSR repeats within a sequence. In silico validation was performed using FastPCR. Primers were designed with the aid of Primer3plus tool. Primer pairs are designed to amplify each discovered SSR site. Based on the hit percentage of contigs containing SSR, Sequences are selected.

**Results:** From 7000 contigs created, about 10,307 SSRs were identified using MISA. Around 1713 SSRs were identified using SSRIT. In MISA, Di type of SSR was found to possess higher percentage than other types of SSR. In SSRIT, Mono type of SSR was found high. By performing comparative evaluation it was found that MISA showed more promising SSR than SSRIT. In silico validation was performed using FastPCR. SSR with hit percentage between 80% -100% was chosen. Primers were designed with the aid of Primer3plus tool.

**Conclusion:** Novel markers developed with the aid of these prediction tools which will aid in developing varieties resistance to dasheen mosaic disease in *Amorphophallus*. The availability of large EST sequence data makes it an economical choice to develop SSR markers. DNA polymorphism discovery using computational tools will help in the identification of SSRs in sequence data as well as designing primers for these markers. These will help plant breeders, new to molecular breeding and marker assisted selection to opt for SSR markers to solve crop disease related problems. Therefore it is more economical and efficient to use computational tools to identify SSR loci.

**Keywords:** Simple sequence repeats, Primers, Expressed Sequence tags, Markers

02-25

#### EXTRACTION OF ANTIMICROBIAL PIGMENT FROM *PSEUDOMONAS AERUGINOSA* ISOLATED FROM SEA WATER

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**Background:** The *Pseudomonas aeruginosa* strains were isolated from sea water samples. Some of the strains produced pigments and it showed antimicrobial activity against pathogenic microorganisms. The antimicrobial activity was screened and the antimicrobial pigment were extracted and purified and subjected to UV-VIS absorption spectra analysis at a range of 200-700nm.

**Methods:** *Pseudomonas aeruginosa* strains were isolated from sea water samples in Zobell Marine agar plates and identified by Vitek 2 system analysis. Antimicrobial activity was screened by Cross streak method and Scrap method. The extraction of antimicrobial pigment was done. Purification of the pigment was done by column chromatography. Purified pigment was subjected to UV-VIS absorption spectra analysis at a range of 200-700nm (SHIMADZU UV-3600).

**Results:** The antimicrobial activity of the isolated *Pseudomonas aeruginosa* strains against test organisms such as *Escherichia coli*, *Salmonella typhi*, *Staphylococcus aureus* and *Bacillus cereus* were done. In Cross streak method, after incubation, the *Pseudomonas aeruginosa* strain that does not produce any pigments does not inhibit the growth of the test organisms. The *Pseudomonas aeruginosa* strain that produced blue green pigment, pyocyanin inhibited the growth of all the test organisms. The strain showing antimicrobial activity was subjected to scrap method. After incubation, it was observed that the growth of all the test microorganisms were inhibited. The UV-VIS absorption spectra analysis of purified pyocyanin in 0.1N HCl showed peaks at 206 nm, 258.20 nm and 310.80 nm and that in methanol showed peaks at 218.80 nm, 230.20 nm and 308.80 nm.

**Conclusion:** This work concludes that the *Pseudomonas aeruginosa* strain that produced blue green pigment, pyocyanin showed antimicrobial activity against all the test organisms.

**Keywords:** Pyocyanin, *Pseudomonas aeruginosa*, Antimicrobial activity.

02-26

### MOLECULAR CHARACTERIZATION OF A HISTONE DERIVED PEPTIDE FROM THE MALABAR TREVALLY, *CARANGOIDES MALABARICUS*

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**Background:** Antimicrobial peptides, which form the effector molecules of innate immune system of every class of life, continue to garner attention as alternatives to conventional antibiotics. Pioneering studies have led to the discovery of various types of these 'host defense peptides' with remarkably different structures and bioactivity profiles. Among the various cationic peptides, reported so far histones and histone-derived fragments with antimicrobial activities have been found in some specific cells of a diverse range of organisms from microbes to mammals.

**Method:** Isolation and molecular characterization of a putative Histone-derived antimicrobial peptide from the Malabar trevally, *Carangoides malabaricus* has been done. Total RNA was isolated from gills using TRI<sup>®</sup> reagent (Sigma) following manufacturer's protocol. First-strand cDNA was generated. PCR amplification of the cDNA was done using Hippisin primer. PCR products were cloned into pGEMT Easy Vector, and transformed into DH5 alpha *E.coli* competent cells. Positive recombinant clones were selected for plasmid isolation. Recombinant plasmids were sequenced and *in silico* analysis done.

**Results:** *Carangoides malabaricus* Histone H2A (CMH2A) nucleotide sequence consisted of 243 bp, encoding 81 amino acid sequences, which showed 90% similarity to H2A identified from *Serioladorsalis*.

**Conclusions:** Histones are conserved eukaryotic cationic proteins present in the cells and are involved in the antimicrobial activities. Hence, characterization of CM H2A showed that they can be a potential candidate for development of therapeutic drugs.

**Keywords:** Antimicrobial peptide, Histone, *Carangoides malabaricus*

02-27

### TARGETED DISRUPTION OF SURVIVAL SIGNALING: AN EFFICIENT INTERVENTIONAL APPROACH TO REVERSE TUMOR RESISTANCE AND RECURRENCE

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**Background:** Drug resistance is a major problem associated with cancer chemotherapy which limits the effectiveness of drug treatment. Cancer cells evade drug treatment by entering a reversible drug tolerant state which is non-cycling in nature. The survival signalling mechanism can be targeted to limit the drug escape of these tolerant cells.

**Method:** Cancer cell lines of different origin were engineered to express genetically encoded probes for apoptosis, autophagy and cell cycle. These cells are treated with different classes of anticancer agents at very high concentrations to generate drug tolerant cells and these cells were analysed for various survival signaling pathways by immunoblotting and live cell imaging.

**Results:** Adaptive autophagy with the induction of stress proteins like Hsp90 and Nrf2 stabilize the drug tolerant cells in their non-cycling state and protect the cells. These novel pathways can be targeted by small molecule inhibitors to prevent drug escape and tumor recurrence.

**Conclusions:** Autophagy and stress signalling by Nrf2 and Hsp90 plays a key role in the generation of drug tolerant cells during cancer chemotherapy

**Keywords:** Drug resistance, Tumor recurrence, Autophagy, Live cell imaging

02-28

## PRECLINICAL EVALUATION OF THE CHEMOTHERAPEUTIC EFFECT OF KAEMPFERIDE AGAINST CERVICAL CANCER

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**Back ground:** Cervical cancer is the fourth most common cancer among women, with four-fifths of the global burden in low- and middle-income countries. We have already reported the isolation and identification of kaempferide from the dichloromethane extract of *Chromolaena odorata*, which induces apoptotic mode of cell death in cervical cancer cells, while being pharmacologically safe (Nath *et al.*, 2015). However, the *in vivo* validation of its anticancer efficacy has not been discussed yet. So in the present abstract evaluates the efficacy of kaempferide in reducing cervical cancer and elucidates the probable mechanism behind its preferential cytotoxicity towards cervical cancer cells.

### Methods:

**Cell lines:** HeLa cell line was procured from NCCS, Pune.

**Chemicals and Antibodies:** Antibodies against P53,  $\beta$ -actin, P-Rb were obtained from Cell Signalling Technologies (Beverly, MA, USA). All other chemicals were purchased from Sigma Chemicals (St. Louis, MO, USA) unless otherwise mentioned.

**Western blot analysis.** The whole cell lysate was prepared from the cells treated with or without drug and subjected to Western blot analysis.

**In vivo studies.** All animal studies were done in accordance with the protocols approved by Institute Animal Ethical Committee (IAEC No: 189(b)/RUBY/2012 for *Chromolaena odorata*). A xenograft model in NOD-SCID (NOD.CB17-Prkdcscid/J) mice was used for evaluating the anti-cancer properties of kaempferide. The pathology of liver and tumor tissue sections were examined and verified by Dr. Sankar Sundaram, Professor of Pathology, Medical College, and Thiruvananthapuram.

**Results:** Antitumor effect of kaempferide was analyzed in NOD-SCID mice bearing human cervical cancer xenografts on the flank region. The reduction in tumor volume and reduced expression of PCNA in tumor cryosections of kaempferide-treated mice compared to that of untreated controls demonstrates the efficacy of this compound against cervical cancer. It has been suggested that up to 80% of sexually active women will acquire HPV infection at some point during their life time. Although approval of the Merck vaccine, Gardasil has proceeded rapidly in many countries, it is still unaffordable to patients from developing countries, who are the real victims of cervical cancer. Interestingly, kaempferide was found to abrogate/inhibit the expression of E6 effectively both *in vitro* and *in vivo*. This strongly implicates its effectiveness against cervical cancer. The enhancement of apoptosis in cervical xenograft tissues treated with kaempferide as evidenced by the high expression of cleaved PARP in immunohistochemistry results was also in concordance with the *in vitro* results. Hence, the efficacy of kaempferide as a promising candidate molecule against cervical cancer is more evident in the present study.

**Conclusions:** This is the first preclinical intervention study evaluating the antitumor efficacy of kaempferide against human cervical cancer.

**Key words:** Cervical cancer, Kaempferide, *Chromolaena odorata*, Xenograft model

## 03 - CHEMICAL SCIENCES

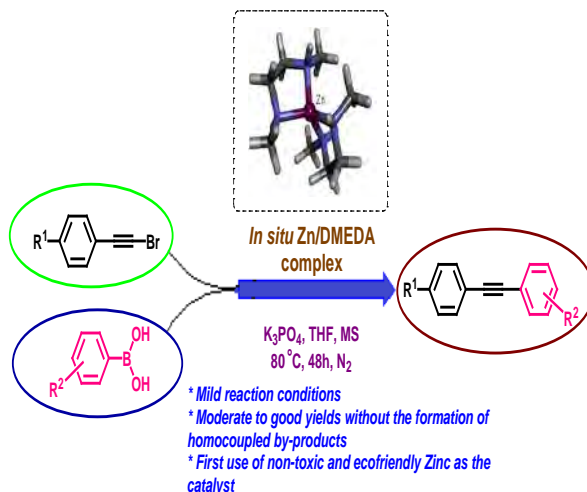
03-01

## A NOVEL ZINC-CATALYZED SUZUKI-TYPE CROSS-COUPLING REACTION OF ARYL BORONIC ACIDS WITH ALKYNYL BROMIDES

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A novel Suzuki type cross-coupling reaction of organoboron reagents with alkynyl bromides have been developed in the presence of catalytic Et<sub>2</sub>Zn/DMEDA system. The reaction afforded a variety of internal alkynes in moderate to excellent yields under mild reaction conditions without the formation of any homocoupling products. The resulting internal alkynes have valuable applications in pharmaceutical as well as in industrial areas. The use of relatively non-toxic zinc and chelating amine ligand, low reaction temperature make this protocol a better alternative for the synthesis of internal alkynes. The scope and limitations of this protocol were investigated.



**Scheme 1.** Zn-catalyzed coupling of aryl boronic acids with 1-bromoaryl acetylenes.

03-02

## PREPARATION AND CHARACTERIZATION OF NOVEL POLYMER SUPPORTED METAL CATALYSTS AND ITS APPLICATIONS IN COUPLING REACTIONS

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Transition metal catalyzed coupling reactions have been widely explored for the development of various carbon-carbon and carbon-heteroatom bond forming reactions. Normally, these reactions are performed in the homogeneous catalytic process, but the difficulty for separating or removing the homogeneous transition metal catalysts from the products strongly hinders their wide applications in large scale due to the high cost of catalysts coupled with toxic effects associated with environmental and economical concern. To solve this problem, immobilization of metal catalysts on various supports such as polymers, zeolites and silica have been employed. Recently, there are several polymer supported metal

complex have been developed and identified as suitable catalyst for coupling reactions.

In our study, we have successfully developed a novel reusable copper and palladium supported polymer catalysts by metal complexation on chemically modified polymer. As heterogeneous catalysts, they exhibit both high activities and excellent recyclability in classical coupling reactions. The results of this investigation involving optimization and generality studies using a series of substrates with various electron demands are described.

**Keywords:** Polyacrylonitrile; Supported Catalysis; Coupling reaction; Copper; Palladium

03-03

### N-RICH ZEOLITE LIKE METAL ORGANIC FRAMEWORK (SOD-ZMOF): REVERSIBLE THERMOCHROMISM AND ANION TRIGGERED METALLOGELATION

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**Background:** Metal organic frameworks have aroused a flurry of interest in recent years owing to their fascinating architectures and potential applications. To date large number of coordination polymers have been synthesized on the basis of carboxylate, phosphonate, sulfonate and nitrogen heterocyclic ligands. Herein, we employed a new polytopic compartmental ligand, 2,3-butanedione bisisonicotinichydrazone (BDIH) with three remote binding sites for the construction of a novel Cd-MOF.

**Method:** The ZMOF was synthesized by simple refluxing rather than hydrothermal methods. The single crystals were isolated by recrystallization. The complex was characterized by X-ray diffraction, thermal analysis, UV-Vis and FTIR spectroscopy, SEM and rheology.

**Results:** Cd(II) in MOF is heptacoordinated and adopts a pentagonal bipyramidal geometry. The framework contains hexagonal channels along crystallographic 'c' direction and resembles SOD topology. The complex exhibit reversible thermochromic behavior over a working temperature ranging from room temperature to about 80 °C. The thermochromism is investigated by variable temperature UVDRS, FTIR and PXRD studies. Coordination driven gelation of Cd-MOF is also demonstrated. It shows a super smart and fully reversible thixotropic property and anion selectivity.

**Conclusions:** A novel Cd-MOF derived from a polytopic compartmental ligand have been constructed. The unusual thermochromism and gelation property of this MOF opens up new insights into the construction of novel smart MOF materials.

**Keywords:** sod-ZMOF, Thermochromism, Coordination polymer gel, Rheology

03-04

### PHOTOLUMINESCENCE PROPERTIES OF PARA-AMINOBENZOIC ACID COMPLEXES OF EU<sup>3+</sup> AND Tb<sup>3+</sup> ENCAPSULATED IN ZEOLITE Y

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**Background:** Lanthanide organic complexes show advanced luminescence properties and high colorimetric purity of the emitted light but their applications are limited due to low mechanical and thermal stability. In order to overcome this limitation lanthanide based hybrid materials which combine the advantages of inorganic part (high thermal and mechanical stability) with the benefits of organic part (synthetic versatility, luminescence property etc) are synthesized. This study reports stable inorganic organic hybrid material; para amino benzoic acid lanthanide(Eu<sup>3+</sup> or Tb<sup>3+</sup>) complex encapsulated in zeolite Y.

**Methods:** Lanthanide exchanged zeolite Y was synthesized by ultrasonication of the lanthanide solution with activated zeolite Y followed by annealing. Para-amino benzoic acid was introduced to the lanthanide exchanged zeolite Y via ultrasonication to form zeolite Y encapsulated Eu<sup>3+</sup>/Tb<sup>3+</sup> complex.

**Results:** The synthesized Tb<sup>3+</sup> based hybrid material showed good luminescence property and increased thermal stability

**Conclusion:** High luminescence property together with the high thermal stability would enable the use of synthesized Tb<sup>3+</sup> based hybrid material in applications like luminescent probes, sensors, etc.

**Key words:** inorganic-organic hybrid material, zeolite Y, luminescence

03-05

### NIR-II MOLECULAR PROBE AS CONTRAST AGENT FOR PHOTO ACOUSTIC IMAGING

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**Background:** Photoacoustic (PA) imaging is an emerging modality that brings significant promise to enhance the depth of penetration as well as spatial resolution, while maintaining the high contrast of optical imaging. However, the utility PA imaging has not been fully established owing to a lack of analyte-specific photoacoustic probes. In this work, we will present the development and evaluation of novel PA contrast agent based on squaraine (SQ) dye, which has an intense absorption at NIR-II region, poses much better photostability and higher PA efficiency compared to commercial ICG (Indocyanine green)dye.

**Methods:** SQ dyes were synthesized by the condensation reaction of benzindolium salts (1) and squaraine derivatives in 1:1 butanol/benzene mixture at 100°C gave the corresponding SQ dyes in 10% yields. The structure was characterized via <sup>1</sup>H & <sup>13</sup>C NMR, and mass spectrometry. The spectral features of dyes were measured using UV-Vis-NIR spectrophotometer (Evolution 220). To evaluate the PA efficiency, solutions of SQ1, SQ2 and ICG in dimethylsulphoxide (DMSO) at optical density (OD) of 1.0 were prepared and their photoacoustic spectrum was measured using Vevo 2100/LAZR system operating with a 40 MHz linear array transducer (FUJIFILM VisualSonics, Inc., Toronto, ON, Canada). **Results and Discussion:** SQ dyes absorbs in the NIR-II window, more specifically, has a strong absorption within 850 to 1000 nm. Furthermore, SQ dyes has high molar extinction coefficients in the range (2-4x 10<sup>5</sup> M<sup>-1</sup> cm<sup>-1</sup>) and exhibit higher photostability. The PA signal strengths recorded for the SQ1 dyes are 4.8 -fold stronger than the signal for the benchmark compound ICG. The signal strength recorded for SQ2 is still nearly 3.6-fold stronger shows the relative advantages of the SQ dyes over ICG.

**Conclusions:** We have demonstrate the synthesis of small organic SQ dyes, absorbing in the NIR-II region by appropriate turning the donor and acceptor moiety. SQ dyes exhibits better photo-stability and higher photoacoustic activity compared to the commercially available ICG, makes it a promising PA contrast agent. Ongoing studies will examine scattering and penetration effect on both tissue mimic phantom and biological hard tissues. Future work will focus on the application of SQ dye as contrast agent for *in vivo* PA imaging.

**Keywords:** Near Infrared, Contrast agent, Photoacoustic Imaging,

03-06

### GRAPHENE QUANTUM DOT- PORPHYRIN NANOCONJUGATES FOR PHOTODYNAMIC THERAPY

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**Background:** Cancer is one among the leading cause of death globally and around one third of deaths from cancer are due to the behavioral and dietary risks. In one year, Kerala has roughly 35,000 new cancer cases. Traditional therapeutic approaches such as surgery, chemotherapy, and radiation have significant drawbacks, increasing patient's physical and mental trauma and relatively low success rates. Thus, more effective and targeting cancer therapies are required. Photodynamic therapy (PDT) which involves the combination of light, photosensitizer(PS) and molecular oxygen, has been recognized as a valuable treatment option for localized cancers. Herein we demonstrate porphyrin derivative conjugated with graphene quantum dots (GQDs) for PDT applications. Porphyrins are efficient candidates widely being used for PDT applications owing to their efficient singlet oxygen production and high absorption coefficient in the long

wavelength region. QGDs, by virtue of its size in the nano range, aqueous solubility, high photostability and easy accumulation in tumor cells can be used as a suitable platform for the delivery of PDT agents conjugated through covalent and non-covalent strategies. Hence QGDs conjugated with porphyrin thereby reduces the toxicity, enhance the water solubility and increase the biocompatibility of the system making them efficient candidates for cancer therapy.

**Method:** Amino functionalized QGDs of size less than 5 nm were prepared by bottom up approach using glutamic acid as the carbon precursor. Acid functionalised porphyrin (POA) was synthesized and coupled with the amino groups of QGDs via EDC coupling resulting in the formation of the conjugate, POA-GQ.

**Results:** Nano conjugate, POA-GQ was successfully synthesized and characterized by using various microscopic and spectroscopic techniques. Though porphyrins are hydrophobic in nature, the nanoconjugates with QGDs have high water solubility which makes them useful in medical applications such as PDT for cancer treatment. To understand the transient intermediates involved during the excitation of porphyrin and POA-GQ conjugates, we have carried out nano-second laser flash photolysis studies using a 532 nm laser pulse excitation. The lifetime of the transient was determined from the decay profile and it was found to be 1.49  $\mu$ s and 1.56  $\mu$ s for porphyrin and POA-GQ respectively. The triplet excited state yields ( $\Phi_T$ ) of the samples, BDPA and GQD-BDPA were determined to be 0.718 and 0.702 respectively. The efficiency of the nanoconjugate as an agent for PDT was investigated by following the real time singlet oxygen production. POA-GQ exhibited higher singlet oxygen generation quantum yield of 53%, almost in par with that of free the free porphyrins, POE (48%) and POA (55%). Triplet quantum yield for porphyrin and POA-GQ were obtained as 71.8% and 70.2% respectively.

**Conclusion:** In summary we synthesized nanoconjugate of graphene quantum dot-porphyrin sensitizer, POA-GQ. Absorption and emission properties of the nanoconjugate confirmed successful conjugation of the sensitizer with QGDs. The conjugate exhibited higher singlet oxygen generation quantum yield demonstrating the potential of these nanoconjugates for PDT applications. Further evaluation of the photodynamic activity of these nanoconjugates in various cancerous cell lines also will be discussed.

**Keywords:** Graphene quantum dots, Porphyrin, Nanoconjugate, Photodynamic therapy

03-07

### A CATALYST-FREE, ECO-FRIENDLY PROTOCOL FOR THE SYNTHESIS OF 2, 3-DIHYDRO-1H-PERIMIDINES “ON WATER”

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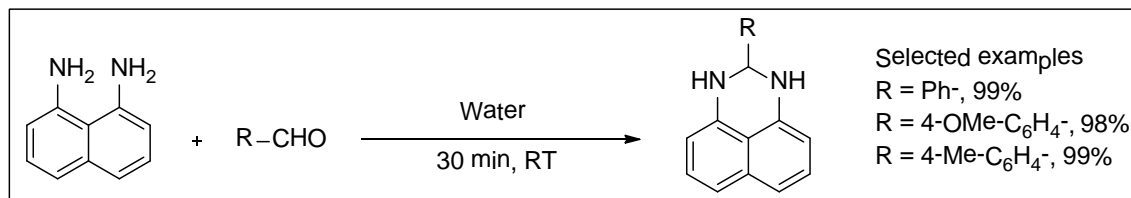
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**Background:** Perimidines are important class of heterocyclic compound that are found to exhibit a diverse range of biological properties, like anti-fungal, anti-microbial, anti-ulcer and anti-tumor activities and can be used as dye intermediates and coloring materials. “On water” reactions are reactions that take place in water as an emulsion and exhibit unusual reaction rate acceleration when compared to the reactions in other organic solvents.

There exist many methods for the synthesis of 2,3-dihydro-1H-perimidines by the reaction of 1,8-diamino naphthalene with a carbonyl compounds using different catalysts and most of them require higher temperature and prolonged reaction time. Herein, we report the first greenest protocol for the synthesis of perimidines in the absence of any catalyst on water at room temperature in 30 minutes.

**Method:** To 1,8-diamino naphthalene was added different aldehydes followed by water. The mixture was stirred for 30 minutes under room temperature. The reaction mixture was extracted with ethyl acetate and the solvent was evaporated *in vacuo*. The crude mixture was purified by performing silica gel column chromatography using Hexane-Ethyl acetate mixture to furnish the product.



**Results:** Different aldehydes were reacted with 1,8-diamino naphthalene on water. 2,3-dihydro-1H-perimidines were

obtained in moderate to excellent yields. The reaction is more effective in room temperature than at elevated temperature.

**Conclusions:** We have developed a simple, rapid, efficient and green method for the synthesis of perimidines from 1,8-diamino naphthalene and benzaldehyde in the absence of any catalyst on water at room temperature in 30 min time.

**Keywords:** Perimidine, 1,8-diamino naphthalene, aldehyde, water, heterocycle

03-08

### CHITIN NANOWHISKER - NATURAL RUBBER NOVEL COMPOSITES FOR GREEN TIRES: SYNTHESIS, CHARACTERIZATION AND PROPERTY EVALUATION

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**Background:** With the evolution and progress of nanofillers, rubber technology has been undergoing a sea change. The present work has been undertaken in this context to develop nanofillers from biobased and renewable sources through simple and eco-friendly methods to upgrade natural rubber (NR). This work is particularly relevant to the state of Kerala which produces 92 % of the country's natural rubber. The research has been focused on developing new fillers/methods that can be utilized for the sustainable development of the society. By the proper channelization of the agricultural waste materials into value-added products, problems like waste disposal, pollution etc. can be minimized.

**Method:** Chitin nanowhiskers (CHNW) were synthesized from chitin powder by acid hydrolysis method. The synthesized nanowhiskers were characterized using different analytical techniques like FTIR, XRD, SEM, TEM, TGA etc. NR-CHNW composites were prepared by using a masterbatch of CHNW in NR latex followed by dry rubber compounding in a two roll mill. The cure behavior, mechanical, thermal, dynamic mechanical, transport and fractographic properties of the composites were analyzed using ASTM standards.

**Results:** Chitin nanowhisker (10-30 nm) with high crystallinity index was synthesized in the alpha form. Cure enhancement was shown by natural rubber composite with 10 phr CHNW addition (NR-CHNW10). The tensile strength and tear strength of NR-CHNW10 composite showed an improvement of 10 % and 14 % respectively compared to neat NR. The swelling index of NR-CHNW10 composite was found to be less than that of NR gum. The fractographic studies of NR-CHNW composites revealed that effective stress transfer has taken place in the composite. The NR-CHNW10 composite showed an ample improvement in the onset degradation temperature ( $T_{on}$ ), the temperature at which 50 % degradation occurs ( $T_{50}$ ) and the temperature at which maximum degradation occurs ( $T_{max}$ ). The DMA studies revealed that there is no notable change in the glass transition temperature of NR-CHNW10 composite in comparison with neat NR. The loss tangent ( $\tan \delta$ ) at 60 °C of NR-CHNW composite was found to be less than that of NR gum, indicate low rolling resistance. Thus they can be recommended for green tire applications.

**Conclusions:** Mechanical, thermal, dynamic mechanical and transport properties of NR can be improved by the addition of chitin nanowhiskers.

**Keywords:** Chitin nanowhiskers, Crystallinity, Composite, Green tire.

03-09

### ISOLATION OF CELLULOSE NANO WHISKERS (CNW) FROM COUNTRY ALMOND SHELL (CAS) AND DEVELOPMENT OF THEIR BIOCOMPOSITES

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**Background:** The isolation of micro/nano cellulose from natural fibres has engrossed significantly in the last few decades due to its significant advances in cellulose modification and their potential applications. The present study focused on isolation of cellulose nano whiskers (CNW) from an agricultural non-wood source- Country almond/ Badam shells and development of CNW reinforced biocomposite.



**Method:** After the preliminary treatments the obtained  $\alpha$ -cellulose was used for the isolation of CNW. In a typical procedure 1 g of  $\alpha$ -cellulose was hydrolysed by refluxing with 10 mL of 68% con  $H_2SO_4$  at 40 °C for 1 h with vigorous stirring, followed by the addition of distilled water to quench the reaction. The suspension was centrifuged to remove excess acid. The resultant residue was rinsed, centrifuged and dialyzed against distilled water until constant pH was achieved. The resultant suspension was freeze dried. Different weight percentage of isolated CNW was dispersed in water containing PVA via ultrasonic treatment for 1 h at 30% amplitude. The PVA-CNW composite developed through solution casting technology.

**Results:** The isolated CNW was systematically characterised using different spectral and analytical studies. The FT-IR spectra confirm the delignification process and structure of CNW. The SEM images of  $\alpha$ -cellulose and CNW indicates the self-assembled and highly agglomerated structures like stacked flakes. Strong hydrolysis also influence the length of the fibers. The TEM images of CNW suggest that cellulose fibre aggregate to form network of sub fibrils and are crystallized to nano fibrils. XRD results suggest that harsh hydrolysis affect both crystalline and amorphous domain. With respect to the pure PVA the tensile strength of composite was enhanced. The increase in mechanical strength of PVA composite revealed the presence of strong interfacial interaction and uniform dispersion of CNW on PVA matrix. However, a decrease in tensile strength of PVA composite is observed by changing the quantity of CNW from 2 wt % to 3wt %. This decrease in tensile strength can be explained on the basis of flocculation of CNW where CNWs are highly stabilized in water medium

**Conclusions:** During the isolation of CNW different components are isolated from Country almond shell and the isolated components are successfully characterised using different spectral and analytical studies. The potential capability of CNW was confirmed from mechanical studies on PVA-CNW biocomposite.

**Keywords:** Country almond shell, cellulose nano whiskers (CNW), Poly (vinyl alcohol), Solution casting.

03-10

### MOLECULARLY IMPRINTED CONDUCTING POLYMER FOR ELECTROCHEMICAL SENSING OF CHLORPYRIFOS

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**Background:** Chlorpyrifos (CPF) is one of the most widely used organophosphorus pesticides in agriculture to control broad-spectrum of insect pests. Many reports have demonstrated that CPF could produce toxic effects by inhibiting acetylcholinesterase (AChE) and also induce oxidative stress and DNA damage. Molecular imprinting technique, produce selective and specific binding sites coupled with voltammetry offers fast response and sensitive CPF quantification.

**Method:** The present work involves the synthesis of multiwalled carbon nanotube (MWCNT) based molecularly imprinted conducting polymer (MICP) based electrochemical sensor for the trace determination of CPF in real samples. MICP was synthesized on thiophene linked MWCNT by in-situ oxidative polymerization mechanism using 3, 4-ethylenedioxythiophene (EDOT) as cross linker. Organized material was characterized by FTIR, SEM, and TEM analysis. The sensor electrode was fabricated simply by drop-casting MICP into glassy carbon electrode.

**Results:** The cyclic voltammetric curves demonstrated that MICP had a higher electrochemical response for  $[Fe(CN)_6]^{3-/4-}$  compared with the other modified electrodes. The maximum peak response of the sensor was observed at pH 7.0 and was selected as optimized value for the electrochemical oxidation of CPF.

**Conclusions:** An efficient molecularly imprinted conducting polymer composite based electrochemical sensor for the sensitive and selective determination of CPF was successfully constructed using surface immobilizing of the template. A lower detection limit and a dynamic linear range obtained during DPV analysis can concluded to the applicability of the sensor in the analysis of CPF from real samples.

**Keywords:** Chlorpyrifos; Multiwalled carbon nanotube; Molecularly imprinted conducting Polymer; Electrochemical Sensing

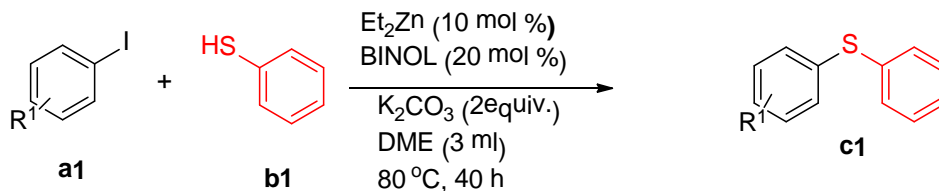
03-11

### A COMPETENT ZN(II)-BINOL CATALYTIC SYSTEM FOR C-S CROSS-COUPLING REACTIONS

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We have successfully achieved a promising protocol for the zinc-catalyzed S-arylation of aryl thiols with differently substituted aryl iodides. The *in situ* generated Et<sub>2</sub>Zn-BINOL in DME in the presence of K<sub>2</sub>CO<sub>3</sub> at 80 °C showed moderate catalytic activity in C-S cross-coupling reactions.



R<sup>1</sup> = 4-CN, 4-COCH<sub>3</sub>, 4-OCH<sub>3</sub>

03-12

### RECOGNITION OF Al<sup>3+</sup> ION VIA TRANSMETALATION OF Ni (II) BASED BICOMPARTMENTAL SALEN SCHIFF BASE COMPOUNDS

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**Background:** Selectivity and availability of cost-effective methods are the major drawback for the recognition of a metal ion. In order to solve this problem, we have systematically prepared and studied three different Ni (II) salen complexes for detecting Al<sup>3+</sup> by emission enhancement *via* transmetalation reactions in an organic solvent DMSO or pure water. These probes recognize Al<sup>3+</sup> ion both colorimetrically as well as fluorometrically *via* transmetalation of Ni(II) metal centre. Transmetalation is relatively new or less explored method for the sensing of a metal ion. The geometry of the central metal ion in the probe plays a pivotal role in the sensing action.

**Method:** In order to investigate the sensing performance, 0.1 mmol of the synthesized compound (probe) was taken in R.B. flask and was heated under reflux condition at a temperature of 50 °C. To this solution, 0.2 eq of AlCl<sub>3</sub> in aqueous media was added and refluxed for 10 minutes. From the reaction mixture, 2000 μL was withdrawn and absorption and emission measurements were done to monitor the spectral changes and thereby the sensing performance. Job's plot and Life time measurements were done in order to study the mechanistic aspects. The selectivity of the analyte was also tested.

**Results:** The synthesized Ni(II) compounds quenches the fluorescence of corresponding ligands (off fluorescence) due to the coordination of non-emissive Ni(II) ion. Upon the addition of Al(III) ion, Ni(II) is displaced and Al(III) complexes of the respective ligands were formed which in turn results in a "on fluorescence" and the fluorescent enhancement was noted in the 470 to 510 nm range. At the same time colorimetric response were also monitored from the absorption titration curve and the job's plot reveals the complexation of Schiff base by Al<sup>3+</sup> ion with 1:1 stoichiometry which is further supported by <sup>1</sup>HNMR data.

**Conclusions:** A systematic study of sensing ability of three novel nickel complexes were performed for the detection of Al<sup>3+</sup>. All the three complexes are excellent chemo sensors for Al<sup>3+</sup> with an appreciable detection limit (DL). Structural parameters play a significant role in the detection of Al<sup>3+</sup> as the nickel complex with square pyramidal geometry completes the transmetalation process at a relatively faster rate with the highest detection limit (DL = 2.04 × 10<sup>-6</sup> M).

**Keywords:** Transmetalation, Salen Schiff base, Al<sup>3+</sup> ion, Detection limit

03-13

### STRUCTURAL INSIGHTS, SPECTRAL ASPECTS AND *IN VITRO* CYTOTOXICITY OF A ONE DIMENSIONAL COPPER (II) COORDINATION POLYMER

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**Background:** Investigation of coordination complexes with halogen/pseudo halogen bridging ligands is of enduring interest to coordination chemists for their rich structural aspects and potential applications in various fields. However, up to now, 1D chain like compounds with chlorine as bridging ligand are rarely reported. Copper complexes of Schiff bases have aroused considerable attention to find new chemotherapeutic drugs because of their diverse biological activity and oxidative nature.

**Method:** An NNO donor tridentate Schiff base ligand, 4-bromo-2-(((3-(methylamino)propyl)imino)methyl)phenol and its one dimensional polymeric copper(II) complex were synthesized and physicochemically characterized by means of elemental analysis, molar conductivity measurements, FT-IR, UV-Vis, fluorescent and NMR spectral studies. Molecular structure of the copper complex was confirmed by X-ray crystallography. Hirshfeld surface analysis of the complex has been carried out. Moreover, the cytotoxicity of the complex has been screened *in vitro* against lymphoma ascites cell lines.

**Results:** From X-ray crystallography, copper complex is found to be a 1D coordination polymer in which chlorine acts as a bridging ligand. Value of Addison parameter for this complex is found to be 0.1813. Presence of different types of non-classical intermolecular interactions, which strengthen the polymeric chain of the complex, were further supported by Hirshfeld surface analysis and associated fingerprint plots. The emission profile of the copper complex reveals its quenching behaviour. Furthermore the copper complex exhibited a concentration dependent cytotoxicity against lymphoma ascites cell lines.

**Conclusions:** A one dimensional copper(II) coordination polymer of a Schiff base ligand has been synthesized and physicochemically characterized. From the value of Addison parameter, geometry of the complex is confirmed to be square pyramidal. Through the coordination to the metal centre, fluorescence of the Schiff base ligand has been quenched. As the concentration of the copper complex increases, its cytotoxic activity against lymphoma ascites cell lines increases. Complex produced a maximum of 78% cytotoxicity at 200 µg/mL.

**Keywords:** 1D coordination polymer, Schiff base, Hirshfeld surface analysis, Cytotoxicity

03-14

### CONDUCTIVITY STUDIES OF POLYBUTYLMETHACRYLATE (PBMA) BASED NANOCOMPOSITES USING CeO<sub>2</sub> NANOPARTICLES

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The present work emphasizes on the effect of Ceria (CeO<sub>2</sub>) nanoparticles on the conductivity properties of polybutylmethacrylate [PBMA] polymer. The PBMA nanocomposites with different loadings of CeO<sub>2</sub> nanoparticles were synthesized via in situ polymerization method. The incorporation of CeO<sub>2</sub> nanoparticles in the PBMA matrix were examined by FTIR, XRD and optical micrograph studies. The FTIR and XRD results confirmed the effective incorporation of CeO<sub>2</sub> nanoparticles in the PBMA matrix. The optical micrographs of the samples revealed the homogenous dispersion of nanoparticles in the PBMA matrix. The conductivity properties such as dielectric constant, dielectric loss and AC conductivity of the PBMA- CeO<sub>2</sub> nanocomposites were measured in various frequencies and are compared with bare PBMA. It was observed that the composites have better conductivity properties than bare PBMA.

03-15

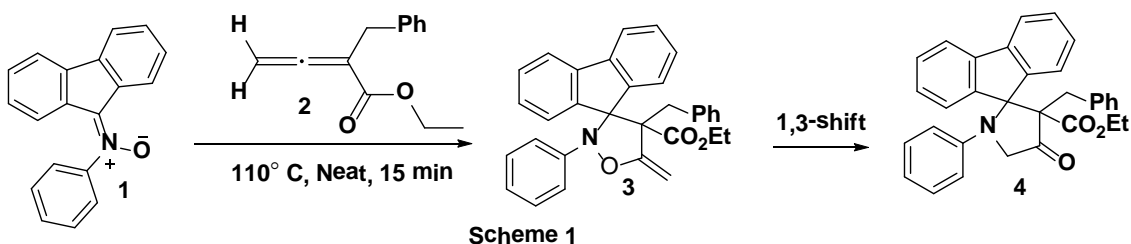
### SOLVENT FREE SYNTHESIS OF SPIROPYRROLIDINONES

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**Background:** Spiranes have received great attention nowadays because of their valuable properties. Spiropyrrolidinones, for example, are major structural motifs in many biologically active compounds. As the synthesis of spiroheterocyclics requires specific synthetic strategies the synthesis of these compounds are challenging for synthetic organic chemists. Furthermore, due to steric strain, the spiro compounds easily rearrange to different cyclic compounds. 1,3-Dipolar cycloaddition reactions represent a powerful tool for the synthesis of many pharmacologically important N-heterocyclic compounds. Here we adopted a solvent free reaction of fluorenylnitrones with 1,1-disubstituted allene to afford spiro-pyrrolidinones. Our synthetic protocol is operationally simple and green.

**Method:** *N*-Fluorenylidene-*N*-phenyl nitrone (**1**, 0.27 g, 1 mmol) and allene (**2**, 0.2 g, 1 mmol) were heated at 110 °C in a sealed tube for 15 min.



**Results:** We have examined the reaction between *N*-fluorenylidene-*N*-phenyl nitrone (**1**) with allene (**2**) under solvent free conditions. Here the spot of spiro-pyrrolidinone (**4**) was seen in TLC (thin layer chromatography) after 15 min. The product was isolated by routine column chromatography. Prolonged heating led to the decomposition of reaction mixture. IR spectrum of **4** indicated an additional carbonyl group which was confirmed as a keto carbonyl at 204 ppm in <sup>13</sup>C NMR spectrum. This structural feature ruled out the normal [3+2] adduct (**3**) as the final product. Moreover, in <sup>1</sup>H NMR peaks corresponding to an exocyclic double bond in **3** are absent; instead, signals corresponding to diastereotopic methylene protons were observed at δ 4.53 and 4.67 ppm, which further confirmed the possible rearrangement of isoxazolidine (**3**) to **4**.

**Conclusion:** We have developed a simple solvent-free green approach for the synthesis of spiro-pyrrolidinones. Our method is operationally simple and requires a short reaction time. Spiropyrrolidinones are important structural motifs with a wide range of pharmaceutical applications as antibacterial, antifungal, antimalarial, and anticancer agents.

**Keywords:** Nitrones, Allenes, Spiropyrrolidinones

03-16

### A COST EFFECTIVE AND FACILE METHOD TO SYNTHESIZE BEADLESS POLYCARBONATE NANOFIBERS AND FURTHER MODIFICATION USING SURFACE COATED SEMICONDUCTOR NANOPARTICLES

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**Background:** Growing demand of nanotechnology based materials has attracted researchers to produce nanofibers and nanocomposites with attractive morphology and properties.

**Method:** Electrospinning is a simple and cost-effective method which can produce fibrous materials with a broad range of diameters. This work explains the process of nanofiber formation and fabrication of ultrafine beadless polycarbonate (PC) fibers from a very small quantity of polymer using less toxic solvents. Highly dispersive surface-protected semiconductor cadmium sulphide (CdS) nanoparticles with attractive band gap, thermal stability, and prominent photolumi-

nescence properties were prepared by a low temperature and less toxic method. The PC nanocomposites prepared by dispersing the surface protected semiconductor nanoparticles were also characterized by various methods.

**Results:** Uniform fibers with average diameter 90 nm without any beads were formed at a PC solution concentration of 14 w/v%. TEM images of PC fibers incorporated with CdS shows dispersed nanoparticles throughout the fiber. This is confirmed by XRD analysis. The uv-visible spectrum of the PC fiber composite shows a red shift in absorption. The composite shows a characteristics optical property by the photoluminescent spectra.

**Conclusions:** The large specific surface area and small pore size of nanofibers obtained by this method making them excellent candidates for filtration and membrane applications. The polymer nanocomposites prepared by electrospinning after dispersing various nano sized materials also have wide variety of applications.

**Keywords:** Polymer nanocomposite, Electrospinning, Photoluminescence, nanofibers, Bead, Nanoparticles.

03-17

### STUDIES ON OIL RESISTANCE AND BIODEGRADABILITY OF COMPOSITES FROM CHICKEN FEATHER FIBRE AND ACRYLONITRILE BUTADIENE RUBBER

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**Background:** The strategies of waste management nowadays aim at making wealth from waste. Chicken feathers from poultry waste are an excellent prospect, because they are inexpensive and abundant. The present study aims on the use of waste chicken feather as filler in acrylonitrile butadiene rubber (NBR), which is a synthetic rubber that possesses good heat and oil resistance.

**Method:** Composites with three series of chicken feather fibres were studied i.e., raw (RCF), sterilized (SCF) and alkali treated (ACF). Composites were prepared using a conventional laboratory two roll rubber mixing mill. Surface modification of the fibre was done by alkaline treatment to improve the interfacial adhesion and it characterised by FTIR. The swelling behaviour of the composites in N, N-dimethylformamide, acetonitrile, dimethyl sulfoxide and water were analyzed for the swelling coefficient values. The biodegradable characteristics of CF reinforced NBR composites were studied by soil burial test. Effect of soil burial on the rubber was primarily followed by quantitatively observing the change in their mechanical properties.

**Results and Discussion:** Tensile strength, moduli at 10 and 20 % elongation and hardness of the composites decreased after ageing under soil due to the degradability of fibre. ACF- NBR composite shows highest drop in tensile strength and modulus. This is due to the degradation of fibres which easily takes place in the ACF composites by the direct involvement of micro-organisms. As the loading of fibre increases, the swelling coefficient value decreases in all solvents except in water. This is due to the increased hindrance exerted by the fibre at higher loading. It can be seen that the composites with ACF shows higher values of swelling coefficient than the gum sample.

**Conclusions:** The investigation shows that the addition of chicken feather to NBR improves its biodegradability as indicated by the decrement in values of mechanical properties. The solvent resistance of the composites also increases upon the incorporation of fibres.

03-18

### LUMINESCENT POLY (VINYL ALCOHOL) COMPOSITES CONTAINING SULPHUR-DOPED GRAPHENE QUANTUM DOTS FOR ULTRASENSITIVE DETECTION OF ENVIRONMENTAL POLLUTANTS

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**Background:** Optical methods based on photoluminescence properties of fluorescent probes provide an ideal approach for the facile and ultra-trace detection of environmental pollutants like pesticides. When compared to other fluorescent probes, graphene quantum dots (GQDs) show superior properties such as high photostability, aqueous dispersibility,

biocompatibility, lower toxicity and good chemical and thermal stability. Polymer-based fluorescent nanocomposite materials can be formed into technologically relevant structures such as thin films which could be used for sensing application.

**Method:** This work focuses on developing a sensing platform for the ultrasensitive detection of a few common pesticides. As part, sulphur-doped graphene quantum dot (S-GQD) as fluorescent probe was synthesized using graphene oxide as starting material,  $\text{KMnO}_4$  as oxidising agent and  $\text{H}_2\text{SO}_4$  as precursor for sulphur by sonochemical method with intermittent microwave heating at 400 W keeping the reaction temperature constant at 90 °C in 5 minutes. In order to make a solid state fluorescent material as a sensing device, polymer composite film based on poly (vinyl) alcohol (PVA), as matrix polymer and S-GQDs, were prepared by casting from aqueous solutions.

**Results:** Transmission electron microscopy (TEM) and atomic force microscopy (AFM) analysis show that as-synthesized S-GQDs exhibited high crystallinity, uniform size distribution (4 nm) and monolayer graphene thickness. Moreover, S-GQDs showed a higher quantum yield of 27.8% and a production yield of 85 %. Successful doping of sulphur atom in graphene quantum dots was established by FTIR and XPS analysis. Optical and fluorescent properties of S-GQD and PVA/S-GQD nanocomposites were studied. Both S-GQDs and PVA/S-GQD nanocomposites were used for the ultrasensitive detection of a set of common pesticides namely, carbofuran (CF), Methyl-parathion (MPr) and Thiram (Tr) with achievement of very low detection limit in ppb level.

**Conclusions:** Organophosphate and carbamate pesticides are environmentally toxic due to their persistent nature which causes serious health hazards. A facile and rapid approach was developed for the ultrasensitive detection of such environmental pollutants at ppb level using sulphur-doped graphene quantum dots and its polymer nanocomposite film as fluorescent probes.

**Keywords:** Sulphur-doped graphene quantum dots, fluorescent probe, ultrasensitive detection, sonochemical method, microwave heating, fluorescent polymer composites.

03-19

### SYNTHESIS, SPECTRAL STUDIES, CRYSTAL STRUCTURE AND *IN SILICO* MOLECULAR DOCKING OF THIOSEMICARBAZONE CU(II) COMPLEX

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**Background:** Thiosemicarbazones (TSCs) are ligands with an admirable profile in medicinal chemistry. In pharmacology, the inhibition of tyrosine kinase activity of EGFR family could have the significant therapeutic potential. So this EGFR kinase represents an attractive target for the development of novel therapies for the treatment of cancers.

**Method:** The Cu(II) thiosemicarbazone synthesized were characterized by various techniques CHN analysis, FT-IR, UV-Vis, NMR and SCXRD measurements. The molecular docking studies were also performed against Epidermal Growth Factor Receptor (EGFR) enzyme and is compared with a standard drug. Also the cytotoxic study of the complex was carried out using Daltons Lymphoma Ascites cell.

**Results:** The structure of the complex was obtained by spectral and elemental analysis. The molecular structure was confirmed by SCXRD analysis. The cytotoxic study of the complex was carried out using Daltons Lymphoma Ascites cell. Molecular docking acted as an additional tool for pharmacophore-based virtual screening to make the discovery of potent EGFR TK inhibitors more efficient. This is one of the enzymes responsible to cause the cell proliferation and tumor cell survival. Binding energy of the compound was better as compared to erlotinib drug and the interactions of the compound was almost identical to that of the drug.

**Conclusions:** Cu(II) thiosemicarbazone complex was synthesized and studied for its biological activity, which can be the foundation stone for its applications in the field of drug development.

**Keywords:** Cu(II) thiosemicarbazone, Synthesis, Characterization, Molecular docking

03-20

**DEVELOPMENT OF COBALT NICKEL BASED METAL ORGANIC FRAMEWORK FOR PHOTOCATALYTIC HYDROGEN EVOLUTION****P. C. Meenu<sup>a</sup>, Rani Pavithran<sup>a</sup>, S. M. A. Shibli<sup>b</sup>**<sup>a</sup>*Department of Chemistry, University College, Thiruvananthapuram*<sup>b</sup>*Department of Chemistry, University of Kerala, Kariavattom Campus*

Photocatalytic water splitting is a promising method for hydrogen generation and is receiving great interest due to its advantages, including simplicity of actual practice than the other methods. Metal Organic Framework, a class of material with metals and organic linkers provides a great platform for photocatalysis for hydrogen production. The MOF with metals in its cluster can generate the water splitting reaction due to its ability to transfer electrons from HOMO to LUMO of the organic linkers.

Co and Ni are efficient co-catalyst for photocatalytic application in metal organic framework. Bimetallic metal organic framework developed from terephthalic acid with cobalt and nickel showed photocatalytic activity for hydrogen evolution reaction. Successful incorporation of the two metals into the nodes of metal organic framework caused high impact on its photocatalytic performance. The XRD and IR analyses revealed the formation of Metal organic Framework. XPS and EDS analyses revealed the bonding and elemental composition of the MOF respectively. TEM analysis indicated a rod morphology for CoNiMOF. The CoNiMOF had a layered structure with a diameter size between 2-4 nm. The CoNiMOF had absorption at 515 nm in the solid state UV spectrum indicating its efficient photocatalytic activity for hydrogen production. The activity was tested in aqueous solution having triethylamine and acetonitrile as sacrificial electron donors. A narrow band gap of 2.1 eV and less intense photoluminescence also revealed its high photocatalytic activity. The bimetallic CoNiMOF generated a high rate of hydrogen production (95  $\mu\text{mol/hr}$ ) without sacrificial electron donors and an amount of 115  $\mu\text{mol/hr}$  with the sacrificial electron donors. Thus CoNiMOF can be used as an efficient photocatalyst for hydrogen evolution by water splitting.

**Keywords:** MOF, water splitting, hydrogen

03-21

**POLY (P-AMINO HYDROXYL NAPHTHALENE SULPHONIC ACID) MODIFIED ELECTROCHEMICAL SENSOR FOR THE SIMULTANEOUS DETERMINATION OF XANTHENE AND HYPOXANTHENE****Manna Rachel Mathew and K. Girish Kumar***Department of Applied Chemistry, Cochin University of Science and Technology, Kochi-22*

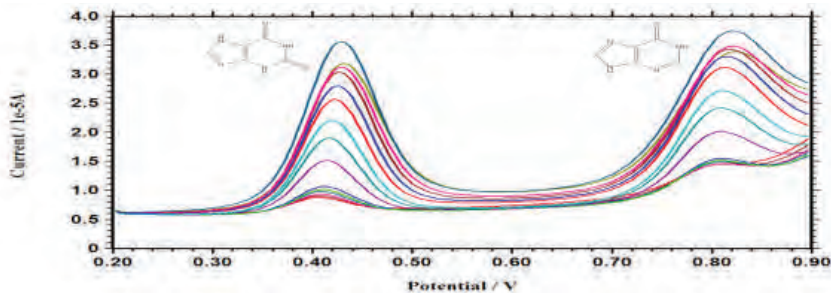
**Background:** Xanthene (XA) and hypoxanthene (HX) are the purine bases which are the important intermediates in the purine metabolism. The abnormal levels of xanthene and hypoxanthine are indicative of many clinical conditions. Thus their determination is important from the clinical diagnostic point of view. Among the reports for the determination of XA and HX, enzymatic sensors are not effective in making specific determination. But non-enzymatic electrochemical sensors offer rapid, reliable, less expensive, sensitive and selective determination. In view of this, attempt has been made to develop a poly (para amino hydroxyl naphthalene sulfonic acid) modified glassy carbon electrode (*p*PAHNSA/GCE) as a sensor for the simultaneous determination of XA and HX.

**Method:** The electrochemical experiments were performed on CHI6023D electrochemical analyser comprising of a three electrode set up and *p*PAHNSA modified glassy carbon electrode (GCE) was employed as the working electrode for the measurements. The experimental parameters for the simultaneous determination on the *p*PAHNSA/GCE has been optimised. Novel methods have been developed for the determination of xanthene and hypoxanthene in urine and serum using the developed sensor.

**Results:** The lowest potential for the electro-oxidation of XA and HX was obtained in 0.1 M NaOH. The increase in peak current with concentration was linear for individual as well as simultaneous determination of these analytes. For simultaneous determination, peak current changes with concentration in the range 20-700  $\mu\text{M}$  for XA and 60-500  $\mu\text{M}$  for HX. The sensor was successfully applied for determination of XA and HX in artificial urine and serum.

**Conclusions:** A *p*PAHNSA/GCE has been fabricated for the simultaneous as well as individual determination of XA and HX. The experimental conditions for optimal sensor performance has been determined and the utility of the sensor for the determination of the purines in spiked urine and serum samples has been demonstrated.

**Keywords:** xanthene, hypoxanthene, poly (para amino hydroxyl naphthalene sulfonic acid), simultaneous determination.



03-22

### SYNTHESES, SPECTRAL ASPECTS AND BIOLOGICAL STUDIES OF BROMIDE AND AZIDE BRIDGED BOX DIMER COPPER(II) COMPLEXES OF NNO DONOR AROYLHYDRAZONE

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**Background:** The design and synthesis of halide/pseudohalide bridged dinuclear copper(II) complexes of aroylhydrazones have been an attractive area of research. Structural and magnetic properties of asymmetric double end-on ( $\mu_{2-1,1}$ -N<sub>3</sub>) azido-bridged dimeric complexes are relevant in the current situation. Among the various transition metals, dinuclear copper(II) complexes are gaining more importance because of their relevance in biological fields.

**Methods:** Molar conductivity measurements, infrared, electronic, EPR and single crystal XRD measurements were used for the characterization of synthesised compounds.

**Results:** Crystallographic measurement reveal that the two copper(II) complexes were bromide/azide bridged box dimers having distorted square pyramidal geometry with monoclinic space group symmetry  $P2_1/n$ . Antibacterial and cytotoxic studies gave good results.

**Conclusions:** This work gave an idea about the syntheses, crystal structures, various stabilising interactions present in box dimer copper(II) complexes of aroylhydrazone. Also the antibacterial and cytotoxicity studies of complexes were explored.

**Keywords:** Halogen bridged box dimer; Copper(II) complexes; Square pyramidal; Antibacterial

03-23

### SYNTHESIS OF NOVEL MECHANORESPONSIVE AND SELF-HEALABLE POLY (METHYL METHACRYLATE) INCORPORATING STRATEGICALLY POSITIONED ANTHRACENE- BISMALEIMIDE DIELS-ALDER ADDUCT DERIVED MECHANOPHORE THROUGH SINGLE ELECTRON TRANSFER- LIVING RADICAL POLYMERIZATION (SET-LRP) UNDER AMBIENT CONDITIONS.

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**Background:** The inevitable mechanical stress on polymeric materials leads to polymer degradation resulting in deterioration of material quality and consequently limit material's lifetime. With the advancement in polymer mechanochemistry, chemists sought to redirect the destructive mechanical energy to productive form by incorporating structural motifs called mechanophores which respond to mechanical force in a constructive manner and makes it possible for the material to perform stress induced strengthening, stress responsive and self-healing function. Here we report the synthesis of novel anthracene-bismaleimide Diels-Alder (DA) adduct derived mechanophore incorporated poly(methyl methacrylate) (PMMA) tailored to exhibit stress-sensing, self-healing and stress induced strengthening characteristics through stress induced sequential Diels-Alder (DA) Unclick /Click chemistry.

**Method:** Mechanophore centered polymers were synthesized using modified SET-LRP. We have demonstrated a sim-

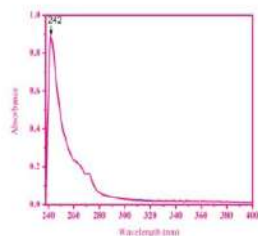


ple, efficient and economical approach for SET-LRP in which tiresome deoxygenation procedures were eliminated by the use of triphenylphosphine and this report constitutes the first description of SET-LRP using triphenylphosphine under ambient conditions.

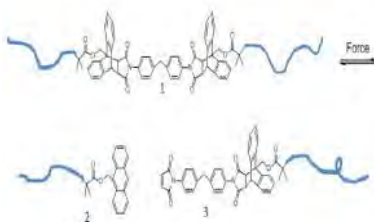
**Result:**

We showed that anthracene-bismaleimide DA adduct structural motif undergo *retro* DA reaction under the influence of mechanical stress to generate free anthracene and bismaleimide terminated chains, which can thus function as a stress sensor (**Scheme 1**) observed by concomitant development of UV-Vis absorption (**Figure 1**) and emission of anthracene chromophore. Interestingly both anthracene emission and absorption of sonicated polymer faded over time (**Figure 2**) indicating self-healing.

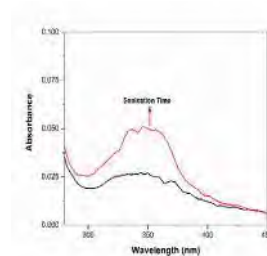
**Conclusion:** We have developed an efficient SET-LRP method for the synthesis of high molecular weight materials under ambient conditions. The newly synthesized polymer combines stress-sensing with self-healing. Judicious selection of monomers and initiators can even lead to polymers that can potentially achieve self-strengthening of polymers under stress.



**Scheme 1**



**Figure 1**



**Figure 2**

**Keywords:** Mechanophore, Single Electron Transfer-Living Radical Polymerization, Mechanoresponsive, Self-healing, Click/Unclick Chemistry

03-24

### METAL FREE MODIFICATION ON $\text{Ag}_3\text{VO}_4$ PHOTOCATALYST FOR AUGMENTED SUNLIGHT INDUCED DEGRADATION OF ORGANIC POLLUTANTS IN WATER

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**Background:** Clean water is a necessity to life, while access to it became knotty than ever owing to recent floods. Recently, photocatalysts have been assessed to address this worsening concern. Herein, we demonstrate a sonochemical method for obtaining sulphur doped graphene oxide modified silver vanadate ( $\text{sGO-Ag}_3\text{VO}_4$ ) nanocomposites as photocatalysts where  $\text{Ag}_3\text{VO}_4$  nanoparticles are dispersed on the sulfonated graphene oxide nanosheets. Modification by sGO is much desirable since it provides metal free, stable, eco-friendly and economic method to improve photocatalytic action of  $\text{Ag}_3\text{VO}_4$ .

**Methods:** The structural and optical properties of obtained nanocomposites were characterized by XRD, FTIR, UV-vis, DRS, PL, SEM and TEM analysis.

**Results:** Analysis revealed that the composite is star shaped and dispersed on sGO sheets promoting charge mobility and vanadate is present in  $\alpha$ - $\text{Ag}_3\text{VO}_4$  form. Strong absorption span from 200-500 nm without much change in band gap (2.15 eV for composite) and a huge collapse in emission intensity was observed for composite relative to pure  $\text{Ag}_3\text{VO}_4$  indicating enhanced charge mobilization effect of sulphur doping, thus reducing charge recombination and photo corrosion rather than band gap. The photocatalytic degradation performance of the composite towards organic pollutants was explored by using methylene blue (MB) as a model compound. The results showed that 1%  $\text{sGO-Ag}_3\text{VO}_4$  nanocomposites could degrade ~99% of the dye within 30 min, under sunlight. Sulphur doping render  $\text{sGO-Ag}_3\text{VO}_4$  with superior activity than sGO,  $\text{Ag}_3\text{VO}_4$  and  $\text{GO-Ag}_3\text{VO}_4$ . With holes as the predominant active species in the system, the catalyst could bring about 99% degradation of textile dyes rhodamine B (RhB) while 50% for methylene orange (MO) and reactive red (RR) in 30 minutes.

**Conclusions:** The present work highlights the competence of metal free modification to photocatalyst for wastewater treatment in real time degradation of organic pollutants. The major contribution to the enhanced catalytic activity of our system is not from noticeable change in absorption profile, but from plentiful transportation and thus minimized recombination of charges resulted by the presence of largely conducting sGO sheet. The activity and stability of the composite are promising to extend application to degradation of other organic pollutants such as pesticides and deactivating bacterial strains from real water samples just by exposure to sunlight.

**Keywords:** Sunlight, Photocatalysis, sGO, Ag<sub>3</sub>VO<sub>4</sub>, Pollutant, Degradation

03-25

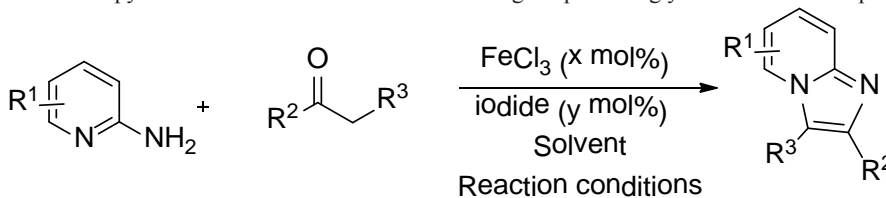
### NOVEL SYNTHESIS OF IMIDAZO [1, 2-a]PYRIDINES *via* Fe(III)- IODIDE CATALYZED ORTOLEVA-KING-TYPE REACTION

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**Abstract:** Imidazopyridines are very important nitrogen containing heterocyclic compounds well known for their pharmacological activities including anti-microbial, anti-inflammatory, anti-heart failure, anxiolytic, anti-ulcer, anti-tumor, etc. Synthesis of these molecules are of very much interest and seen promising developments. Ortoleva-King-type reaction involves the reaction of active methyl or methylene compounds with stoichiometric amounts of molecular iodine and 2-aminopyridine to form imidazopyridines and is one of the simplest methods to generate these compounds. The major disadvantage of this methodology is the formation of the iodide by-products leading to complex separation procedures often resulting in lower yields. Later many modifications came in this area by the use of catalytic quantities of iodide salts in the presence of metal catalysts like copper or cerium providing more efficient conversion compared to the original methods. Iron is a cheap and non-toxic transition metal which is widely employed in synthetic organic chemistry especially in heterocycle synthesis. To the best of our knowledge, Ortoleva-King-type reaction catalysed by iron has not yet been reported. Herein we have developed the first iron catalysed Ortoleva-King-type reaction towards the synthesis of imidazopyridines. In the initial studies we could get a promising yield of 52% of the product.



**Scheme:** First iron catalyzed Ortoleva-King-type reaction towards the synthesis of imidazo[1,2-a]pyridines. Efforts to achieve quantitative yield of the product and to explore the scope of the reaction are going on in our laboratories.

**Keywords:** Ortoleva-King-type reaction, Catalysis, Iron, Iodine, Imidazopyridine.

03-26

### A NOVEL LIGAND-FREE MANGANESE-CATALYZED C-O COUPLING PROTOCOL FOR THE SYNTHESIS OF BIARYL ETHERS

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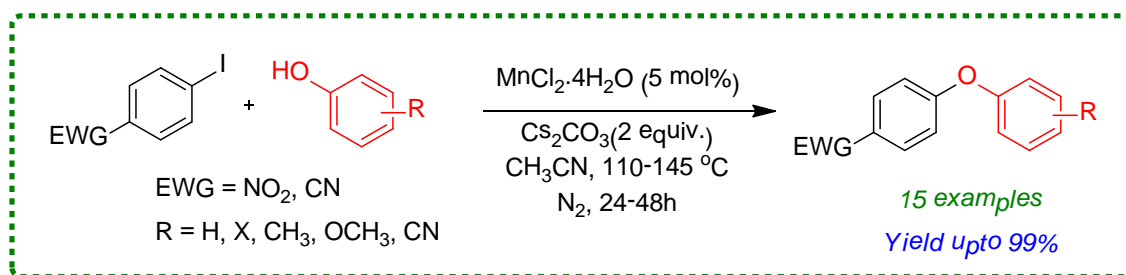
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**Background:** In modern synthetic organic chemistry, transition metal catalysis plays a prevalent role since it provides tremendous contributions in the establishment of C-C and C-heteroatom bond formations. Due to the relevance in natural existence and biological importance of heteroatom bearing systems, C-heteroatom single bond formation by metal catalyzed coupling reaction gathered large attention. In this context, etherification protocols are very significant due to the presence of ether moiety in many natural products and drugs. After the first report of coupling between aryl halides

and phenols using stoichiometric amount of copper in 1904, there has been continued efforts to modify the methodology using catalytic amount of copper and also with various other metals such as Palladium, Nickel, Iron, Zinc etc. To the best of our knowledge, Manganese catalysis has not yet been explored for the synthesis of ethers.

**Methods:** Into an oven dried sealed tube containing magnetic stirring pellet was added aryl iodide (0.5 mmol),  $\text{MnCl}_2 \cdot 4\text{H}_2\text{O}$  (5 mol%),  $\text{Cs}_2\text{CO}_3$  (1 mmol), phenol (0.75 mmol) and acetonitrile (3 mL). The tube is then evacuated, back-filled with nitrogen and stirred in a preheated oil bath kept at 110-145°C for 24-48 h. On the completion of time period the reaction mixture is quenched using water and extracted with ethyl acetate, dried and concentrated. The crude mixture obtained thus was purified with silica gel column chromatography using hexane/ethyl acetate.

**Results:**



**Conclusions:** The first manganese-catalyzed etherification of phenols to afford a variety of biaryl ethers is described. This protocol avoids the use of ligands, co-catalysts, transmetallating agents and employs relatively cheap, less toxic and easy to handle manganese chloride tetrahydrate as the metal catalyst. The scope and limitations of the novel protocol will be disclosed in the paper.

**Key words:** Homogenous catalysis, Manganese catalysis, Etherification, Cross-coupling.

03-27

### MICROWAVE ASSISTED SYNTHESIS OF INTERNAL ALKYNES USING COPPER-CATALYZED SUZUKI TYPE COUPLING REACTIONS

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**Background:** The C-C bond forming reactions are important tools in organic chemistry, and among this, transition metal-catalyzed protocols are of great significance because transition metal catalysts make nearly impossible reactions possible. Suzuki coupling is one such reaction, where coupling between an organoboron reagent and an organic halide or pseudohalide takes place in presence of Pd catalyst, phosphine ligand and a base. Most of the Suzuki reactions involve costly palladium and toxic, air and moisture sensitive phosphine as the catalytic system. Therefore, a better, cost effective and greener catalytic system is required. Cu is one such metal having low cost, high abundance, low toxicity, easy recyclability, high catalytic activity and excellent functional group tolerance. Internal alkynes are important structural units present in many natural products and are used in the synthesis of antimicrobics, antibiotics, polymers, and optical or electronic materials. We herein report the first ligand-free microwave assisted synthesis of internal alkynes using Cu-catalyzed Suzuki type coupling reactions of alkynyl bromides with aryl or alkylboronic acids/esters.

**Methods:** A 10 ml glass vial was charged with 1-bromo 2-substituted acetylene (0.5 mmol, 1 equiv.), organoboron compound (0.6 mmol, 1.2 equiv.), CuI (0.05 mmol) and  $\text{K}_3\text{PO}_4$  (2 equiv.) in ethanol (3 ml). The mixture was stirred at 130 °C for 15 min in a microwave reactor. The reaction was quenched with distilled water and extracted with ethyl acetate (3 x 10 ml). The ethyl acetate layer was separated, dried using anhydrous sodium sulphate, concentrated and the product was purified by column chromatography using a mixture of hexane and ethyl acetate as eluent. Similar fractions were combined on the basis of TLC and the solvent was evaporated off using a rotary evaporator to give the products.

**Results:** At first the initial reaction was conducted by choosing phenylbromoacetylene **1a** and 4-phenylboronic acid **2a** as model substrates in ethanol expecting the formation of 1,2-diphenylacetylene as the product **3a**. Firstly we started our reaction by screening different Cu salts and found that CuI showed good catalytic activity compared to other Cu salts.  $\text{Cu}(\text{acac})_2$  also gave comparatively good yield. Cu salts like CuBr and  $\text{CuBr}_2$  showed some catalytic activity but

less than that of CuI. Then we focused our investigation on the effect of different bases on the microwave assisted copper-catalyzed coupling reaction. Among the screened bases, inorganic bases gave considerably good yield compared to organic bases and  $K_3PO_4$  was found to be the most effective one giving the coupled product in 83% yield.

When the reaction was carried out using higher catalyst loading of 15 mol%, the yield of the desired product **3a** remained the same as 83%. In order to optimize the temperature, the reaction was conducted at higher and lower temperatures than the 130 °C used in the above reaction, which afforded only decreased yield in both the cases. Increasing the reaction time from 15 min to 20 min showed no change in the yield of the reaction. Thus, under the optimized condition of 10 mol% CuI and 2 equiv. of  $K_3PO_4$  in 3 mL ethanol under microwave irradiation at 130 °C for 15 min we could successfully prepare the differently substituted diphenyl acetylenes in good to excellent yield.

**Conclusion:** In short, we have developed a copper-catalyzed protocol for the synthesis of 1,2-disubstituted acetylenes in good to excellent yields from organoboron derivatives and alkynyl bromides using microwave irradiation under ligand-free conditions. The best condition that we have observed was a catalytic system consisting of copper (I) iodide (10 mol%) in the presence of  $K_3PO_4$  (2 equiv.) as base in ethanol (3 ml) at 130°C for 15 min under a MW reactor. Internal alkynes are important synthons present in many complex molecules and thus it is worthwhile to develop an eco-friendly and cheap catalytic method with minimum consumption of time.

**Keywords:** Cu-catalysis, C-C bond formation, Suzuki coupling, internal alkynes, alkynyl bromides, boronic acids.

03-28

### FABRICATION OF SOLID STATE DYE SENSITIZED SOLAR CELL WITH CARBAZOLE BASED HOLE TRANSPORTING MATERIAL

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**Background:** At present the world is in great need of technologies providing renewable energy. The challenge is how to meet the increasing global energy consumption without sacrificing our future environment. More solar energy strikes the earth in one hour than all the energy consumed on the earth in a year. Solar energy provides clean abundant energy and is therefore an excellent candidate for a future environmentally friendly energy source. Solar cells are the devices that convert light energy into electrical energy. Looking at photovoltaics, dye sensitized solar cell is considered to be a promising candidate, they having long shelf life and are low cost renewable energy sources.

Carbazole based derivatives have attracted much attention because of their interesting photochemical properties. Recent interest in the carbazole derivatives have been caused by its good charge transport function, which can be exploited in the molecular design of new types of HTMS in DSCs. Another fascinating advantage is the versatility of the carbazole reactive sites that can be substituted with a wide variety of functional groups, allowing fine tuning of its optical and electrical properties. The carbazole derivatives generally possess good thermal stability and hole transport properties. The combination of carbazole derivatives and triphenyl amine derivatives is expected to offer the improved thermal and morphological stabilities as well as their good hole transport properties.

Molecules contain a  $\pi$ -rich heterocyclic or aromatic ring system functionalized with one or more electron donating substituents exhibits good hole transporting properties. The most commonly encountered substituents are amino and alkoxy groups, which contain single bonded heteroatoms possessing sharable lone pairs. The most widely used hole transport molecule are aromatic amines. Carbazole based derivatives have attracted much attention because of their interesting photochemical properties, good chemical and environmental stability provided by the fully aromatic unit, easy substitution of the nitrogen atom with a wide range of functional groups permitting a better solubility and a fine tuning of the electronic and optical properties.

The present work focuses on the synthesis of a hole transporting material based on carbazole by Ullmann coupling. By using the synthesized compound and a natural dye, organic dye sensitized solid cell was fabricated and the performance analysed.

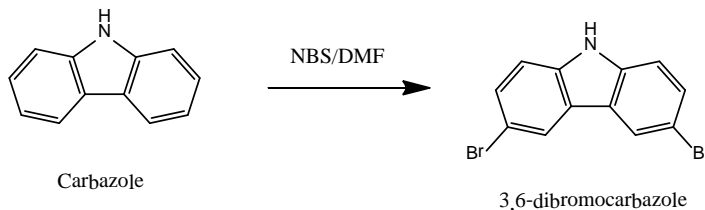
**Materials:** The reagents Carbazole, Dimethyl formamide, NBS, Potassium carbonate, Copper powder, Copper(I) chloride, Ethanol (Commercial- distilled), 1,2-Dichlorobenzene, Sodium, Sodium nitrite, Aniline, Glacial acetic acid, Chloroform, Ethylacetate, 18-crown-6 were purchased from Merck. The solvents were distilled before use according to availing procedures in literature. Spectroscopic grade solvents (Merck) were used for UV-Visible spectroscopic measurements.

Infrared (IR) spectra were recorded on a Shimadzu FT-IR 8400 S spectrometer as Potassium bromide (KBr) disc.

UV-Visible spectra were recorded on a UV-Vis Shimadzu 1700 using 1.0 cm length quartz tube. <sup>1</sup>HNMR spectra were recorded on a NMR-JEOL GSX-400 spectrometer with tetramethylsilane as the internal reference using CDCl<sub>3</sub> as solvent.

#### Synthesis of 3, 6 – dibromocarbazole (A)

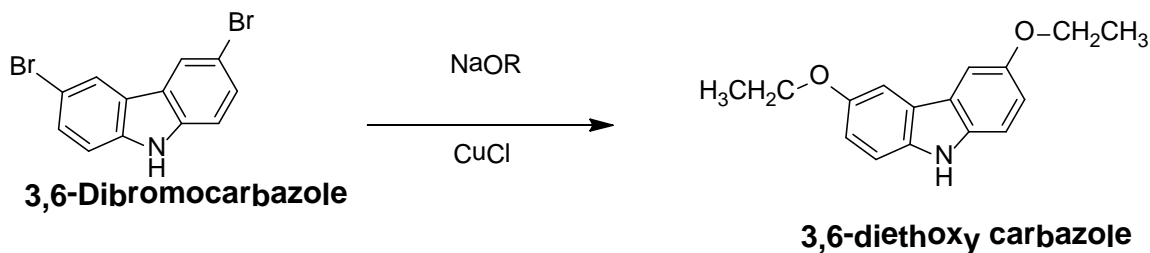
Carbazole 1.67 g (0.01mol) was dissolved in 15 ml DMF at 0°C with stirring followed by the addition of a solution of NBS 3.63 g (0.02 mol) in 10 ml of DMF. The resulting mixture was stirred at room temp for 2 hr and the solution then poured into 100 ml of water, filtered and washed with water. The crude product was recrystallised from ethanol. Yield: 64%, Appearance: White crystalline solid, Melting point: 204°C. The completion of the reaction was monitored by TLC.



Scheme 1

#### Synthesis of 3, 6 – diethoxycarbazole (B)

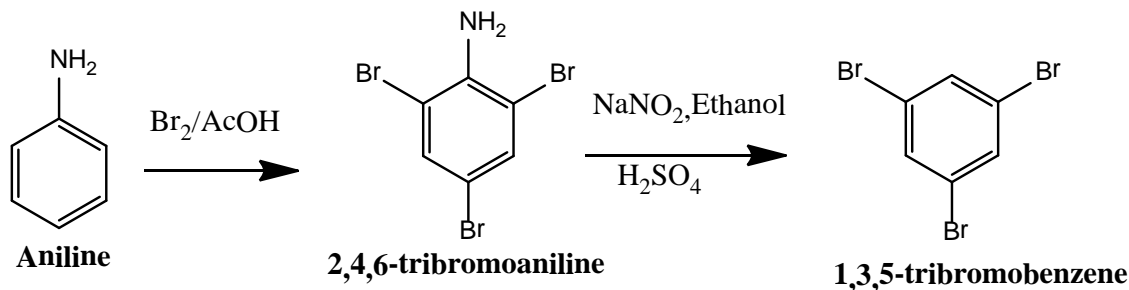
3, 6-diethoxycarbazole (B) was prepared from 3,6-dibromocarbazole on treatment with sodium ethoxide and copper (I) chloride. Yield: 60%, Appearance: Pale brown solid, Melting point: 185°C



Scheme 2

#### Synthesis of 1, 3, 5 – Tribromobenzene(C)

1,3,5-Tribromobenzene(C) was prepared from 1,3,5-Tribromoaniline according to available procedure of Vogel. Appearance: white solid, Melting point: 122°C

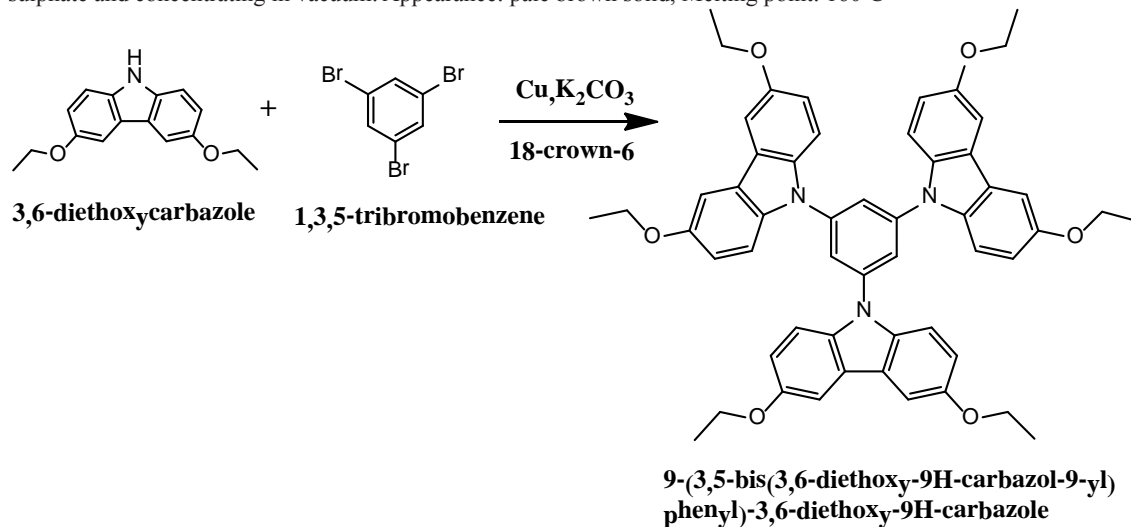


Scheme 3

#### Synthesis of 9-(3,5-bis(3,6-diethoxy-9H-carbazol-9yl)phenyl)-3,6-diethoxy-9H-carbazole(D)

3,6-Diethoxycarbazole 1.25g (0.0075 mol), Tribromobenzene 0.8g (0.0025 mol), 2.65g K<sub>2</sub>CO<sub>3</sub>, 1.8g Copper powder and 200mg of 18-crown-6 were heated together in 50ml of orthodichlorobenzene under nitrogen atmosphere and the resulting mixture was refluxed for 24hrs at 170°C. The inorganic compounds were removed by filtration and the filtrate was diluted with water. The combined organic layers washed with brine, drying by passing through sodium

sulphate and concentrating in vacuum. Appearance: pale brown solid, Melting point: 160<sup>o</sup>C



**Scheme 4**

#### Dye extraction

Red sandalwood was commonly known as 'rakta chandan' (botanical name: '*Pterocarpus santalinus*', C<sub>14</sub>H<sub>14</sub>O<sub>7</sub>). Perkin and Everest have identified that there are at least two or more maroonish red colouring components in the red sandalwood, viz. santalin A, santalin B and deoxysantalin of which santalin A is considered as the main component. Red sandal was extracted according to the literature (Samanta *et al* 2006)

#### Results

The synthetic strategy employed for the synthesis of the hole transporting material, are described in scheme (1-4). The synthesis of the final compound involves multistep organic reactions. The compound synthesized in every step was subjected to purification process. The purity of the compound is checked by TLC. The synthesized compounds were characterized by UV, IR and NMR spectroscopic techniques.

#### Characterization of 3, 6 – dibromocarbazole

UV-Visible spectra (Ethanol,nm):363, 353, 338, 303, 267.

In UV-Visible spectra the  $\lambda_{\text{max}}$  of 3,6-Dibromo carbazole is observed at 363nm. The parent compound carbazole shows  $\lambda_{\text{max}}$  at 293 nm. The increase in  $\lambda_{\text{max}}$  may be due to substitution of Br with lone pair of electron.

FT- IR Spectra (KBr, cm<sup>-1</sup>): 3406, 3068, 1471, 1284, 570

FT-IR gave characteristic peaks 3406cm<sup>-1</sup> indicated NH stretching frequency, 3068cm<sup>-1</sup> indicated the Ar C-H stretching, 1471 cm<sup>-1</sup> indicated the Ar C=C stretching, 1284 cm<sup>-1</sup> indicated the C-N stretching and 570 cm<sup>-1</sup> indicated the C-Br stretching.

#### Characterization of 3, 6 – diethoxycarbazole

UV-Visible spectra (Ethanol,nm): 361, 303, 266, 240, 229.

In UV-Visible spectra the  $\lambda_{\text{max}}$  of 3,6-Diethoxy carbazole is observed at 361nm.

#### Characterization of 1, 3, 5 – Tribromobenzene

UV-Visible spectra (Ethanol,nm): 224, 210

In UV-Visible spectra the  $\lambda_{\text{max}}$  of 1,3,5-tribromobenzene is observed at 224 nm.

FT- IR Spectra (KBr, cm<sup>-1</sup>): 3409, 1326, 1053

FT-IR gave characteristic peaks at 3409 indicated NH stretching frequency, 1326cm<sup>-1</sup> indicated the Ar C=C stretching and the peak at 1053cm<sup>-1</sup> is due to C-O stretch.

#### Characterization of 9-(3,5-bis(3,6-diethoxy-9H-carbazol-9yl)phenyl)-3,6-diethoxy-9H- carbazole (D)

UV-Visible spectra (Chloroform,nm): 354, 340

In UV-Visible spectra the  $\lambda_{\text{max}}$  of coupling product is observed at 354 nm. This may indicate that the coupling reaction make the compound to bathochromic shift, when comparing to the individual compounds.

FT- IR Spectra (KBr, cm<sup>-1</sup>): 3070, 1326.

FT-IR gave characteristic peaks 3070cm<sup>-1</sup> indicated the Ar C-H stretching, 1326cm<sup>-1</sup> indicated the Ar C=C stretching. The peaks due to N-H stretch and C-Br stretch are absent, this confirms the formation of coupling product.

<sup>1</sup>H NMR Spectra (CDCl<sub>3</sub>, ppm): 7.1-7.9 (m, 21 H), 3.48 (s, 12H), 1.58 (s, 18 H)

The NMR spectrum confirms the presence of aromatic ring at  $\delta$ 7.1-7.9 $\delta$ ,  $-\text{OCH}_3$  group at  $\delta$ 3.48 $\delta$  and  $-\text{CH}_3$  group at  $\delta$ 1.5 $\delta$ . The structure of the synthesized compound 9-(3,5-bis(3,6-diethoxy-9-H-carbazol-9yl)phenyl)-3,6-diethoxy-9H-carbazole is confirmed from the spectral data.

#### Device Fabrication

DSSC device comprised of a transparent conducting oxide (TCO) glass electrode coated with porous nano crystalline titania ( $\text{TiO}_2$ ), dye molecule attached to the surface of the nano crystalline titania, hole transporting material and a counter electrode. Fluorinated tin oxide (FTO) coated transparent glass strips (25mm x 25mm) with resistance of 30 $\mu\text{ohms}$  were used for the device fabrication. The structuring of the TCO is done using a chemical etching method. Zinc granulates are spread out on the glass ( $\sim$  mg/cm<sup>2</sup>). Scotch tape is used to mask the TCO area needed for the back contact. The fast reaction between HCl and Zinc powder leads to the removal of the  $\text{SnO}_2$ . After two treatments of 3 minute reaction time, the  $\text{SnO}_2$  is completely removed. The structured glass is then cleaned by ultra sonication in various solvents such as acetone, ethanol and water, for 10 min in each solvent. Compact  $\text{TiO}_2$  (30 nm) were deposited on FTO glass by spin coating that acts as a blocking layer. The FTO is placed in a chamber for 1 min and accelerated at a speed of 1000 rpm. 150  $\mu\text{l}$  of  $\text{TiO}_2$  solution is applied onto the substrate. The substrate is spun up to a speed of 1000 rpm for 30 second with an acceleration of 200 rpm/s. The samples were dried for 30 min. After deposition, the prepared TCO/  $\text{TiO}_2$  was annealed at 200 $^\circ\text{C}$  for 1 hour in air with a hot plate to achieve complete pyrolysis of organic species. Then nanoporous  $\text{TiO}_2$  ( $\sim$ 2.5 $\mu\text{m}$ ) was coated by doctor blading. The layers were sintered for 30 min at 350  $^\circ\text{C}$  to consume the organic additives and to obtain mechanically stable samples. Then the sample is cooled down slowly to 80  $^\circ\text{C}$  and placed into alcoholic solution of red sandal dye overnight. After the dip coating, HTM in THF deposited on the cell by spin coating method. The cells were kept overnight to allow maximum penetration of HTM in  $\text{TiO}_2$ . The metal electrode silver (200 nm) is coated on HTM of DSSC by thermal evaporation. The current-Voltage (I-V) characteristics is monitored and measured by using a Keithley 276 source measurement unit.

Photocurrent-Voltage (I-V) characteristics of DSSC based on D as HTM is measured using I-V characteristic curve plotted in figure 1. The result for photocurrent density ( $I_{sc}$ ), open-current voltage ( $V_{oc}$ ), fill factor (FF) and corresponding photo-energy conversion efficiency ( $\eta$ ) are summarized in table 1. The low conversion efficiency may be due to the following reasons: (i) instead of the ruthenium dye, which is commonly used for DSSC s, we used a natural dye, the red pigment of red sandal and (ii) instead of gold as back electrode we applied silver.

Compound	$V_{oc}$	$I_{sc}$	$J_{sc}$	FF	
D	1.7476	0.006487	0.2162	2.223	0.84

Table 1

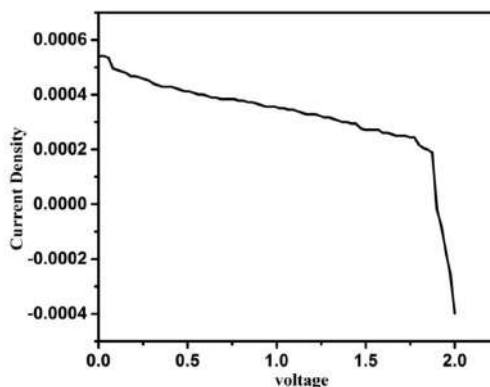


Figure1: I-V curve of DSSC using D as HTM

#### Conclusion

The solar power is presently a rapidly growing but often relatively expensive renewable energy form. One of the key element in DSSC is HTM, which is responsible for the regeneration of the oxidized sensitizer after electron injection into the semiconductor and for the transport of positive charge to the counter electrode. Carbazole based hole transporting materials find increasing applications in various electro optical devices like organic photovoltaic cells.

Here we have synthesized a carbazole based starburst HTM, 9-(3,5-bis(3,6-diethoxy-9-H-carbazol-9yl)phenyl)-

3,6-diethoxy-9H-carbazole. The synthesized compounds are characterized using UV-Visible, FT-IR and <sup>1</sup>H NMR spectroscopic techniques. Efficiency of the dye sensitized solar cell is measured using current-voltage (I-V) characterization. Efficiency is minimum due to the presence of natural dye. We would like to highlight the total cost effect of the cell, which will be down to nearly 30-40% of a similar type of fabricated cell. The conversion of the non-conventional energy, even if for very low percentage is advancement to mankind.

**Keywords:** Carbazole; Hole-transporting material; Dye Sensitized Solar Cell; Ullmann coupling

**Acknowledgment**

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03-29

**DESIGN AND EVALUATION OF STRUCTURAL AND *IN VITRO* CHARACTERIZATION OF CHITOSAN FUNCTIONALIZED LAYERED DOUBLE HYDROXIDE NANOCOMPOSITE: A VERSATILE NANOCOMPOSITE FOR DUAL RESPONSIVE ANTICANCER DRUG DELIVERY**

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**Background:** Breast cancer is one of the incurable diseases to human lives worldwide. Both the incidence and mortality of cancer are increasing day by day. The current treatment approaches in breast cancer therapy has limited due to high rate of tumour revival and toxicity towards the normal cells. Hence, there is a necessity to develop chemo-photothermal and sustained drug delivery systems, which can extend the stay time of the drug in the cancerous cell, and thereby increase the therapeutic efficacy of the drug. The convenient treatment biodegradable drug carriers are developed to encapsulate the drug. Curcumin (CUR) is an effective drug used for the treatment of breast cancer. In the present work biodegradable chitosan functionalized layered double hydroxide (LDH) nanoparticles for the safe loading and targeted-controlled delivery of curcumin (CUR) to the diseased sites.

**Method:** The current work reveals the synthesis strategy of functionalized LDH-gold nanoparticle (AuNP) based nano-carriers with targeted and photothermal release behaviours and improved biosafety features. The residual isocyanato (NCO) in the LDH was coupled to chitosan and gold nanoparticle to form the final material. The anti-tumor drug CUR was successfully loaded into the carrier through electrostatic and hydrogen bonding interactions. The resulting DDS was non-toxic to breast cancer cells (MCF7).

**Results:** The drug CUR loaded in the LDH-TCS/AuNP nanocomposites through electrostatic and hydrogen bonding interactions and the whole conjugate displays a dual responsive CUR release behavior with a faster rate and a greater amount being released in acidic conditions. This system combines advantages of both high drug storage capacity and property of stimuli responsive controlled release and has a potential for the application of drug delivery.

**Conclusions:** This system combines advantages of both high drug storage capacity and property of dual responsive controlled release and has a potential for the application of drug delivery. This is promising drug carrier for the safe loading of CUR and it significantly improves the bioavailability, biocompatibility and biodegradability of the DDS.

**Keywords:** Drug Delivery System; Curcumin, Layered double hydroxide

03-30

**NEW MOLYBDENUM DIOXIDE COMPLEX INCORPORATING N (4) - (3-METHOXYPHENYL) THIOSEMICARBAZONE: SYNTHESIS, CRYSTAL STRUCTURE, OXO TRANSFER PROPERTIES AND CATALYTIC USE IN THE OXIDATION OF STYRENE THROUGH OXIDO - PEROXO MOLYBDENUM INTERMEDIATE**

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**Background:** Catalytic olefin epoxidation in liquid-phase is very outstanding topic in organic synthesis and aqueous



hydrogen peroxide serves as the best terminal oxidant next to dioxygen. Among the various transition metals used as catalysts, molybdenum(VI) compounds containing the *cis*- [MoO<sub>2</sub>]<sup>2+</sup> core have been successfully studied in recent years due to their application in biological and industrial oxidation processes and oxo- transfer reactions. Among the various co-ligands used, O, S based systems *viz.*, thiosemicarbazones have been received considerable attention owing to the essential role played by these atoms in the coordination sphere of molybdenum containing enzymes.

**Method:** This work deals with the synthesis of a new dioxidomolybdenum complex, *viz.*, [MoO<sub>2</sub>L(MeOH)] (where H<sub>2</sub>L= 3 Ethoxy-salicylaldehyde-N(4)- (3-methoxyphenyl) thiosemicarbazone) as catalyst which can be used along with NaHCO<sub>3</sub> as co-catalyst to function as an efficient peroxidicepoxidation catalyst.

**Results:** The single crystals of the synthesized complex were separated and structure of the complex was elucidated using SC-XRD analysis. The complex exhibited a distorted octahedral geometry around molybdenum ion. The structural features were further substantiated by Hirshfeld surface analysis. The OAT studies of the complex resulted in the formation of two oxo-molybdenum complexes. The catalytic activity of the complex was tested for the oxidation of styrene by optimizing the reaction condition. Oxidation yielded two products *viz.*, styrene oxide (major product) and benzaldehyde (minor product).

**Conclusion:** Catalytic study revealed that the synthesized complex has got excellent oxygen atom transfer properties and can function as a good catalyst for the oxidation of styrene *via* oxido-peroxo molybdenum intermediate yielding two oxidation products and selectivity of the two product varies in the order, styrene oxide (98.3 %) > benzaldehyde (1.7 %).

03-31

### SYNTHESIS AND EVALUATION OF PHOTOPHYSICAL PROPERTIES OF AN OXADIAZOLE- PHENOTHIAZINE HYBRID DONOR- ACCEPTOR SYSTEM

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**Background:** Conjugated organic molecules with Donor-Acceptor architecture have been extensively studied due to their potential applications in the field of optoelectronics. 1,3,4-Oxadiazoles are widely employed in optoelectronic devices owing to their high electron deficient nature and thermal stability. Phenothiazines, on the other hand, are known to exhibit high electron donating ability. Herein, we report the synthesis of a linear tetrad *viz.* 2-cyano-3-(4'-(5-(10-octyl-10H-phenothiazin-3-yl)-1,3,4-oxadiazol-2-yl)-[1,1'-biphenyl]-4-yl)acrylic acid. Optical, photophysical and electrochemical properties of the tetrad were examined both experimentally and theoretically.

**Method:** The targeted compound was prepared through a series of reactions *viz.* iodine mediated cyclization, Suzuki coupling and Knoevenagel condensation reaction.

**Results:** The structure of the compound was established on the basis of Mass, IR and NMR spectral data. UV-Vis spectrum of the tetrad exhibited two distinct bands. Band observed in the 290-310 nm range is assigned to localized aromatic  $\pi-\pi^*$  transitions. The less intense longer wavelength band observed in the 320-400 nm range is ascribed to intramolecular charge transfer transitions. Fluorescence quantum yield ( $\phi_f$ ) of the compound determined in DCM is moderately high at 0.48. Electrochemical measurements were carried out in acetonitrile solution using ferrocene as the external standard. Electrochemical HOMO- LUMO energies are -5.61 eV and -2.65 eV respectively. Further DFT calculations were performed to explore the electronic structure and theoretical HOMO-LUMO band gap. The compound showed HOMO orbitals centred on the donor (phenothiazine) and the LUMO on the acceptor group (cyanoacrylic acid group). The theoretical HOMO-LUMO energies are -6.91 eV and -3.68 eV respectively.

**Conclusions:** We have designed and synthesized a conjugated donor-acceptor compound comprising of phenothiazine unit as an electron donor and cyanoacrylic group terminus as an electron acceptor. Structure of the newly synthesized compound was established on the basis analytical and spectral data. The compound was found to be fluorescent and displayed desirable fluorescence quantum yield. Optical band gap obtained from absorption thresholds of the compound is in good agreement with that obtained from DFT calculations.

**Keywords:** 1, 3, 4-oxadiazole, phenothiazine, cyanoacrylic acid, DFT

03-32

### PLANARITY CONTROLS THE ULTRAFAST INTRAMOLECULAR SINGLET FISSION DYNAMICS IN PENTACENE DIMERS

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**Background:** One of the sustainable techniques to meet world power consumption, with reduced manufacturing costs and adequate power conversion efficiency is the design of efficient photovoltaic devices. The third generation solar cell, aimed to improve power conversion efficiency, can be accomplished by singlet fission (SF) process, since it converts high energy photons into two triplet excitons and exceeds the Shockley-Queisser limit. The understanding of the SF mechanism is challenging, influenced by the various factors including, molecular orientation, conformation and energy levels of the chromophores.

**Method:** The influence of planarity of the bridge on intramolecular singlet fission (iSF) dynamics in series of 2,2'-linked bipentacene derivatives has been investigated using femtosecond time resolved spectroscopy and nanosecond laser flash photolysis. Hence we synthesized three dimers having different bridges such as (i) fluorine, planar with rigid, (ii) 2,2',6,6' tetramethyl 1,1'-biphenyl, twisted and (iii) diphenylacetylene, planar with longer conjugation.

**Results:** Transient absorption spectra of these dimers revealed the occurrence of the iSF dynamics by changing the excitation energy and concentration. A large difference of formation of triplet excitons was observed between planar (200 ps) and twisted dimers (12 ns). The ultrafast photoexcitation of planar dimers yields ~200% triplet compared to twisted yielding 20%.

**Conclusions:** Ultrafast investigation of these bridged pentacene dimers revealed that the planarity of bridge controls iSF dynamics and provides new guidelines to design efficient iSF chromophores.

**Keywords:** Intramolecular singlet fission, Pentacene dimers, Femtosecond pump-probe spectroscopy, Nanosecond laser flash photolysis.

03-33

### IRON-LOADED BIOCHAR AS A SUPER CAPACITORS

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**Background:** In this work, we demonstrate a facile fabrication method for the synthesis of Fe loaded biochar/PANI composite by using low-cost banana stem waste. The produced polymer composite shows an enhanced specific capacitance 613 F/g.

**Method:** Characterization study of Fe loaded biochar/PANI composite done by FTIR and the electrical conductivity as well as the electrochemical performance were analyzed using cyclic voltammetry.

**Result:** Functional groups are well characterized by FTIR. Data obtained from electrical conductivity and CV helps to calculate the Cs value of polymer composite (613 F/g).

**Conclusion:** Fe loaded biochar/PANI composite exhibits a good potential for future supercapacitor applications.

**Keywords:** Fe loaded biochar/PANI composite, specific capacitance, supercapacitors

03-34

### BIOSYNTHESIS OF CALCIUM OXIDE NANOPARTICLE AND ITS ANTIBACTERIAL ACTIVITY

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**Background:** Green synthesis of metal oxide nanoparticles offers numerous benefits of ecofriendliness and compatibil-

ity for pharmaceutical and other biomedical applications as they do not use toxic chemicals for the synthesis. Calcium oxide nanoparticles have several applications in catalysis, adsorption, water purification and also as antibacterial agents. **Method:** This work made use of Piper betel leaf extract for the synthesis of nano calcium oxide from calcium nitrate [Ca (NO<sub>3</sub>)<sub>2</sub>·4H<sub>2</sub>O]. The polyols present in the leaf extract acted as capping as well as reducing agents for the synthesis. The precipitate formed in the reaction between calcium nitrate and leaf extract was collected, dried and calcined at 600°C for 3 hours. It was then tested for antibacterial activity towards Staphylococcus aureus and Pseudomonas aeruginosa using agar well diffusion method.

**Results:** The crystalline nature and particle size of calcium oxide nanoparticle was obtained using XRD technique. The average crystallite size was found to be 24.9 nm. SEM image showed that the prepared nanoparticles were spherical in shape. Absorption spectrum of CaO nanoparticle was recorded and  $\lambda_{\text{max}}$  was found to be 262 nm. The band gap energy calculated using Planck's equation was found to be 4.73 eV. It was observed that CaO nanoparticles showed good antibacterial activity at a concentration of 1000µg/ml towards Staphylococcus aureus (13mm) and Pseudomonas aeruginosa (13mm).

**Conclusion:** The present work demonstrates a good method for developing a simple, safe, cost effective and ecofriendly preparation of CaO nanoparticles using an aqueous extract of piper betel. Piper betel leaf extract act as reducing as well as capping agent and proves to be an excellent source for synthesizing nano CaO. XRD and SEM studies confirmed the formation of nano CaO of spherical shape. FTIR analysis reveals that biomolecules with carbonyl, hydroxyl and amine functional groups have the potential for metal ion reduction and for capping the newly formed nanoparticles. Anti bacterial activities were assayed and exhibited good activity against the tested bacterial pathogens. CaO nanoparticles exhibit unique structural and optical properties, so they can be exploited for a variety of biomedical applications such as photodynamic therapy (PDT), photo-thermal therapy (PTT) and synaphic delivery of chemotherapeutic agents.

**Keywords:** Green synthesis, piper betel, calcium oxide nanoparticle, antibacterial activity.

03-35

#### THE CONTROLLED RELEASE STUDY OF THE ANTI-CANCEROUS DRUG 5-FLUOROURACIL FROM MODIFIED NATURAL CLAY

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**Background:** The controlled drug delivery is better than free conventional dosage to reduce the cell toxicity and side effect due to overdosage. Among different kinds of drug delivery systems, the pH stimuli responsive controlled drug delivery system has a special attention because human body exhibit variation in pH along gastro-intestinal tract from the stomach to colon. In this study, the biocompatible natural clay bentonite was modified to attained better pH responsive property for the controlled release of anti-cancerous drug 5-Fluorouracil.

**Method:** Drug delivery system was synthesised by modifying bentonite using 3-aminopropyltriethoxysilane. The encapsulation and *invitro* release study was optimised under wide range of pH from 1.0 to 9.0. The drug delivery system was characterised by FT-IR, XRD, TG/DTA and FE-SEM analysis.

**Results:** Maximum encapsulation of drug was occur at pH 8.0 (90.5%). And the maximum release was found to be at pH 1.2 (70.5%). Release profile follows Korsemeier-Peppas kinetic model with  $n = 0.5866$ , follows non-Fickian diffusion, means the release of drug controlled by both swelling and diffusion.

**Conclusion:** Modified bentonite can be used as a promising drug delivery system to deliver 5-Flurouracil for the treatment of gastric cancer, without leakage of drug in other biological pH conditions.

**Keywords:** Bentonite, Controlled drug delivery, 5-Flurouracil, *In-vitro* release.

03-36

#### A NOVEL ELECTROCHEMICAL SENSOR FOR THE DETERMINATION OF MORPHINE BASED ON THE CONDUCTING POLYMER POLY (CTAB)/GRAPHENE OXIDE NANOCOMPOSITE.

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The electrochemical determination of Morphine (MO) was carried out at a modified glassy carbon electrode via in-situ

electropolymerisation of (Cetyltrimethylammonium bromide) (CTAB) and Graphene Oxide (GO) and it was subsequently characterized by FESEM(EDX), FT-IR. The electrochemical measurements illustrates oxidation of both its tertiary amine and phenolic group occurs at lower potential. A detection limit of 0.36 $\mu$ M with a linear range of 50 nM- 60 $\mu$ M was observed. Good reproducibility, stability and excellent anti-interference to electroactive molecule were demonstrated. A plausible mechanism for the oxidation of phenolic and tertiary amine groups of MO at Poly (CTAB)/GO modified GCE is also suggested.

**Keywords:** Poly (CTAB), GO, Morphine, Surfactant, GCE, DPV, FESEM

03-37

### POST-SYNTHETIC MODIFICATION OF KETONE BASED AROMATIC MICROPOROUS ORGANIC FRAMEWORKS FOR CARBON DIOXIDE CAPTURE

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**Background:** Microporous organic polymers (MOPs) have been intensively exploited as gas sorption materials in material chemistry, since these polymers mimic most of their inorganic counterpart such as zeolites, carbon black etc. Synthetic modification of different functionalities shows the possibility of finely tuned MOPs suitable for carbon dioxide capture.

**Method:** Microporous hypercrosslinked networks **PFBC, PTCPC and PTCPB** were synthesised by Friedel Crafts reaction using FeCl<sub>3</sub> as the catalyst. The post modified materials such as **PFBCA, PTCPCA and PTCPCA** were synthesised by the amination of the above three by using trimethylenediamine.

**Results:** The TG results of polymeric materials shows that all these materials are thermally stable upto about 450 °C. All materials exhibit good surface area. The post modified materials demonstrate high surface area and carbon dioxide capture potential.

**Conclusion:** We have successfully synthesised and post modified the microporous organic materials with good thermal stability and high surface area. The synthesised materials are having good carbon dioxide capture capacity. This method is efficient enough to meet the energy and environmental demands.

**Keywords:** Microporous Organic polymers, post-synthetic modification, carbon dioxide capture

03-38

### ANTIMICROBIAL LEUKOCYTE REMOVAL FILTER BASED ON ELECTROSPUN POLYMER HYBRID FIBRE FUNCTIONALIZED WITH NANOPARTICLES

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**Background:** White Blood Cells (WBC) or leukocytes are considered to be an unwanted component in the blood-transfusion because it has been proven to cause several adverse effects such as reperfusion injury, alloimmunization, leukotropic virus transmission, hemolysis of RBC etc. Therefore, leukodepletion of blood during transfusion is essential to prevent the above-mentioned infections. In addition to that, deactivation and removal of microbial or skin particle-associated contaminants during transfusion is of great challenge. Herein we tried to fabricate multifunctional polymer hybrid filters for the effective removal of leukocytes and microbial contaminants.

**Method:** The antibacterial silver and titania nanoparticles are immobilized to the non-woven electrospun PET fibre via layer-by-layer (LBL) coating method. Further, as-fabricated hybrid filters were subjected for antimicrobial study and the optimized hybrid filters were used for leukodepletion analysis.

**Results:** LBL method resulted in uniform coating of nanoparticles on to the hybrid filter. The synthesized hybrid coating possessed excellent antimicrobial activity against gram-positive and gram-negative bacteria. Sample (T-Ag)<sub>5</sub>@PET showed an antibacterial activity of twenty times compared to that of neat PET sample. Furthermore, the fabricated hybrid filter exhibited ~97% leukocyte removal efficiency.

**Conclusion:** Herein, we developed an efficient antimicrobial multilayer titania/silver hybrid filter, which could be a

promising candidate as both leukocyte and microbial filter in blood transfusion.

**Keywords:** Non-woven Electrospunfibre, LBL, TiO<sub>2</sub>, Silver nanoparticles, Antimicrobial, Leukocyte removal

03-39

### DNA CONDENSATION THROUGH ORDERED ASSEMBLY OF FULLERENE AMPHIPHILE

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**Background:** The long DNA strands can be folded to make tiny, compact structures using various cationic species such as histone protein, metal ions, polyamines etc. Different DNA nanostructures with unique morphologies can be achieved through this process and is termed as DNA condensation. Incorporation of self-assembling, functional materials to the DNA condensates open up new avenues in DNA architectonics. Here, the ordered assembly of amphiphilic fullerene is achieved through the non-covalent interaction of DNA and an amphiphilic, pyridinium appended fullerene derivative (FPy<sup>+</sup>).

**Method:** This work exploits the condensation of plasmid and lambda DNA with an amphiphilic pyridinium appended fullerene derivative (FPy<sup>+</sup>) in 10% DMSO-phosphate buffer solution. Preliminary DNA condensation studies were carried out with UV-visible absorption spectroscopy and further morphological studies were conducted through AFM and TEM analysis.

**Results:** UV-visible absorption studies of FPy<sup>+</sup> with increasing concentration of DNA show hypochromism at 260 nm, which is a clear evidence for the DNA condensation in presence of FPy<sup>+</sup>. The formation of micrometer sized nanosheets were observed by AFM analysis and is further confirmed through TEM analysis. SAED pattern obtained from TEM analysis provides further information about the crystallinity of the nanosheet and is attributed to the ordered assembly of fullerene in the resultant nanostructure.

**Conclusions:** This work explores the utilization of DNA in the ordered assembly of amphiphilic fullerene derivative with consequent DNA condensation.

**Keywords:** DNA condensation, Fullerene Amphiphiles, Self-assembly, AFM, TEM

03-40

### CONVENIENT SYNTHESIS OF PYRIDINE AND PYRIMIDINE DERIVATIVES USING PORPHYRIN CORED G1 PAMAM DENDRIMER AS HOMOGENEOUS CATALYST

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Multicomponent reactions (MCRs) occupy an outstanding position in organic and medicinal chemistry for their high degree of atom economy, applications in combinatorial chemistry, and diversity-oriented synthesis. The venerable Biginelli reaction and Hantzsch reactions are, one-pot cyclocondensation of aldehyde, 1,3-ketoester, and nitrogen source, was inarguably two most useful MCRs. Polyfunctionalized dihydropyrimidines and pyridines represent the heterocyclic system of remarkable pharmacological efficiency. Notably, monastrol is the only cell-permeable molecule currently known to specifically inhibit mitotic kinesin Eg5 and is considered a lead for the development of new anticancer drugs. In this work porphyrin cored G1 POR-PAMAM dendrimer based simple, mild, and selective homogeneous base catalyst was successfully synthesized. It was characterized by different spectral studies including UV-Vis, IR, <sup>1</sup>H, <sup>13</sup>C NMR and GPC. The G1 POR-PAMAM was very active and efficient organocatalyst capable of promoting chemical reactions in an environmentally friendly way with high efficiency. The product selective property of G1 POR-PAMAM was mainly studied in Biginelli and Hantzsch pyridine synthesis reactions. It was a convenient, green and efficient procedure for the selective synthesis of 1,4-dihydropyridine, and 3,4-dihydropyrimidin-2(1H)-one derivatives using the three-component coupling reaction of aldehydes, ethylacetoacetate and ammonium thiocyanate. The G1 POR-PAMAM catalyst acts as a chemical switch for the selective synthesis of pyridine and pyrimidine. A variety of these compounds were produced in single step by the use of different starting materials including Nifedipine and Nitredipine. The products were obtained in high yield and within 45 minutes. The catalyst can be reused upto six reaction cycles without significant loss of its catalytic activity.

**Keywords:** Product selective catalyst, Biginelli reaction, Hantzsch reaction, Porphyrin cored PAMAM dendrimer, Homogeneous catalysis

03-41

### A NOVEL NEUROTRANSMITTER SENSOR BASED ON METAL DOPED GRAPHENE- CHITOSAN COMPOSITE

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Graphene a single layer of carbon atoms arranged in a hexagonal honeycombed network is the fundamental building block of all graphitic materials. The novel properties associated with graphene offer many advantages for electrochemical applications. The present work aims at preparing graphene copper chitosan composite for the voltametric determination of the most prominent catechol amine dopamine. Graphite oxide (GO) was prepared by modified Hummers method. GO and CuSO<sub>4</sub>·5H<sub>2</sub>O were brought into an aqueous solution, to this chitosan was added which was refluxed and subsequently reduced to obtain the required graphene–copper composite. The composite was characterized structurally and morphologically by XRD, SEM and it was used for modifying a glassy carbon electrode. The modified electrode was used for sensing dopamine by CV and DPV. The influence of scan rate and pH on the performance of glassy carbon electrode was evaluated. The fabricated electrode was also evaluated for the simultaneous determination of dopamine in presence of uric acid. This electrochemical sensor was found to be most sensitive and reliable at the physiological pH 7.

**Keywords:** Graphene-Copper composite, electrochemical sensor, Dopamine

03-42

### CRYSTAL STRUCTURE AND SUPRAMOLECULAR INTERACTIONS IN NITRATE COMPLEXES OF SM(III) AND CE(III) WITH 5,5'-DIMETHYL 2,2'-BIPYRIDINE.

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**Background:** Structural studies and investigation of supramolecular chemistry of f-block complexes continue to be an active area of research. Research interest on 5,5'-dimethyl 2,2'-bipyridine containing complexes has been increased within a few years. It is mainly because of the presence of extended  $\pi$ -systems and bidentate chelating ability which have been used in designing complexes to mimic the non-covalent interactions in biological processes. Many of the bipyridine based complexes also show luminescence property. 5,5'-dimethyl 2,2'-bipyridine molecule and its protonated species constitute an important aspect in the understanding of the properties of this ligand in coordination chemistry.

**Method:** Slow evaporation method has been adopted for the synthesis of single crystals of the complexes. Nitrate salts of corresponding metals (of Sm(NO<sub>3</sub>)<sub>3</sub>·6H<sub>2</sub>O for complex **1** and Ce(NO<sub>3</sub>)<sub>3</sub>·6H<sub>2</sub>O for complex **2**), 5,5'-dimethyl 2,2'-bipyridine and methanol are used. Intensity data sets for complex **1** and **2** were collected on a Bruker Smart X2S benchtop diffractometer. Structure was solved by SHELXS97 and refined by SHELXL14.

**Results:** The asymmetric unit of complexes, [Sm(NO<sub>3</sub>)<sub>3</sub>]<sub>0.5</sub>(2H-DPY)<sub>0.5</sub>(1H-DPY) (complex **1**) and [Ce(NO<sub>3</sub>)<sub>3</sub>]<sub>0.5</sub>(2H-DPY)<sub>0.5</sub>(1H-DPY) (Complex **2**) contains one half of metal hexanitrate unit, a half of diprotonated 5,5'-dimethyl 2,2'-bipyridine (2H-DPY) and a molecule of monoprotonated 5,5'-dimethyl 2,2'-bipyridine (1H-DPY). From the values of bond length and bond angle protonation of nitrogen atom in the ligands are confirmed if any. These two complexes show similar non covalent interactions like N-H...O, N-H...N and C-H...O hydrogen bond and  $\pi$ ... $\pi$  interactions forming three dimensional supramolecular architectures.

**Conclusions:** Isomorphous complexes of two lanthanide complexes were synthesised. Crystal structure and supramolecular interactions of complexes **1** and **2** are studied. From the studies, it is clear that, the conformations of DPY and its protonated species constitute some important aspects in the understanding of the properties of this ligand in coordination chemistry.

**Keywords:** Supramolecular interactions, asymmetric unit, isomorphous

03-43

### SILVER BASED NANOHYBRID AS AN EFFICIENT ELECTROCHEMICAL SENSOR AND PHOTOCATALYST

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**Background:** Different nanohybrids are reported either as a good electrochemical sensor or as an efficient photocatalyst. Very few nanohybrids are only reported as having both electrochemical and photocatalytic activity. So here we develop a simple silver based ternary nanohybrid as a good electrochemical sensor and an efficient photocatalyst.

**Method:** The developed ternary nanohybrid can be used as a wonderful electrochemical sensor for determining the minute concentrations of different toxic organic pollutants, especially the phenolic isomers such as hydroquinone, catechol and quinone. Also it is an efficient photocatalyst for the degradation studies of different toxic organic dyes.

**Results:** By using the voltammetric analysis, very minute concentrations of the toxic phenolic isomers can be effectively detected with this ternary nanohybrid. The simultaneous detection of these phenolic isomers can be easily analyzed using this sensor. The better degradation of different organic dyes such as methylene blue and pesticides such as methyl viologen can be easily done with this ternary sensor.

**Conclusions:** The development of this silver based nanohybrid is via a simple heating method and the presence of Fe<sub>3</sub>O<sub>4</sub> nano rods provides magnetic separation of the hybrid. A high limit of detection is obtained for the phenolic isomers with this electrochemical sensor. Better photodegradation occurs for dyes such as methylene blue and pesticides such as methyl viologen.

**Keywords:** Nanohybrid, Voltammetric sensor, Pesticides, Electrochemical sensor, Photocatalyst

03-44

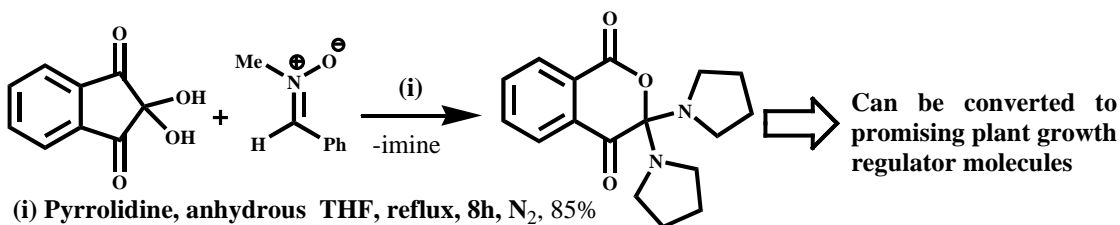
### SYNTHESIS OF NOVEL ISOCHROMANS – PROMISING MOLECULES TO SHOW PLANT GROWTH REGULATING PROPERTIES

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**Background:** Sustainable landscaping includes maintenance of the flora in such a way that a proper balance between the various species is assured. In this context, plant growth regulators or “plant hormones” form an important class of molecules responsible for the growth and development of a plant. Apart from natural molecules such as auxins, gibberellins, cytokinins and abscisic acid, several synthetic plant growth regulators have also been developed in order to maintain healthy ecosystems. These synthetic molecules include benzopyrans such as isocoumarins, isochromans, flavanoids, chromones etc. For instance sclerin and sclerotinin are known to promote seed germination and shoot elongation of moong bean, rice and other plants.

**Method:** In the present study we have synthesized a series of novel isochroman derivatives by a one-pot reaction of ninhydrin, secondary amines and nitrones. The scheme below shows a representative reaction (compounds confirmed by NMR, IR and Mass spectroscopy)



**Results:** The synthesized molecules show appreciable fluorescent properties and are amenable to be transformed to isochromans which may exhibit plant growth regulating properties. The current reaction also opens a new chemistry as it portrays a novel reactivity for nitrones which act as an oxygen atom donor and gets expelled off as the imine after

the reaction.

**Conclusions:** The generality of the reaction has been proved using various secondary amines. The details of this novel chemistry and the photophysical properties of the isochromans will be presented.

**Keywords:** Plant hormones, isocoumarins, isochromans, ninhydrin, secondary amines and nitrones

03-45

### HPTLC QUANTIFICATION OF A NEUROTOXIC ACETOGENIN ANNONACIN IN DIFFERENT PARTS OF *ANNONA MURICATA*

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**Background:** The genus *Annona* are a potential group of plants explored for their edible fruits and also used in different herbal preparations. *Annona* species are rich source of structurally diverse acetogenins which possess several biological properties. Among the *Annona* species grown in south India, *A. muricata* is reported to show promising anticancer activities. The present study reports the distribution and quantification of annonacin, a neurotoxic acetogenin, from *A. muricata* seeds, by HPTLC method. Also, the antioxidant properties of the plant parts are discussed.

**Methods:** The marker compound annonacin was isolated by column chromatography of *n*-hexane extract of seeds of *A. muricata*. The structure of the isolated compound was confirmed by <sup>1</sup>H, <sup>13</sup>C NMR, mass spectral analysis and comparison with literature. Different parts of *A. muricata* were extracted by Soxhlet extraction and the content of annonacin were estimated by HPTLC (Camag HPTLC, Switzerland). Antioxidant properties of the extracts were evaluated by DPPH assay.

**Results:** HPTLC quantification revealed that *A. muricata* seeds contain maximum amount of annonacin (54.35 µg/g) while, annonacin content was least in bark (40.11 µg/g). Antioxidant analysis revealed lower ability to scavenge DPPH radicals (IC<sub>50</sub> value 88.01 µg to 24.55 µg) and the result is in corroboration with low range of phenolic content (< 48.5 mg/g GAE).

**Conclusions:** The study revealed *A. muricata* as rich source of a mono-THF acetogenin annonacin and it was confirmed that the seeds contain high amount of annonacin. The plant possesses low phenolic content and also low antioxidant activity. This is the first report of the comparative phytochemical profiling of different parts of *A. muricata*.

**Keywords:** *Annona muricata*, annonacin, HPTLC, antioxidant properties

03-46

### FLUORESCENCE TURN ON SENSOR FOR CARBOFURAN BASED ON GRAPHENE QUANTUM DOT- MANGOSTEEN INTERACTIONS

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**Background:** The extensive use of pesticides may cause the environment pollution and thereby adversely affect the human life. So the development of detection protocols for pesticides is a challenging issue. In this context we are utilising natural resources derived platform for the detection purpose. We developed mangostin based analytical system for the detection of pesticides

**Methods:**  $\alpha$ -mangostin was isolated from the pericarp of the mangosteen fruit and purified by column chromatography and characterised by different techniques. Graphene Quantum Dots (GQDs) are synthesised from honey via emulsion template method.

**Results:** The fluorescence intensity of GQDs is quenched by  $\alpha$ -mangostin which was regained by the addition of the pesticide carbofuran. This off-on system was exploited for the construction of molecular logic gate.

**Conclusion:** An analytical platform based on  $\alpha$ -mangostin – GQDs system (both derived from natural resources) was developed for the detection of the pesticide carbofuran. Based on this system we have designed a molecular logic gate.



**Keywords:**  $\alpha$ -mangostin, Graphene Quantum Dots, Fluorescence Quenching, Carbofuran, Logic Gate

03-47

### ENHANCED FLUORESCENCE USING HOST-GUEST FORMATION ON SOLID SURFACES

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**Background:** Fluorescence (FL) based detection techniques are increasingly captivating the attention with its well-known advantages such as simplicity, high sensitivity, selectivity, cost-effectiveness and is one of the most widely used techniques for environmental monitoring, disease diagnosis and genomic/proteomic research. Currently, many efforts focus to improve its performance by amplifying the fluorescent signal for obtaining higher sensitivity and lower limit of detection. Herein, Fluorescence (FL) enhancement has been achieved by the synergistic effect of colloidal photonic crystal (PC) and a macrocyclic container molecule, cucurbituril (CB).

**Method:** Polystyrene (PS) colloidal PCs were made by colloidal self assembly method. FL intensity of rhodamine B (RhB) was amplified by making an inclusion complex with cucurbit[7]uril (CB7) and was infiltrated into three dimensional colloidal PC for further FL enhancement.

**Results:** PS colloidal PCs were fabricated by evaporation induced vertical deposition method onto a hydrophilic glass substrate. FL enhancement of RhB were examined by infiltrating the dye solution into the voids of the colloidal PCs. FL enhancement factor (EF) is found to be 21.9 $\pm$ 1.7, 23.2 $\pm$ 6.5 and 32.6 $\pm$ 7 for violet, green and orange PCs respectively. FL of RhB was amplified by making host-guest complexes with CB7. Further FL enhancement of CB7-RhB host guest complex was studied on violet, green and orange colloidal PCs. We obtained a highest FL EF value of 190 $\pm$ 0.3 on orange PC, which is due to the enhanced light-matter interactions by the localized density of states (LDOS) in the solid phase.

**Conclusion:** We successfully demonstrated that FL intensity can be amplified significantly by the synergistic effect of PC and CB7. This novel approach can be extended into highly sensitive fluorescence based detections such as chemical/biochemical sensing.

**Keywords:** Photonic crystal, Cucurbituril, Fluorescence enhancement

03-48

### WASTE HEAT TO ENERGY: THIOPHENE BASED SEMICONDUCTING OLIGOMERS FOR THERMOELECTRIC APPLICATIONS

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**Background:** Over the years, the development of thermoelectric materials as a means of harvesting electricity from waste heat is continuously progressing. The power conversion efficiency of any thermoelectric (TE) material is related to its figure of merit,  $ZT = \alpha^2 \sigma T / \kappa$ , where  $\alpha$ ,  $\sigma$ ,  $T$  and  $\kappa$  are Seebeck coefficient, electrical conductivity, absolute temperature and thermal conductivity respectively. Hence, a small  $\kappa$  in organic materials is therefore an advantage to obtain high  $ZT$ . The advantages of organic semiconducting materials over the inorganic ones apart from the lower thermal conductivity includes abundance of resources, ease of production, flexibility and the potential in large area production. In addition to conducting and semiconducting polymers, organic small molecules are of keen interest over the recent years.

**Method:** In this work, we have synthesized two acceptor-donor-acceptor (A-D-A) type thiophene oligomers which are flanked by dioctyl terthiophenes on either side and an acceptor *N*-ethyl dicyanorhodanine (**OT1**) or *N*-octyl rhodanine (**OT2**). We have extensively explored the thermoelectric properties of the oligothiophene derivatives.

**Results:** Giant Seebeck effect was observed in both the small molecule based organic semiconductors. The magnitude of  $\alpha$  intensely varied from 1-22 mV/K by doping with transition metal salts like ferric chloride.

**Conclusions:** This work establishes the effect of transition metal salt dopants on the oligothiophene derivatives and its upshot on the thermoelectric performance.

**Keywords:** Thermoelectric material, Giant Seebeck effect, thiophene oligomers

03-49

### THERMALLY INDUCED DYNAMIC SWITCHING OF SOLID-STATE LUMINESCENCE FOR SMART OPTOELECTRONIC DEVICE APPLICATIONS

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**Background:** Stimuli responsive organic solid-state fluorescent materials attract increasing interest in both fundamental and technological applications. Reversible switching of solid-state fluorescence with high contrast and reproducibility is a challenging task but important for several optoelectronic applications. One promising approach towards this end is to control the mode of solid-state packing of luminescent organic chromophores with an external stimulus. The attachment of flexible alkyl chain to a functional chromophore has a significant impact on the solid-state fluorescence.

**Method:** In this work, we have designed and synthesized a series of benzoxazole derivatives with different length of alkyl chains (R= **DMBO**: CH<sub>3</sub>, **DHBO**: C<sub>6</sub>H<sub>13</sub>, **DBBO**: C<sub>12</sub>H<sub>25</sub>, **DOdBO**: C<sub>18</sub>H<sub>37</sub>) and their fluorescence properties were extensively investigated.

**Results:** Thermally induced high contrast switching of solid state luminescence were observed for all of them except in the case of **DMBO**. Interestingly, the spectral shift towards heat stimuli and the measured colour transition temperatures of the four oligomers are different and have dependence on the alkyl chain length. DSC and XRD analyses further confirmed that heating of these oligomers results in a phase transformation between two states having different molecular packing modes.

**Conclusions:** These findings reveal the structure-property relationship of thermochromic materials that would benefit the development of luminescent thermochromic solids.

**Keywords:** Solid-state fluorescence, Thermochromic materials, Benzoxazole

03-50

### YELLOW PHASE $\delta$ -FAPbI<sub>3</sub> NANORODS – AN INSIGNIFICANT MATERIAL RENOVATES INTO VALUABLE RESISTIVE SWITCHING MEMORY DEVICE

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**Background:** Resistive random access memory (ReRAM) emerge as a promising candidate for the next-generation optoelectronic devices due to its smaller size, simple device architecture, minimum power consumption, low switching voltage, scalability, high operation speed (ns), long data retention, endurance and low-cost fabrication. Recently, organic-inorganic perovskite materials are found to be potential candidates for resistive random access memory devices due to their low switching voltage and high On-Off ratio.

**Method:** The phase pure hexagonal  $\delta$ -FAPbI<sub>3</sub> nanorods (NRs) were prepared via self-assembling of individual nanocrystals for memory device applications. The dielectric  $\delta$ -FAPbI<sub>3</sub> NRs dispersed in toluene was probe sonicated for 30 minutes and spin coated on the FTO glass plate to get uniform and smooth film with the thickness of around 200 nm. After drying the film under ambient condition, 200 nm thick aluminium was thermally evaporated on the NRs layer using a shadow mask, to form FTO/NRs/Al devices.

**Results:** The devices showed better switching voltage, endurance and retention properties with greater ON/OFF ratio of 10<sup>5</sup>. These 1D hexagonal nanorods are more stable compared to other PNCs due to their face sharing octahedras and hence the devices showed long-term stability.

**Conclusions:** The performance of the  $\delta$ -FAPbI<sub>3</sub> NRs based devices were found to be better compared to other PNCs based memory devices in many ways. The electronic properties of the current devices could be further improved by modifying the device structure.

**Keywords:** Hybrid perovskites, Nanocrystals, Nonvolatile memory, Resistive switchin

## 04 - EARTH & PLANETARY SCIENCES

04-01

### CRUSTAL STRUCTURE ACROSS AND ALONG THE WESTERN GHATS: INSIGHTS FROM PS CONVERTED PHASES

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**Background:** The Western Ghats (WG) is one of the great escarpments that extends ~1500 km parallel to the west coast of India in the NNW-SSE direction, with an average elevation of ~1.2 km. It is a mosaic of disparate geological formations of diverse structural and physical characteristics. Generally, geological processes like upliftment, erosion, sedimentation, have an expression within the Earth's interior from the shallow subsurface to the deeper parts. In this context; we decipher the crustal structure along and across the WG to shed light on its evolution processes.

**Method:** In the present study, three component teleseismic waveform data recorded at 27 broadband seismological stations are analysed to investigate the crustal structure in terms of crustal thickness and Poisson's ratio along and across the Western Ghats through application of slant stacking (H-K) and common conversion point (CCP) imaging to the converted phases (Ps) isolated by receiver functions.

**Results and Conclusion:** The receiver functions computed at 27 broadband seismological stations spread along and across the WG yield important results on the crustal structure beneath each station. The variation in the arrival times of the first positive conversions from ~4.5 s to 5.5 s indicate undulations in the Moho. Further, the variation in crustal thickness along and across the WG from 33 km to 46.8 km is ascertained by H-K analysis and CCP images. The images of the crust along two profiles parallel to the WG reveal a central high (~12°N to 16°N) with a crustal thickness of ~42 km, that decreases to ~36 km towards both the southern and northern parts. These results are in conformity with the geological units covering the WG. Further, a clear step-like variation is observed across the WG, with a sudden jump in the Moho depth from ~39 km to ~44 km. We could clearly discriminate the Archean-Proterozoic Granulites and the Archean-Proterozoic Peninsular Gneiss. The obtained results do not favour a thick crust beneath the WG, lithospheric/crustal thinning and/or magmatic underplating models. The results from the present study support the rifting model proposed for the west coast of India. A strong negative phase just after the Moho is observed in the RF images, which could be due to the existence of a low velocity layer (LVL) below the Moho. The LVL(s) at such depths could be attributed to the different rifting episodes experienced by the west coast of India and gain support from the strong and consistent negative isostatic anomalies over the WG.

**Keywords:** Western Ghats, Receiver Functions, Moho, LVL and Rifting.

04-02

### SUBMERGENCE OF MUNROE ISLAND: QUANTIFIABLE INSIGHTS FROM SATELLITE BASED DINSAR TIME SERIES

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**Background:** Munroe Island – an estuarine island within the Ashtamudi Lake in the southwest coast of India has long been under menace of submergence due to flooding. Multitudes of notions have been attributed to this phenomenon, like loss of sediment input from the Kallad River, tidal flooding and self-weight consolidation of the buildings, etc. Speculation *in vogue* also advocates displacements due to neo-tectonic activity. Foremost perception of flooding with minimal/scattered field observations attribute the events to tidal inundation, though the residents always lived under the fear that the island is sinking (subsiding) mainly because of the settlements and structures put up on the land with subsurface sediments rich in carbonaceous clayey substratum. A review into the word of mouth hypotheses on the subsidence of island do lack credibility due to paucity of scientific information to substantiate. In this context, the recent advancements in microwave DInSAR time series analysis technique - Persistent Scatterers Interferometry (PSI) - is applied with the sole objective to identify surface displacement in the island.

**Method:** The DInSAR time series technique takes advantage of the variation in “phase” of the Radar pulse backscattered from the scattering target over time. The satellite radar measures the phase of the microwave signal backscattered

from the target during consequent acquisitions and any change in phase is attributed to the displacement of the target after the removal of the phase variation induced by the change in earth topography. In this study, the line of sight displacement of the permanent scatterers in the estuarine island were estimated using the Sentinel 1A SLC datasets acquired during February 2015 upto September 2018. The persistent scatterer Interferometry (PS InSAR) technique is used to process the time series stack of 83 datasets by constructing differential interferograms assuming a single master. The selection of the persistent scatterers depends on the coherence threshold (0.6) and the amplitude stability index (0.6) during Atmospheric Phase screening which accounts for the variation in the amplitude of the pixel due to atmospheric influence. The Line of sight displacement with respect to the satellite for the resultant persistent scatterer points is quantified to assess the magnitude of surface deformation over the island region.

**Results:** Line of Sight displacement at selected locations within and around the island shows deviation between the points selected as stable and unstable. The points categorized under stable do display certain minor deformation trends between +5 mm to -5 mm per year which invariably is due to the compaction properties of the subsurface sediment built-up of Quarternary to Recent formation forming the island. The unstable points indicate accelerated displacement of the order of 20 mm/year. This classical categorization of the scattering points negates the claim of the island's subsidence whereas the buildings/hard structures constructed on the unconsolidated sedimentary surface obviously undergo deformation, the process termed as self – weight consolidation.

**Conclusion:** Satellite remote sensing provided an unblemished picture on the present situation of the island. The outcomes have clearly distinguished the possibilities for perceptible sinking of the buildings in addition to answering the question of subsidence. This has augmented the scope for further research to revisit the issue of submergence. Further research is mooted to quantify for the variable displacement by 3D settlement modelling collocated with tide induced flood modelling for the island.

**Keywords:** Microwave Remote Sensing, Synthetic Aperture Radar, Single Look Complex, Persistent Scatterers, Submergence

04-03

#### INTENSIFICATION OF SOUTHWEST MONSOON OVER KERALA IN 2018: QUANTIFICATION AND MECHANISMS

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**Background:** Heavy rainfall over a small area in a short span of time can lead to flood. Studies related to extreme precipitation events are essential for the prediction as well as mitigation purpose. Recently, Kerala visualized a high amount of rainfall in south-west monsoon which results in the filling of dams from its extreme capacity. A heavy rainfall from 14 August 2018 to 17 August 2018 made a drastic situation to drain all dams. In this study, we investigated the possible mechanism that drove to heavy precipitation and quantified the amount of rainfall distributed over the entire state. Rainfall over an area can be influenced by many factors but we are focusing some of the possible situations which might have helped the intensification of rain in the month of August 2018.

**Method:** INSAT 3D L3B Hydro estimator data with a temporal resolution of one day and spatial resolution of 4 km at nadir is used for analysis (<https://www.mosdac.gov.in/>). Cumulative precipitation for four days is estimated. For U-wind and V-wind NCEP/NCAR Reanalysis 1 Pressure data with a special resolution of  $2.5^{\circ} \times 2.5^{\circ}$  is used for analysis (<https://www.esrl.noaa.gov/psd/>). NINO 3.4 Index is used to analyse the presence of ENSO. Indian Ocean Dipole Index based on INCOSIS-GODAS SST analysis and monthly climatology OISST constructed using 1981-2010 data is used to study the Indian Ocean Dipole (IOD). NOAA Interpolated Outgoing Longwave Radiation (OLR) is used to analyse convections over the Indian Ocean region (<https://www.esrl.noaa.gov/psd/>).

**Results:** Thrissur, Ernakulam, Idukki, and Pathanamthitta districts showed high intensity in rain from 14th -17th August 2018. Isolated places of Malappuram, Wayanad and Trivandrum also showed heavy showers. In 2018, the monsoon months showed a positive dipole in which the onset season had an exceptional value. But all other months showed high positive dipole which is favourable for the Indian Summer Monsoon Rainfall. The intense convection over the Bay of Bengal acts as a heat source that leads to an increase in westerly winds in the Arabian Sea, with a lag of about 3 days.

**Conclusions:** The study concluded that Thrissur, Ernakulam, Idukki, and Pathanamthitta districts of Kerala received heavy rainfall during 14th to 17th of August 2018 with isolated places of heavy rainfall in Wayanad and Trivandrum. ENSO and IOD during the study period showed a favourable condition for normal monsoon rainfall. It was found that the magnitude of wind over the Kerala region was too high and this higher westerly winds increased the advection of moist air into the Indian landmass, which caused heavy rainfall over Kerala. Depression which formed over the Odisha

coast also contributed to the intensification of wind speed in west coast resulting in excess rainfall.

**Keywords:** Precipitation, ENSO, Indian Ocean Dipole, Convection, Low-Pressure System.

04-04

#### GROUNDWATER-SEAWATER INTERACTION ALONG THIRUVANANTHAPURAM COAST, KERALA

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**Background:** In a steady state condition, freshwater-saltwater interface (transition zone) in the coastal aquifer is stationary which indicates a dynamic equilibrium between the fluids due to their density difference. Due to increased sea level rise, tidal fluctuation, over exploitation of groundwater and modification of hydrological cycle, the shape, size and position of the transition zone will migrate towards inland. The present study investigates two main processes such as submarine groundwater discharge (SGD) and seawater intrusion (SWI) that control the coastal groundwater dynamics.

**Method:** Based on the literature and archival data available with CGWB and State groundwater department, well locations were selected for regular monitoring. Groundwater investigations were carried out in the coastal aquifers of Thiruvananthapuram District in Kerala through hydrogeological surveys. The depth to water table was measured in wells, after taking GPS locations. 90 samples were collected and analyzed in the laboratory to check water quality. Radon (Rn-222) values were obtained from the pore-water/well water samples of locations.

**Results:** Majority of the wells in the area have less supply of fresh water in the summer season and good supply in the post monsoon season. Most of the groundwater samples in the study area shows acidic trend in nature. The wells trapped in the coastal alluvium aquifer show salinity problem due to the encroachment of seawater in the pre-monsoon period. Majority of the groundwater samples are CaCl type. From the different radon-salinity observations, radon concentrations high in the inland wells and lower in the porewater samples.

**Conclusions:** The current work provides strong evidences to select the significant locations for advance studies in SGD and SWI. It was evident that decrease in freshwater discharge in the pre-monsoon was the most sensitive parameter causing saltwater intrusion. The SGD and SWI zones were mapped based on the dynamism prevailed in 2017-2018.

**Keywords:** Coastal Aquifer, Freshwater-Saltwater Interface, Submarine Groundwater Discharge, Seawater Intrusion

04-05

#### ROLE OF CHANGING DYNAMIC PARAMETERS IN CONTROLLING THE EXTREME EVENTS OVER PENINSULAR INDIA IN THE RECENT DECADES

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**Background:** As part of the global climate change, extreme events are increasing in weather pattern over the tropical region also. The signals of climate change have already visible in the synoptic events like Indian summer monsoon itself. Scientists have already reported the changes happened to the Findlater Jet in the recent decades over the Indian subcontinent. Recent events like Chennai rainfall 2016 and Kerala rainfall during 2018 are some of the examples to show that how divergence fields at the lower and upper levels of the atmosphere will become a potential danger to lead extreme spells.

**Method:** During the advent of an abnormal event, the divergence field at the surface levels and the upper levels are in a favourable condition to support large scale convection vertically. Increasing air temperature gives enormous opportunity for the atmosphere to hold and dissipate large amount of water in a small time scale itself. Thus atmosphere is supporting extreme spells which may reach upto 30 to 40 cm in a day itself and causes severe consequences.

**Results:** The standard Pet test reveals that a change in the rainfall pattern over Kerala during the southwest monsoon has happened from 1960 onwards. These changes are having a direct link to the changes occurred in the global oceans during these periods. As part of the global green house impact, the atmospheric temperature has increased about 0.9 °C over the study region in the last six decades itself and which allows the atmosphere to hold more water vapour in the recent decades. An effective mechanism of lifting all these moisture to the upper levels especially during a monsoon depression will give extreme rainfall pattern over the region. Even though generally a decrease in strength of Findlater Jet eventually reduced monsoon rainfall activity over the peninsular India in the recent decades, invariably it helped

another way to trigger more localised convective activity over the region in the presence of some meso-scale phenomena like monsoon depression and offshore vortex etc. There by atmosphere will work as a moisture siphon during these events and initiate the available water vapour to precipitate over the region within a period of 24 hours itself. This has resulted to create extreme precipitation anomaly over the study region in the recent years.

**Conclusions:** The global climate changes are showing its signals not only in the lower levels but also in the upper levels of the atmosphere in the recent years. The divergence field associated with wind systems over the upper and lower levels as well as an increased storage of moisture at various levels of atmosphere is invariably becoming a potential threat to create extreme precipitation anomaly over the study region.

**Keywords:** Findlater jet, Divergence field, Pet test, Moisture siphon

04-06

### MAJOR ION CONCENTRATION IN THE GROUNDWATER SOURCES OF BHAVANI RIVER BASIN (KERALA) - ITS IMPLICATIONS ON SILICATE WEATHERING

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**Background:** Groundwater is one of the most exploited fresh water resources that sustains life on earth. The quality of groundwater deteriorating year after year and is a major concern all over the world, and India is not an exception. This is mainly attributed to limited recharge processes and effluent discharges in the critical zone due to human intervention and climate change. For an effective management of groundwater resource it is important to identify the drivers of changes in the quality of groundwater system. In the present study we examine the hydro-chemical attributes of one of the important east flowing rivers of Kerala - the Bhavani river, which is not hitherto been well studied.

**Method:** Thirty-seven well water samples were collected and analysed for various physicochemical parameters. The parameters like pH, EC, TDS and DO were estimated *in situ* using a portable water quality analyser and other physico-chemical parameters were analysed in lab following standard methods. The chemical parameters are compared with that in the rain and river water samples in order to address their level variabilities in the groundwater. Correlation existing among the major ions was determined using the XLstat and other statistical procedures.

**Results:** The geochemical analysis shows that groundwater is slightly alkaline. About 76% of water samples show fresh water character while the remaining are brackish due to high solute contents. Water samples in the study area are moderately hard to very hard. The samples exhibit low sodium hazard properties. The parameters are compared with the WHO standard and most of the samples are good for the domestic uses. The concentration of ions in the water samples are of order of  $Ca > Na > Mg > K$  for cations and  $HCO_3 > Cl > SO_4$  for anions. Hill-piper diagram was prepared to understand the geochemical relationship existing among the groundwater samples and it is inferred that majority of the water samples are Ca-HCO<sub>3</sub> type. The ionic concentrations are low in the upper catchments of Bhavani river basin than the lower counterparts. Scatter diagrams of Ca+Mg vs HCO<sub>3</sub>, Ca+Mg vs HCO<sub>3</sub>+SO<sub>4</sub>, Na+K vs total cations, Na vs Cl, and Na-Cl vs Ca + Mg-HCO<sub>3</sub>-SO<sub>4</sub> and also the chloro alkaline indices were attempted to unravel the role of silicate weathering in solute dynamics in the groundwater regime. It is inferred that the silicate weathering and reverse ion exchange are major processes responsible for the observed ionic proportions in the groundwater sources of the Bhavani basin.

**Conclusions:** Rock water interaction during percolation and movement of water through the critical zone is responsible for the observed solute loading in the groundwater sources of the study area. The groundwater in the Bhavani river basin is generally good for both irrigation and domestic uses. Silicate weathering and reverse ion exchange are major processes that attribute the observed ionic concentrations in the groundwater resource of the Bhavani river basin in Kerala.

**Keywords:** Groundwater, Bhavani river basin, Hydrochemical Characteristics, Silicate weathering.

04-07

### HYDROBIOLOGICAL CHARACTERISTICS AND COMMUNITY STRUCTURE OF MICROPHYTOPLANKTON ALONG THE SOUTH EASTERN ARABIAN SEA DURING EARLY SUMMER MONSOON

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**Background:** The South Eastern Arabian Sea (SEAS) is one of the most productive regions of the world ocean, is influenced by coastal upwelling mainly during the summer monsoon period. The summer monsoon upwelling positively influences the phytoplankton production which can directly or indirectly influence the trophic structure and biological productivity of SEAS.

**Method:** The data presented in this study has been obtained from field observations made onboard research vessel FORV Sagar Sampada during the summer monsoon season along the coastal and open ocean regions of South Eastern Arabian sea (SEAS). Samplings were carried out from Thiruvananthapuram in the south (8°N) to Goa (15°N) which is the northern limit of SEAS.

**Results:** Based on the analysis of various physico-chemical parameters along the study area, upwelling was well evident along the southern region which decreased further north. The coastal waters of Thiruvananthapuram had high chlorophyll *a* concentration (10.8 mg m<sup>-3</sup>). Although along Mangalore and Goa upwelling was confined to narrow coastal zone, also showed high chlorophyll *a* concentration. Microphytoplankton community of upwelled waters showed 60% similarity with diatoms as dominant species, whereas dinoflagellates dominated the non-upwelled waters. Highest phytoplankton cell density was observed along off Thiruvananthapuram, with maximum cell density along coastal waters (3.2x10<sup>4</sup> cells L<sup>-1</sup>). The abundance of phytoplankton decreased towards offshore as well as northward of the SEAS.

**Conclusions:** The present study provides an account on the phytoplankton community structure along with the physico-chemical characteristics of SEAS during early summer monsoon. There appears significantly higher production in the upwelled waters with the dominance of diatoms.

**Keywords:** South Eastern Arabian Sea (SEAS), Summer Monsoon, Upwelling, Phytoplankton

04-08

### SOLUTE TRANSPORT THROUGH THE RIVERS DRAINING SILENT VALLEY AND ADJOINING REGIONS OF SOUTHERN WESTERN GHATS, INDIA

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**Background:** The river water chemistry and solute transport are controlled by many natural and anthropogenic factors. The hydro chemical characteristics of water can be used as a tool to investigate the biogeochemical processes operating in the catchments because hydrochemistry of rivers is being regulated by complex interactions among various physical, chemical and biological subsystems of the catchments. With this mind, an attempt has been made in this paper to address the spatio-temporal variability and the role of natural and anthropogenic effects in the Bhavani-Kunthipuzha twin rivers draining respectively the eastern and western flanks of the pristine natural system, the Silent Valley in the southern Western Ghats, India.

**Method:** Hydrochemistry data of the both Bhavani and Kunthipuzha were obtained from field work, sampling and in-situ and laboratory analysis. In order to understand the spatio-temporal changes in the river water chemistry and causal mechanisms behind the changes in the long-term discharge characteristics, data from 4 gauging stations (Nellithurai, Thengumarahada and Savandpur for Bhavani river, Pulamantole for Kunthipuzha) have been obtained from the Central Water Commission (CWC) via the surface water module of the India - WRIS (Water Resources Information System).

**Results:** The cations and anions in the river waters of both Bhavani and Kunthipuzha exhibit marked spatial and seasonal variations. The annual particulate sediment transports for the Bhavani and Kunthi river are 0.026 and 0.088 million tonnes, respectively. The annual chemical load that being carried by the main channel in the Savandpur gauging station is estimated to be 0.15 million tonnes while that of Kunthi river is just 0.067 million tonnes. The Particulate load/Dis-

solved load (PL/DL) ratio of the Bhavani river is 0.17 and for Kunthi river the PL/DL ratio came to be 1.31.

**Conclusions:** The eastern part of the Bhavani basin experiences semi-arid/ arid climate with rainfall essentially predominated by North east monsoon, but the western most part of the river basin experiences humid climate with South-west(SW) monsoon dominance. This contrasting character of the river basin is reflected in the solute transport as well the discharge of the Bhavani river. But the Kunthipuzha river basin experiences humid climate with SW monsoon dominance. The low PL/DL ratio of the Bhavani river indicates the dominance of chemical weathering over physical weathering. On the other hand, physical weathering dominates in the Kunthipuzha which is well reflected in the higher PL/DL ratio. Bivariate plots of Gibbs model indicate the role of rock-water interaction and subsequent baseflow contribution in the Bhavani river basin and dominance of rainfall contribution in the Kunthipuzha for controlling the elemental chemistry of the river water. The mixing diagram indicates that silicate weathering plays a pivotal role in contributing solute concentrations in these two river waters.

**Keywords:** Kunthipuzha, Bhavani river, Silent Valley, Solute transport, Western Ghats.

04-09

### SPATIAL VARIATION OF RAINFALL $\delta^{18}\text{O}$ OVER PENINSULAR INDIA REFLECTING THE MOISTURE TRANSPORT MECHANISM DURING NORTHEAST MONSOON RAINFALL

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**Background:** The stable isotopes aided ( $\delta^{18}\text{O}$  and  $\delta^2\text{H}$ ) moisture circulation dynamics related to the tropical rain activities are of current research interest. Numbers of studies have tried to explain the  $\delta^{18}\text{O}$  variations associated with southwest monsoon (SWM) circulation, yet the  $\delta^{18}\text{O}$  swings in north-east monsoon (NEM) rainfall remains poorly addressed. The available information reveals that  $\delta^{18}\text{O}$  depletion is more predominant during NEM and the spatial variation of the amount effect is significant over regions where NEM rainfall exceeds SWM.

**Method:** Here we collated the  $\delta^{18}\text{O}$  data from Global Network of Isotopes in Precipitation (GNIP) stations (monthly accumulated samples) spread over southern peninsula and analyzed the controls on  $\delta^{18}\text{O}$  variations using moisture budget perspective and back trajectory modeling. The enrichment/depletion in  $\delta^{18}\text{O}$  and  $\delta^2\text{H}$  are explained on the basis of moisture budget term (moisture flux convergence-MFC), column integrated moisture transport, outgoing Longwave radiation (OLR) and the presence/absence of cyclone (evaporation and recycling of moisture).

**Result:** Regression analysis doesn't show any significant correlation in rainfall  $\delta^{18}\text{O}$  variations with that of the average moisture convergence over Bay of Bengal (BoB). The spatial variation in MFC over the moisture source along with the presence/absence of cyclonic activity over BoB well interpreted the spatial variation of  $\delta^{18}\text{O}$  in monthly accumulated precipitation.

**Conclusions:** The  $\delta^{18}\text{O}$  depleted months corresponded to back trajectories dominantly derived from BoB while the enriched months showed assorted manner. Particularly in Kozhikode station, many times, dominant moisture influx from BoB (trajectory frequency >80%) results in enriched records. However, the spatial spread in MFC along with vertically integrated moisture transport performs as the better surrogate explaining the  $\delta^{18}\text{O}$  variation. Thus, rainfall proxies capable of providing seasonal variation (teak cellulose) may be interpretable in terms of moisture flux convergence over the oceanic source.

**Key words:** Moisture budget, Moisture Flux Convergence, stable isotopes, Outgoing Longwave Radiation

04-10

### IMPACT OF PENETRATING ELECTRIC FIELDS TO THE EQUATORIAL THERMOSPHERE - IONOSPHERE SYSTEM

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**Keywords:** Equatorial F region, F region dynamo, O<sup>1</sup>D 630.0 nm emission, interplanetary electric field, PPEF, Thermosphere Ionosphere system

**Abstract:** This study reports the response of Equatorial Thermosphere Ionosphere System (ETIS) system over a dip



equatorial station, Trivandrum (8.5° N, 77° E, 0.5° dip lat.) to two distinct prompt penetration electric field (PPEF) events occurred on 25 March 2014 and 14 March 2016. The nights demonstrate the distinctive nature of PPEF on ESF. The investigation carried out using the data from a Portable Nighttime Photometer, Digital Ionosonde, and Fluxgate Magnetometer revealed that the thermosphere responds promptly to the PPEF events. It has been observed that, during the westward PPEF event, the thermospheric nightglow intensity enhances whereas during the eastward PPEF event the intensity decreases. In the first event (25 March 2014) the ESF got suppressed subsequent to the onset of PPEF, by suppressing the dynamo electric fields; while in the second event (14 March 2016) PPEF didn't affect the ongoing ESF, could be due to the fast multiple polarity reversals of the PPEF generated electric fields. Though the PPEF is considered as the transient phenomenon, the two distinct events considered underline the role of lasting effects of PPEF to the ETIS. This study discusses these aspects in detail.

04-11

### IN SITU AND MODELING INVESTIGATION OF LIGHT ABSORBING AEROSOLS OVER THE HIMALAYAS

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**Background:** The Himalayas and Tibetan Plateau, known as the “third pole”, is extremely critical and sensitive to global climate system, which is reported to have increased anthropogenic influence in the recent years. The build up of light absorbing aerosols (LAA) in the free-tropospheric atmosphere over highly reflecting surfaces of Himalayas associated with long-range and their deposition over snow surfaces has become a serious climatic concern.

**Method:** The present study includes the in-situ observations of Black Carbon (BC), made continuously using multi-wavelength Aethalometers over six stations during the period from 2009-2018, in addition to campaign mode observations at a few selected sites, to address the broad features of LAA across the Himalayas extending from Lahaul and Spiti valley in the west to Lachung in the east. Further, SNOW, Ice Aerosol Radiation (SNICAR) model used to understand the implications of LAA on snow.

**Results:** The study reveals that BC loading over the Himalayas peaks mainly during the spring season, unlike the winter time peaks at the lower altitude urban or continental sites. This is attributed to the combined effect of varying anthropogenic influence associated with synoptic meteorological and dynamic processes. The influence of anthropogenic activities leading to higher BC loading is more over the eastern part of the Himalayas. For example, BC mass concentration ( $M_{bc}$ ) at an eastern Himalayan site Tawang (~ 3 km a.s.l.) is nearly double (~  $1788 \pm 1008 \text{ ng m}^{-3}$ ) than the values (~  $991 \pm 741 \text{ ng m}^{-3}$ ) at a central Himalayan site Nainital (~ 2 km a.s.l.).

**Conclusions:** The quantitative information of LAA, when combined with the scattering properties of aerosols, will improve the scientific understanding on both direct and snow albedo effect of aerosols over the vast Himalayan regions.

**Keywords:** The Himalayas, Aerosols, Black Carbon, Snow-Albedo

04-12

### RESPONSE OF EQUATORIAL AND LOW LATITUDE IONOSPHERE OVER INDIAN REGION TO A LONG DURATION MIDNIGHT M1.4 CLASS SOLAR FLARE

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**Background:** Solar flare is the intense brightening and sudden release of electromagnetic energy from solar corona when the accumulated magnetic energy is released by sun's atmosphere. During solar flare events, enhancements in X-ray and EUV rays result in enhancement in the ionization which in turn has several impacts on the ionosphere. Equatorial electrojet (EEJ), which is confined to a narrow band of latitude near the magnetic equator, exhibits variation in its strength during solar flare. In the present study, the effects of a long duration midnight M1.4 solar flare from sunspot region 0808 on 7<sup>th</sup> September 2005 over the equatorial and low latitude Indian region is being discussed.

**Method:** Equatorial electrojet strength (EEJ), maximum height of F2 layer (hmF2) and Total electron content over equatorial (Trivandrum), low latitude (Hyderabad) and Equatorial Ionization Anomaly zone (Bhopal) are compared with non flare day. EIA proxy has been calculated to confirm the flare induced EIA inhibition during the event day.

In order to address the reason for the suppression of EEJ electric field, the observations are compared with quasi two dimensional first principle ionospheric model calculations. The electron density profile are calculated at non flare and flare conditions. The integrated Hall to Pederson conductivity ratios are calculated from these electron density profiles under two conditions.

**Discussion:** Using quasi two dimensional model, the electron density profiles for the flare and nonflare day is simulated. The integrated Hall to Pederson conductivity ratio is calculated by using modeled electron density profiles. The conductivity ratio during flare is less than the non flare day and it is deviated maximum after 10:00 IST, when EEJ started to decrease

**Results:** The M1.4 X-ray flare on 7 September 2005, which was started in the midnight, was a long duration flare lasted for more than 5 hours. Eventhough the flare lasted till 06:15 IST, the EEJ was not normal and it was reduced for a considerable part of the day. In response to the reduction in electrojet strength, hmF2, EIA were also shown reduction.

**Keywords:** Solar flare, equatorial electrojet, conductivity

04-13

### REGIONAL VARIABILITY OF SUMMER MONSOON RAINFALL OVER INDIA AND ITS ASSOCIATION WITH LOWER TROPOSPHERIC STABILITY

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The monsoon that mainly affects India and its surrounding regions during June to September is the Indian summer monsoon. It exhibits large variability on temporal scale as well as spatial scales. These variabilities are influenced by many factors from topography to oceanic and atmospheric factors. So studying the variability of summer monsoon rainfall especially in regional scale is very important and useful to the Indian society and thus to the economy. This paper mainly aims to explore the regional variability of Indian summer monsoon rainfall especially over west coast, northeast and central India for the period 1948-2016, by identifying its relationship with the lower tropospheric stability (LTS). LTS is calculated using potential temperature at different atmospheric levels from NCEP/NCAR reanalysis data set during the period 1948 to 2016. The variations in LTS have a major impact on cloud fraction and thus the summer monsoon rainfall. We used CRU rainfall data for the same period to evaluate the variability during the summer monsoon season. It was found that the summer monsoon rainfall exhibits high spatial variability over the different regions considered. As LTS increases, it reduces the moisture transport between the surface and lower troposphere and thus reduces the rainfall. Thus we arrived at the conclusion that the relation between LTS with monsoon rainfall during the period of study is different over different regions with different influencing mechanisms

**Keywords:** Indian summer monsoon; cloud fraction; spatial variability

04-14

### VOLUME ESTIMATION OF TILE/BRICK CLAY FROM IDENTIFIED SUITABLE SITES FOR MINING IN THRISSUR DISTRICT USING GEOSPATIAL TECHNIQUES

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**Background:** Thrissur district of Kerala, a well renowned for tile/brick clay mining and manufacturing region is home to 283 clay based enterprises. At present clay mining from the paddy field is restricted after the implementation of “The Kerala Conservation of Paddy Land and Wetland Act” during 2008. So the tile industry is in crisis and procuring clay (major raw material) from neighbouring states to meet their demands. Industries & Commerce Department entrusted KSREC to identify the sites converted before 2008 and not included in Paddy and Wetland Act. KSREC carried out the study using the available data of the 15 identified suitable sites in the Clay mining project (2007). The study aims to identify suitable location from the converted lands before 2008, depth and quantity for sustainable clay mining.

**Method:** The suitable sites are visually interpreted in Google Earth images and IRS LISS-IV data during 2007-2008 period and converted area in each suitable site were delineated in 15 locations in ARCGIS(10). The cadastral boundary

overlaid and survey plot level status of suitable area (converted) were generated for the 10 locations. For the remaining 5 suitable locations, cadastral information is not available and the plot wise assessment could not be done. Themes like settlements, roads, assets, village boundary occurs within a buffer of 50m from suitable sites were also incorporated in the map from Google earth imagery. The maps (vector as well as bing overlaid) were provided to Mining & Geology Department (Collaborating agency) for depth estimation of identified suitable sites. They conducted depth estimation of 22 survey plots in 10 identified suitable sites and provided the same.

**Results:** Total of 71 survey plots were recommended by the Mining & geology Department for clay mining. Depth information is provided for 10 identified suitable sites (22 survey plots). Depth of clay observed in the suitable area ranges between 0.5-1.5 m. By using the parameters area and depth of clay, volume and weight is calculated. The total volume of clay present in 22 survey plots is 1, 10,609.88 m<sup>3</sup> and possess 2,14,701.91 MT of clay.

**Conclusions:** The study using geospatial technology facilitated to derive plot wise status of suitable sites for clay mining from the criteria fixed. The total area and volume of the 22 recommended sites are 13,634.93 m<sup>2</sup> and 1,10,609.88 m<sup>3</sup> respectively. The quantity of mineable clay in the proposed sites is 2,14,701.91 MT.

**Keywords:** Tile/brick clay mining, converted area, suitable sites, cadastry, depth of clay, volume estimation

04-15

#### COMPUTATION OF SUBMARINE GROUNDWATER DISCHARGE USING RADON MASS BALANCE MODEL

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**Background:** To distinguish as well as detect the presence of terrestrial and re-circulated marine submarine groundwater discharge (SGD) the tracers that can be used are radon and salinity. Due to its conservative nature, short half-life, high abundance in groundwater compared to surface water, radon (<sup>222</sup>Rn) acts as a good indicator for total submarine groundwater discharge in coastal water. Salinity differentiates sea water and fresh groundwater, with values <2 PSU reflecting the presence of fresh groundwater and values of around 35 PSU reflecting seawater.

**Methods:** Combining radon with salinity measurements in coastal water provides clear distinction of seawater with terrestrial groundwater. We measured radon in groundwater to distinguish the source of groundwater in thirty five coastal wells along the coastline of Kozhikkode, NW Kerala (India). Further, continuous monitoring of radon concentration with tide was carried out to quantify the Submarine Groundwater Discharge flux.

**Results:** In the Northern segment of study area, the wells are fed from both shallow sandy layers and deep lateritic and weathered/fractured rock whereas wells in Southern part are fed from shallow sandy layers. Also time series measurement of radon in coastal water was carried out at three locations (Site A-Gotheeswaram, Site B-Puthyappa and Site C- Kappad) to quantify the rate of submarine groundwater discharge. These sandy and other aquifers systems show definite signatures of terrestrial SGD, which was confirmed based on hydrochemical evaluation and resistivity surveys.

**Conclusions:** The groundwater discharge in Kozhikkode coast varies in the ranges of 0.91-56.3 cm/day, 3.2-43cm/day and 2.5-208cm/day at Site A-Gotheeswaram, Site B-Puthyappa and Site C- Kappad respectively.

**Keywords:** Radon, Submarine Groundwater Discharge, seawater intrusion, coastal aquifer, South West Coast of India, Kozhikkode, Kerala

04-16

#### SPATIAL DISTRIBUTION OF MESOZOOPANKTON ALONG THE SOUTH EASTERN ARABIAN SEA DURING EARLY SUMMER MONSOON

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**Background:** Summer monsoon season and associated coastal upwelling profoundly influence the production dynamics of South Eastern Arabian Sea (SEAS). Mesozooplankton community and its variations in SEAS significantly contribute towards the patterns of productivity in the region and is modulated along with the physical process of coastal

upwelling. The present study attempts to delineate the community structure of mesozooplankton along SEAS during early phase of summer monsoon upwelling along with the variations in the physicochemical characteristics due to the process

**Method:** Present study was carried out during the summer cruise of *FORV Sagar Sampada*. The study surveyed pattern of coastal upwelling and its relation to mesozooplankton distribution between 8°-15°N latitudes. Physico-chemical and biological parameters were collected using standard protocols. Surface mesozooplankton was sampled with Bongo net having a mesh size of 200µm and were sorted, enumerated and identified using standard keys.

**Results:** Upwelling was strong and extensive at southern most transect off Thiruvananthapuram (8°N) and diminished towards Off Goa (15°N). Surface biomass of mesozooplankton varied from 0.03-1.66 ml m<sup>-3</sup>, while its numerical abundance ranged from 473-48,563 ind. 10m<sup>-3</sup>. Biomass and abundance were observed as higher towards near shore waters of southern transects characterized by significant upwelling and nutrient enrichment. Mesozooplankton community along coastal and shelf waters showed more dominance but less diversity. The study observed significant positive correlation between zooplankton biomass (ZBM) and chlorophyll *a*, since both these are concentrated towards neritic waters of shelf and coast. Spatial distribution of mesozooplankton observed maximal biomass and count at the shelf station of Thiruvananthapuram. A total of 22 groups of mesozooplankton were identified. In general, Copepods (49-97%) was the dominant taxon observed throughout the study. Other major mesozooplankton groups included cladocerans, chaetognaths, gelatinous zooplankton, decapods larvae, tunicates etc.

**Conclusions:** Community composition and relative abundance of MZP in the South Eastern Arabian Sea (SEAS) alters significantly with the onset of summer monsoon (SM). The influx of nutrient rich waters enhances the phytoplankton abundance and rate of autotrophic production in the upper water column. The study emphasizes the influence of spatial variations in physico-chemical factors (SST, salinity, DO, inorganic nutrients) and the effect of upwelling event on spatial distribution of MZP in southeastern Arabian Sea (SEAS). Zooplankton being the secondary producers efficiently links primary producers with secondary consumers, thereby channeling biogenic carbon through food web.

**Keywords:** Mesozooplankton (MZP), South Eastern Arabian Sea (SEAS), Summer Monsoon (SM), Upwelling, Phytoplankton

04-17

#### GEOSPATIAL AND ANALYTICAL NETWORK PROCESS TOOL MIX FOR LANDSLIDE VULNERABILITY MAPPING IN KUTTIYADI RIVER BASIN, NORTHERN KERALA

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Landslide vulnerability zonation in highlands and midlands of Kuttiyadi river basin in Kozhikode district, Kerala, India has been carried out using geospatial techniques. From past and recent landslide evidences, being a landslide prone area a hazard zonation is attempted using terrain vulnerability concept. This work explore the usage of Analytical network process based decision making approach for landslide conditioning factors to determine the relationship between each factors effectively. The normalized weight of each factors will obtain after a 1-9 scale comparison increased the accuracy of result. Factor maps of various landslide triggering parameters such as slope, soil, landuse, drainage density, stage of landform, lineament density, geology and geomorphology were prepared and integrated through geospatial analyses in GIS platform, the study area (478km<sup>2</sup>) is categorized into four classes of Very low vulnerability (186 km<sup>2</sup>), low vulnerability (70km<sup>2</sup>), Medium vulnerability (84km<sup>2</sup>), High vulnerability (67km<sup>2</sup>) and Very high vulnerability (74km<sup>2</sup>). The last two categories together form 30% of the area which is the most hazardous regions and it require implication of immediate mitigation measures to prevent future slope failures. The result of this work concluded that application of ANP is an effective tool to weight the factors causing landslides and to generate landslide vulnerability zonation map with maximum accuracy using Geo-spatial technology, the validation of output data with landslide inventory data satisfying it.

**Keywords:** Geospatial, ANP, landside vulnerability and Kuttiyadi river basin

04-18

### A STUDY OF THE URBAN HEAT ISLAND IN A COASTAL CITY INTERLACED BY WETLANDS

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**Background:** Urbanisation leads to significant changes in the local climate of the location. The rapid urbanisation and industrialization bring about microclimatic changes particularly with regard to thermal structure of the cities. The most pronounced effect of urbanisation on the microclimate of a region is the development of the Urban Heat Island (UHI). An urban heat island is the name given to describe the characteristic warmth of both the atmosphere and surfaces in urban areas compared to their non-urbanized surroundings. This study has investigated the development of the Urban Heat Island in Kochi, a tropical coastal city based on the Local Climate Zone classification (LCZ).

**Method:** Mobile surveys were conducted in the city of Kochi in Southern India, during winter season, covering pre-dawn and early evening periods in 2018. In situ measurements were carried out to record urban parameters which best match with each Local Climate Zones. Local Climate Zone map was prepared on the basis of standard zone properties defined in the LCZ classification system.

**Results:** The Urban Heat Island in Kochi, a fast growing urban region in coastal South India, interlaced by a network of canals and wetlands was moderate to high during winter and is seen to relate well with the urbanization. Highest observed urban heat island intensity in Kochi is 4.0°C during winter morning. Highest observed UHI during winter evening is 2.5°C. Maximum intensity was seen in Compact Midrise zones which cover the central part of the city.

**Conclusions:** The Urban Heat Island intensity and spatial temperature distribution during winter season exhibits a good correlation with the Local Climate Zone Classification. Maximum average intensity was seen in Compact midrise zones which cover the central part of the city and minimum intensity found at sparsely built area. Wetlands in the study area play an important role in maintaining the thermal balance. Even though the development demands that determine the choice of the paths upset the natural harmony, conservation of wetlands and paddy fields is the easiest and appropriate method to reduce the heat island effect at the study area.

**Keywords:** Urban Heat Island, Local Climate Zone, Urban Climate

04-19

### MAPPING FLOOD AFFECTED AREAS ON GROUND IN ERNAKULAM, THRISSUR AND PALAKKAD DISTRICTS IN KERALA, INDIA

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**Background:** In the month of August 2018 Kerala witnessed the devastating fury of extreme climatic events, resulted in an unexpected flood which engulfed the entire state. Soon after the flood when the water started receding, KFRI was set off to conduct a pilot study to understand the dynamics of the deluge. Later, the Government of Kerala commissioned KFRI to undertake the flood mapping of Palakkad, Ernakulam and Thrissur districts which includes major rivers of the state Bharathapuzha, Periyar, Chalakudy, Karuvannur and Muvattupuzha. Through this study, detailed mapping of flood intensity of these regions using ground data was done to identify the total area affected.

**Method:** The area inundated was surveyed on foot, and the water levels were marked and recorded in all three districts. A minimum sampling density of four points per square kilometre was ensured as per the directions of the Disaster Management Authority. In order to avoid omissions in the inundated areas, the satellite derived flood maps obtained from the National Remote Sensing Centre and crowd sourced water levels under the Rebuild Kerala initiative of the Government of Kerala were used. The water levels collected from the field were spatially interpolated using Inverse Distance Weighted (IDW) geostatistical technique. The interpolated surface was overlaid on ASTER Digital Elevation Model, and zero water levels were used to mark the boundary of the inundated areas.

**Results:** A total of 2591 samples were collected from the flood-affected areas in Thrissur, Ernakulam and Palakkad districts. An area of about 509 km<sup>2</sup> was flooded in Palakkad district, and the maximum height of water level observed

was 2.5m. The large size of Bharathapuzha has reduced the intensity of flood in the area. In Thrissur district, an area of about 747 km<sup>2</sup> is found to be flooded. A water spread of 2.3 -5.5 m found over 9km<sup>2</sup> of the study area. Ernakulam district which encompasses Periyar and Muvattupuzha a total of 904 km<sup>2</sup> area was flood affected. Isolated places like Manjali Thuruth, Kozhithuruth and Thuruth showed a maximum water height of 6m.

**Conclusion:** The study concluded that one fifth of the three districts was flooded in the mass flood event in August 2018. This comes to 2160 km<sup>2</sup> of the total 10582 km<sup>2</sup> area. Reclamation of wetlands and unplanned constructions in the area has triggered the rate of destruction in Thrissur, Palakkad and Ernakulam districts. Deposition of alluvial soil is a major sedimentation occurred after the flood.

**Key words:** flood, water levels, mapping, DEM, interpolation.

04-20

#### AN OPERATIONAL FRAMEWORK FOR MONITORING WEATHER AND CLIMATE FOR KERALA: DATA SOURCES, PROCESSING AND OUTCOME SHARING

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**Background:** Weather forecasting is the submission of science and technology to envisage the state of the atmosphere at a future time and given location. Since the procedural activities of forecasting is subtle, sometimes the agential errors encompasses which lead to wrong sharing of information with the public and it causes to take precautions erroneously. **Method:** Analyse the available data sets of atmospheric variables like Sea Surface Temperature, Precipitation, Wind vector and Relative Humidity using various data processing software such as GrADS, ArcGIS, MATLAB and Python and so on. Attempts to study the meteorological aspects of the causes of Kerala flood 2018, Evaluate the possibility to have an operational monitoring system that provides vital weather and climate information to the common public.

**Results:** The wind vector intensity from the Arabian Sea at the time was very high, along with that a low pressure depression was formed in the Bay of Bengal and it moved towards the Arabian Sea. There was an involvement of Madden-Julian Oscillation also that is characterized by an eastward propagation of large regions of both enhanced and suppressed tropical rainfall. As the Sea surface temperature is increased along with the tremendous increase in the normal Indian Summer Monsoon activity, the rate of precipitation upraised. In addition the high relative humidity in the region amplified the precipitation.

**Conclusions:** The analysed variables are involved in making the climate terrific. Proper and slip free analysis of future data sets will lead to exact prediction of weather. For the ease of sharing the deduced information with the people, some public friendly interfaces are necessary.

**Keywords:** Sea Surface Temperature (SST), Madden-Julian Oscillation, Indian Summer Monsoon.

04-21

#### MONITORING FLOOD AREAS USING MICROWAVE SATELLITE DATA - A CASE STUDY OF ALUVA TALUK, KERALA

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**Background:** Beginning of the second week of August 2018, Kerala was affected with severe flood. Over 483 people died, and 15 were missing. At least a million people were evacuated Flood Hazard Mapping is a vital component for appropriate land use Planning in flood-prone areas. The study is regards with the extraction of flood area from the microwave data. Flood maps help to analyse the areas affected, intensity etc. Remote sensing and GIS is used as a vital technique for the analysis

**Method:** For this study, two microwave satellite data were used. SENTINEL-1A and ALOS PALSAR were downloaded from the European Space Agency- Sentinels Scientific Data Hub and Vertex ALASKA SATELLITE FACILITY respectively. Water bodies were extracted by SNAP-developed by European space agency, ASTER DEM was downloaded from the USGS earth explorer to analyse the elevation with flood intensity.

**Results:** from also palsar the total flooded area was found to be 27.40 km<sup>2</sup>. This includes rivers, streams, wetlands and other water bodies in the area that were responsible for causing the flood. The Sentinel data flood extent dated 21 August 2018. ALOS PALSAR data

used for the study was captured before the flood, whereas SENTINEL data was captured after the flood. On Aug 21, water from almost all areas receded. It can be seen in the the above image that the south eastern parts of the Taluk are completely flooded. A total of 25.53 km<sup>2</sup> of land area is under water.

**Conclusion:** There is 1.86 km<sup>2</sup> difference between two images. Except some regions in north east the elevation of all other areas of Aluva Taluk is below 100 metre. The areas where maximum flood inundation occurred are found to be in and around the banks of Periyar River. In both the data obtained before and after the flood, the regions where flood inundation occurred are the same and that these regions are found to be low laying lands.

**Keywords:** flood zone extraction ,GIS,Microwave Remote sensing

04-22

### SUBSURFACE DIURNAL TEMPERATURE FLUCTUATIONS AND THERMAL CONDUCTIVITY AT A TROPICAL STATION

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**Background:** Knowledge of thermal characteristics of soil is important to study the surface energy and radiation budgets, to quantify the heat storage required in agriculture for seed germination rate etc. Soil temperature plays an important role in land surface processes, and it is critical in energy balance applications such as land surface modeling, numerical weather forecasting and climate prediction.

**Method:** The data was recorded at Astronomical Observatory (76° 59' E longitude and 8° 30' N latitude), University of Kerala, adjacent to India Meteorological Department, Thiruvananthapuram in South Kerala using Automatic Hydro-meteorological data acquisition system during an observation period , 19– 25<sup>th</sup> February (Winter) and 25-31<sup>st</sup> October 2007 (North-East).

**Results:** On the normal undisturbed dry conditions (winter), the soil temperature in the top layers (0-0.20 m) shows high diurnal variation depicting the peaks in the afternoon hours. At the depths greater than 0.30 m, the soil temperature does not change diurnally or the diurnal temperature variation is damped out. In the north-east monsoon season, the diurnal soil temperature range is small as compared that of the clear day. On both the cases, the amplitude of the diurnal soil thermal wave decreases exponentially with depth. The values of thermal conductivity are nearly equal for the two seasons, but slightly greater in the N-E monsoon than in winter.

**Conclusions:** The amplitude of this wave decreases with depth and at 50cm depth from the surface, the amplitude is practically zero. The most fluctuation in soil temperature with respect to time was observed at the soil surface. Soil temperature at the deeper layers (>0.30 m) stayed almost constant during a day. The amplitude of the thermal wave is found to be high on winter season. The thermal conductivity of the soil during north-east monsoon period is greater than that of winter period.

**Keywords:** Diurnal thermal wave, Thermal wave amplitude, Thermal conductivity

04-23

### DIURNAL AND SEASONAL VARIABILITY OF SUBSURFACE HEAT FLUX AT A TROPICAL STATION

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**Background:** Soil heat flux is an important input component of surface energy balance. Many field studies in topics such as microclimatology and hydrology require reliable measurements of the soil surface flux. The study of the vectorial heat of the soil stratum is important to understand the magnitude of heat exchange across the earth's surface leading to the influence of local climate during various seasons. The objective of this study is to estimate soil heat flux using soil temperature collected at various depths and to study the diurnal variation in various seasons.

**Method:** The data was recorded at Astronomical Observatory (76° 59' E longitude and 8° 30' N latitude), Univer-

sity of Kerala, adjacent to India Meteorological Department, Thiruvananthapuram in South Kerala using Automatic Hydro-meteorological data acquisition system during an observation period, Pre-monsoon (11-17 May 2008), Winter (19-25 February 2008) South-west (SW) monsoon (08-14 July 2008) and North-east (NE) monsoon (25-31 October 2007). Soil heat flux was estimated from soil temperature profile measurements.

**Results:** The diurnal curves of soil heat flux in the Winter and Pre-monsoon seasons exhibit a clearly defined maximum around local noon and have regular and symmetrical shape. Soil heat flux on NE monsoon season could reach a value of only  $15.26 \text{ Wm}^{-2}$  for the layer 0.05-0.10 m in the noon hour. Soil heat flux in SW monsoon season could reach a value of only  $10.59 \text{ Wm}^{-2}$  for the layer 0.05-0.10 m in the noon hour. The 24-hour sum for the day is  $-3.3 \text{ Wm}^{-2}$  which means the overall flow of heat is from the soil to the atmosphere. The top layer accounts an increased heat balance during day and fluctuation in heat balance decreases exponentially with depth.

**Conclusions:** The diurnal variation is characterized by a cross-over from negative to positive values in the early morning occurrence of maximum around noon and return to negative values in the late evening. The amplitude of the diurnal heat flux is found to be high during winter and pre-monsoon seasons as compared to monsoon seasons. During NE monsoon, the daily total heat flux is found to be negative.

**Keywords:** Soil heat flux, Thermal Conductivity, Diurnal variation.

## 05 - ENGINEERING & TECHNOLOGY

05-01

### GROWTH AND CHARACTERIZATION OF MOLYBDENUM OXIDE NANORODS BY PULSED LASER ABLATION: ANNEALING INDUCED PHASE TRANSITION

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**Background:** In recent years, transition metal oxides have attracted much attention due to their scientific and technological applications in various fields. Among the transition metal oxides, molybdenum oxide ( $\text{MoO}_3$ ) possesses interesting properties such as good chemical stability and high electrical conductivity. Molybdenum oxide has shown a variety of technological applications in various fields such as photodetectors, light emitting diodes, photovoltaics, optical and electronic devices, gas sensors, batteries and multi-chromic coatings etc. Molybdenum oxide is a wide band-gap n-type semiconductor and type III electrochromic material which also have thermochromic and photochromic applications because of its various oxidation states, coordination number and stoichiometry. It can be used as a potential electro-active material for high energy density secondary lithium ion batteries due to the existence of different allotropes and sub-oxide phases of molybdenum oxide depending on the chemical composition and the formal oxidation state of molybdenum.

**Method:** In this work, we report the fabrication of thin films of molybdenum oxide ( $\text{MoO}_3$ ) via pulsed laser deposition technique (frequency tripled 355 nm laser radiation from Q-switched Nd-YAG laser) using laser energy 70 mJ on quartz substrates. The deposited films are then annealed at different annealing temperatures (300, 400, 500 and 600 °C) and the effect of annealing on the structural, morphological and optical properties of the films are also studied.

**Results:** It is found that the annealing temperature has an important impact on the predominant phase formation and crystallinity of the  $\text{MoO}_3$  films. Structural studies by X-ray diffraction (XRD) and Micro-Raman spectra confirm the predominance of orthorhombic phase at an annealing temperature of 600 °C. Chemical analysis revealed that the film annealed at 600 °C showed only  $\text{Mo}^{6+}$  oxidation state indicates the growth of  $\alpha\text{-MoO}_3$ . Morphological analysis shows that the film annealed at 600 °C shows a rod-like morphology.

**Conclusion:** It is found that the annealing temperature has profound effect on the predominant phase formation and crystallinity of the  $\text{MoO}_3$  films. Among the various annealing temperatures, 600 °C is found to be optimal for the orthorhombic phase and enhanced photoluminescence emissions.

**Keywords:** Pulsed laser deposition, X-ray diffraction, Field emission scanning electron microscope, X-ray photoelectron spectroscopy, Atomic Force Microscopy.



05-02

### COBALT PHTHALOCYANINE - BASED ORGANIC FIELD EFFECT TRANSISTORS FOR ULTRAVIOLET SENSOR APPLICATIONS

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**Background:** Nowadays skin cancer has become an increasing human health issue. Suntan and sunburn are familiar effects of over-exposure of skin to Ultraviolet (UV) radiation, leading to skin cancer. Organic electronics is an emerging technology for low temperature and portable applications. Organic semiconductors (OSCs) exhibit interesting properties which can be exploited for the fabrication of organic field effect transistors (OFETs). The chemical variety in OSCs allows us to apply them in active layers of OFET based sensors with high sensitivity. Phthalocyanines are considered as the most important organic material for sensing applications. The aim of this paper is to report the performance of cobalt phthalocyanine (CoPc)-based organic field effect transistors for high sensitivity flexible UV-sensor applications.

**Method:** In this work, bottom gate top contact OFETs were fabricated on a silicon (Si) wafer with CoPc as the OSC. Before starting the deposition, the substrates were cleaned in an ultrasonic bath. N-type Si wafer acted as substrate and gate electrode with a 50 nm thick thermally grown oxidized silicon dioxide (SiO<sub>2</sub>) on top, which functioned as the gate insulator. The optimized thickness of 50 nm CoPc film was thermally deposited on the gate insulator. Finally, 100 nm silver electrodes were deposited onto the CoPc film through a shadow mask by thermal evaporation. The OFETs were fabricated with a constant channel width of 1000 μm and a channel length of 135 μm. Finally, the electrical characterizations of the OFETs were done in air using a probe-station connected to an Agilent B2900A semiconductor parameter analyzer.

**Results:** The morphology of the CoPc thin films reveals that the surface has a smooth structure. The absorbance spectrum of CoPc films shows maximum absorption in UV region and makes them more attractive for UV-sensor applications. Also we investigated a time-resolved photoresponse of the device under irradiation on and off. The output characteristic of the fabricated devices with and without irradiation was also studied and shows excellent output characteristics with clear saturation and gate dependence. The OFET revealed an effective mobility of 0.45±0.09 cm<sup>2</sup>/Vs with -4.12±0.05 V threshold voltage, subthreshold swing of the transistors appears to be 715.50±72.37 mV/decade under UV irradiation at drain-source voltage of -2 V.

**Conclusion:** In conclusion, the effects of UV radiation on the electrical properties of CoPc-based OFETs were investigated. The properties of CoPc films were studied through morphological and optical characterizations. The optical studies demonstrated that the material shows maximum absorption in UV region and makes it attractive for flexible UV-sensors. The electrical properties of the fabricated devices with and without irradiation were also studied. These operating parameters show that CoPc-based OFETs can be promising for scalable, low-power flexible UV-sensor applications.

**Keywords:** Organic field effect transistor, Cobaltphthalocyanine, UV-sensor, Mobility, Sub threshold swing.

05-03

### ULTRA FAST HEAT DISSIPATING AEROGELS DERIVED FROM POLYANILINE ANCHORED CELLULOSE NANO FIBERS AS EFFICIENT MICROWAVE ABSORBERS IN THE X BAND

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**Background:** We report a facile and environmentally benign strategy to synthesize ultra-light and highly conductive aerogels derived from cellulose nanofibers (CNF) anchored with polyaniline (PANI) via a simple in-situ polymerization and subsequent freeze drying process. The PANI/CNF aerogels were fabricated solely with a rationale to screen undesired EM radiations emitted out from electronic devices functioning in microwave frequencies and to suppress further electromagnetic pollution. These conductive aerogels were comprehensively characterized using Fourier Transform Infrared Spectroscopy, X Ray Diffraction, Scanning Electron Microscopy, Transmission Electron Microscopy and results were correlated with Vector Network Analyzer to access its EM shielding properties. The obtained conductive aerogels

exhibited density as low as 0.01925 g/cc with a maximum EMI shielding effectiveness (EMI SE) value of -31 dB (> 99.9% shielding) in X band (8.2-12.4 GHz) region at 5.0 mm thickness. It is also noteworthy that the fabricated aerogels demonstrated a strong microwave absorption behavior (ca. 95%) with minimal reflection (ca. 5%) of the incoming EM radiations which is very much crucial to stifle electromagnetic pollution. Nevertheless, PANI/CNF aerogels can also be exploited for a plethora of sensing applications such as gas sensors, strain sensors and biosensors.

**Method:** In this study, oxidative polymerization of aniline monomer onto the surface of cellulose nanofibers was performed via an *in-situ* strategy as reported by *Gopakumar et al* Initially, calculated quantities of aniline was mixed with 1M HCl solution and cooled down below 5°C in an ice bath under constant stirring. This solution was then slowly added to CNF suspension (0.03g/ml) and homogenized at 3000 RPM using a homogenizer to ensure uniform dispersion of aniline in CNF suspension. The oxidant solution was then prepared by dissolving 0.2 molar APS in 1 molar HCl. This was followed by slow drop wise addition of oxidant solution to the aniline coated CNF suspension kept below 5°C in an ice bath with continuous stirring to initiate the polymerization. In all the reaction scheme, APS:aniline ratio was 1:1 and kept constant. After 6 hrs, dark green colored PANI/CNF suspension was obtained which was washed with deionised water, acetone and 0.1 M HCl to remove untreated aniline monomer. The washed PANI/CNF suspension was then cooled at -80°C for 8 hrs and subsequently lyophilized at -85°C at 0.05 mbar for 48 hrs to form robust PANI/CNF aerogels.

**Results:** The conductive aerogels exhibited density as low as 0.01925 g/cc with a maximum EMI shielding effectiveness (EMI SE) value of -31 dB (> 99.9% shielding) in X band (8.2-12.4 GHz) region at 5.0 mm thickness. It is also noteworthy that the fabricated aerogels demonstrated a strong microwave absorption behavior (ca. 95%) with minimal reflection (ca. 5%) of the incoming EM radiations which is very much crucial to stifle electromagnetic pollution. The thermal heat dissipation studies reveal that the these aerogels are capable to cool down from 102°C to 27°C in just 45 seconds when subjected to microwave radiation at 2.54 GHz for 6 seconds. These unique properties make PANI/CNF aerogels as sustainable microwave absorbers for the future.

**Conclusions:** We conclude that PANI/CNF aerogels were fabricated and tested for their microwave absorption and heat dissipation characteristics. The aerogels with ultra low density (0.01925 g/cc) were fabricated via freeze drying process. An effective shielding effectiveness (EMI SE) value of -31 dB (> 99.9% shielding) was achieved in X band. The thermal imaging studies reveal that the fabricated aerogels have demonstrated ultra fast heat dissipation ability when subject to high energy microwave radiations.

**Keywords:** Cellulose Nanofibers, Aerogels, PANI, EMI Shielding, Microwave Absorption, Heat Dissipation.

05-04

## AUTOMATION OF BANDWIDTH REDESIGN AND ITS APPLICATIONS IN AMPLIFIER TUNED OSCILLATORS BASED ON NULLORS

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**Background:** In an amplifier circuit, it is principally the reactive elements (usually capacitors) that establish the higher and lower cut-off frequencies. Capacitors lies along the signal path, which is in series with the flow of signals, can affect the lower cut-off frequency. Coupling and bypass capacitors are belongs to this category. On the other side, capacitors parallel to signal flow can affect higher cut-off frequencies, which include internal capacitors of active devices. The frequency- bandwidth based studies are useful as they find applications in video/audio amplifiers, hearing equipment etc. and it will be more interesting if we go for automation of bandwidth design.

**Method:** The Fixator Norator pair (FNP) is the tool of this methodology. Our strategy in this technique is to define additional sub-circuits containing one or more passive devices (mainly reactive elements) using the FNP so that the addition of the sub-circuit into the original amplifier circuit will revise its frequency response and the amplifier possesses a narrow band-pass behaviour. At this moment, the amplifier can be treated as an active narrow band-pass filter. By giving proper positive feedback, the circuit can be turned into an oscillator. The frequency of oscillation will be same as the designed central frequency.

**Results:** In the proposed approach, the main task is to convert the norator Bode plot into reliable two-terminal sub-circuit. For a systematic designer, this is not so hard, as one can use a pre-defined library for this purpose. Above all, this study connects among amplifier, filter and oscillator circuits and hence it receives pedagogical importance. The benefit of FNP procedure is that the designing can be performed in a linear-like way. The design parameters are immobilized at some pre-determined values and thus the complications incorporated with the non-linear elements get diminished.

**Conclusions:** A method has been propounded for the design automation of narrow band-pass amplifier and hence am-

plifier turned oscillators. Fixator-norator pair together with reference circuit is used for the design of sub-circuits; which is added to the original circuit for getting the desired frequency response. Such a circuit possesses a narrow pass-band similar to that of a narrow band-pass filter. The usages of reference circuit and nullor elements are temporary in the circuit. They can be removed once the sub-circuit is designed. The scope of this approach is wide and it can be extended to other areas of analog design including linear equivalent circuit modelling.

**Keywords:** Analog Circuits, Feedback, Amplifiers, Active Filters, Oscillators, Fixator Norator Pair, Nullor.

05-05

### **PVA/ POLYPHOSPHORIC ACID MODIFIED MMT COMPOSITE : AN EFFECTIVE SOLUTION FOR WATER PURIFICATION**

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**Background:** Two dimensional nano materials such as layered silicates like montmorillonite (MMT), graphene, LDH etc are widely studied due to their high aspect ratio which in-turn enhances the properties like flame resistance, mechanical properties, gas adsorption and gas barrier properties, water purification etc. Among which clays especially montmorillonite clay either pristine or modified form, find its way as adsorbent of dyes from water due to its high surface area and high cation exchange capacity. These are also widely used as fillers to improve mechanical properties of polymers.

**Method:** MMT clay is modified with polyphosphoric acid (PPA) by adding 0.2% PPA to aqueous dispersion of MMT. After 5h stirring the resultant clay washed, dried and named as PMMT. Its organic dye adsorption capability is analyzed by taking Methylene Blue, a cationic dye, as model dye and the adsorption capability is compared with unmodified clay. PVA composite is prepared with MMT and PMMT also and it is evaluated for its dye adsorption capability and improvement in mechanical properties.

**Results:** PMMT synthesized is characterized using XRD and FTIR, TEM and TGA. The BET surface area is well improved when the modification established. Both MMT and PMMT is evaluated for its adsorption capacity using Methylene Blue dye and PMMT shows improvement in dye adsorption. The PVA composite thin films with both clays are also analyzed and PMMT/PVA composite almost removed 100% dye from the solution of concentration 50mg/l. The tensile properties of composites are also improved from 35.42 N/mm<sup>2</sup> (PVA alone) to 39.8 N/mm<sup>2</sup> with only 0.5% PMMT and for MMT/PVA it is only 38.5 N/mm<sup>2</sup>.

**Conclusions:** The chemical modification of MMT with poly phosphoric acid is established in this work. Modified clay found to be better for improving the dye adsorption from water. Its composites with PVA are also good enough for dye removal along with high tensile properties.

05-06

### **EXPERIMENTAL STUDIES ON MECHANICAL PROPERTIES OF FIBER REINFORCED BITUMINOUS MIXES**

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**Background:** Over the past few years, several research efforts are being done on modified bituminous materials which had been developed to improve pavement performance. Fiber reinforcement refers to incorporating materials with desired properties within some other materials lacking those properties. It is a widely accepted fact that the addition of fibers to bituminous mix enhances material strength as well as fatigue characteristics. The effect of physical parameters of fibers and the quantity of fibers to be added has to be analyzed based on performance test of reinforced bituminous mixes. In the basis of continuous increasing in traffic loads in roads the usage of reinforced mixes makes sense as such mixes possess good resistance to deformation and stress strain characteristics.

**Method:** In this study, experiments were conducted to determine the characteristics of and performance of fiber reinforced bituminous mixes. The samples were prepared with varying quantities of coir fiber and polypropylene fiber and were analysed against control samples. The tests conducted are Marshall Test, Dynamic creep test and Dynamic modulus test.

**Results:** The test results show that the dosage and homogenous dispersion of fibers determines the strength of the resulting mixtures. The strength of the mixes is affected not only by different fiber concentrations and also by fiber length. Also optimum binder content of fiber reinforced mixes is more when compared to the control mix. This is due to the increased absorption area formed as a result of addition of fine fibers.

**Conclusions:** The use of fibers increases the stiffness of the mix without appreciable difference in cost of construction, thereby increasing the life of pavements.

**Keywords:** Marshall Test, Natural fibers, Reinforced bituminous mix, Dynamic creep test, Synthetic fibers

05-07

## DEVELOPMENT OF RING ROAD AND NMT CORRIDOR FOR AN EMERGING TOWN IN KERALA

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Kondotty is a revenue village and municipality, and is also a developing town in the Malappuram district, state of Kerala, with an extent of 30.93 sq km, which is located near Calicut International Airport. The National Highway 966 which connects Kozhikode with Malappuram and Palakkad passes through Kondotty.

The pattern of inter-city vehicular movements through Kondotty Town was studied by analysing the origin-destination movements of vehicular traffic at the outer cordon survey locations. It is seen that, about 21 percent of total traffic with their origin and destination points outside the Kondotty town are passing through the town with no purpose of halting. Therefore there is a scope for developing a ring road for the town, so as to segregate the divertible traffic in the future years.

This work deals with examining the need and scope of developing a ring road for the Kondotty town. The work recommends the various possible alternatives for the proposed ring road alignment for the town. This paper also deals with suggesting a non-motorized corridor for the Kondotty Town.

**Methodology:** Extensive traffic surveys were carried out to study the existing traffic scenario of the region. To study the travel pattern of vehicles traversing in and around the town, traffic surveys like Intersection turning movement surveys, Mid-block volume count survey, Origin-Destination surveys etc were conducted at the Kondotty Town. Secondary data were also collected from various sources.

**Results and conclusions:** The proposals of ring roads are made to moderate the mixing up of intra-city and inter-city traffic. It is evident from the findings; about 21% of traffic is by-passable. Since the through traffic which have no purpose of halting in urban area and having its origin and destination lying outside the urban area are divertible to the ring roads. This will help to reduce the congestion in the core area of the town where road widening is not possible. Thus to divert the traffic from major roads, alternative link roads have to be strengthened and developed within the area. Different alternatives for ring road development are proposed for Kondotty municipality. On south west side of NH 966 three alternative roads and on north east side two alternatives are identified. The ring road development is proposed with a ROW of 12m while the road stretches from Chirayil Chungam to Karipur Airport Jn with an additional cross sectional element of cycle track on both sides of the roadway in order to pave way for a NMT friendly corridor in the town. In Kondotty, there is a possibility of developing a walk way/ joggers path and cycle tracks along the sides of less congested roads. This will help in promoting non-motorised transport in Kondotty town which is a pace towards sustainable transport by inculcating a healthier habit and road culture of relying on NMT modes to the extent possible.

**Keywords:** inter-city travel characteristics, Ring Road development, non-motorized transport corridor.

05-08

### PERFORMANCE ANALYSIS OF KSRTC DEPOTS IN THIRUVANANTHAPURAM CITY USING ANALYTICAL HIERARCHICAL PROCESS

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**Introduction:** Public transportation is an important contributing factor to urban sustainability. Improving the quality and efficiency of public transport is important in order to change the daily transport habits of the public. Evaluating the performance of a public transport system is essential for making suitable amendments in its improvement strategy. Thiruvananthapuram is one of the major cities in Kerala State and derives its importance being the capital city of the State. This paper compares the performance of the 19 KSRTC Depots in Thiruvananthapuram. Secondary data was collected from 19 KSRTC Depots to understand the existing public transport service characteristics which included operational details, revenue earned, number of buses, schedule of buses, route length etc. were collected.

**Methodology:** Analytic Hierarchy Process (AHP) was used for the performance analysis of the 19 KSRTC depots. Mainly four factors were considered for analyzing the performance of KSRTC depots: Safety, Revenue, Efficiency and Service coverage and to represent these four factors Number of Accidents per kilometre (NA), Average Earnings per kilometre (AE), Fuel consumption per kilometre (FC) and Average kilometre Operated per day (AO) respectively were selected. The overall efficiency of the KSRTC Depots was obtained after model synthesis and respective ranking were given to them.

**Results and Conclusions:** This study provides an approach for analyzing the performance of 19 KSRTC Depots in Thiruvananthapuram district for four criteria using AHP. In this hierarchical approach of the analysis, we initially computed the importance or weights for the four criteria considered. Then local priorities for the depots for each criterion were formulated. Using the local priorities and the criteria weights, we derived the overall efficiency for 19 depots. The overall efficiency or weights obtained were found to be varying between 0.099 and 0.024. The overall efficiency was then classified into Best performer, Good performer, Average performer and Poor performer. Neyyattinkara Depot was found to be the best performing depot with an overall efficiency of 0.099. This is due to the higher average earning per km for Neyyattinkara depot which is the most influencing factor. Although this approach facilitates the decision-maker in understanding the performance of the depots and provides a benchmark, this study is not extensive. Considering more number of criteria can improve the accuracy of the performance analysis. This approach can be considered as an initial stepping-stone for effectively analysing the performance of various depots.

**Keywords:** Public Transport, Performance Analysis, Analytical Hierarchical Process

05-09

### IDENTIFICATION OF MAJOR FACTORS INFLUENCING WORK TRIPS IN THIRUVANANTHAPURAM CITY

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**Introduction:** A proper analysis of the mode choice decisions in case of work trips can help in addressing issues such as forecasting demand for new modes of transport, mitigating traffic congestion, allocating resources and examining the general efficiency of travel. The major objectives of the present study are to analyse the existing commuting pattern of work trips in Thiruvananthapuram city and also to identify the major socio-economic and travel variables influencing the mode choice behaviour of work trips in Thiruvananthapuram city.

**Methods:** Household survey was conducted to study the travel pattern of the commuters undertaking work trips in the Thiruvananthapuram city.

**Analysis and Results:** It was found that majority of work trips were made by using two-wheelers (56%) and the next higher portion of work trips were shared by bus (20%) and car (5%). The respondents who mainly preferred two-wheeler and car were males whereas female workers preferred bus and two-wheeler for their work trips. Among age groups greater than 30, two-wheeler and car constituted the major mode shares whereas for the age group with age less than 30, two-wheeler and bus were the modes chosen. By conducting linear regression analysis, it was found that the major independent variables that affected the mode choice behaviour of a commuter are monthly income, sex, age, no. of

vehicles, no: of workers, travel time and travel fare.

**Conclusions:** The present study observed that with increase in income, the commuters were switching to personalized vehicles. In Trivandrum city, where there is a predominant share of private vehicle for work trips, improving public transport is the only measure likely to attract more commuters to public transport and which will finally lead to significant reduction in traffic volume on the plying roads. Transport planners must ensure that travel time and travel costs are kept to the minimum to win over more commuters to the public transport system. The study shows that more can be attracted towards public transport by improving service characteristics of transport such as reliability, cleanliness, comfort and safety.

**Keywords:** Linear regression, commuters, work trips

05-10

### IMPROVEMENT PROPOSAL FOR RECTIFICATION OF TRAFFIC PROBLEMS IN CONGESTED JUNCTIONS USING RING ROAD CONCEPT – A CASE STUDY OF KUNNAMKULAM JUNCTION IN THRISSUR DISTRICT

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**Background:** Kunnamkulam junction, situated in the Thrissur District is one of the major junctions where two state highways, SH 90 and SH 79 intersect. Presently, the Kunnamkulam junction is heavily congested and the movement of vehicles and pedestrians across the junction is inefficient and unsafe. Based on various aspects like geometry of main roads, availability of space in junction area and utility of the nearby roads, the ring road concept has found as the best solution to implement at Kunnamkulam town. Finding the suitable roads as ring roads in Kunnamkulam town and implementing the concept considering the traffic conditions, alignment and space constraints are explained in this paper.

**Methods:**

- Conducting reconnaissance survey and identifying suitable roads for ring road.
- Traffic surveys and detailed Topographic surveys of selected areas.
- Design of alignment for the missing link.
- Preparation of least cost estimate for the proposed missing link.

**Results:**

**Proposed alignment for missing link:** A new alignment is proposed for missing link in the ring road that connects TK Krishnan road to Pattambi road using AutoCAD Civil 3D software.

**Pavement design of missing link:** Based on the CBR value obtained from the subgrade soil collected from the junction i.e. 17.1%, and traffic load of 132 msa, the pavement layer thickness is derived from the design charts provided in the IRC: 37-2012.

**Cost Estimate for missing link:** The estimate covers land acquisition cost, material and construction cost of cross-section elements, traffic sign board installation, road markings, cross drainage works and other road appurtenances.

**Conclusions:** The paper presented the salient features of the improvement plan adopted for the junction which include:

- Reconnaissance survey and necessary site visits to assess the existing problems and to identify the possible road stretches to connect as ring road.
- Details of traffic survey conducted at the junction and the bell-mouth of all the ring roads to assess the current traffic flow and have done detailed topographical survey to map the existing roadway features.
- The detailed description about the proposed alignment for a missing link in the ring road with alignment details, pavement design and cost estimate.

**Key words:** Ring road, alignment design, pavement design, cost estimate

05-11

### HOLOGRAPHIC RECORDING OF MICROSCOPIC IMAGES USING PHASE SHIFT INTERFEROMETRY

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**Background:** Phase-shifting interferometry (PSI) is a holographic interferometric technique where multiple holograms are generated by giving appropriate phase shift to one of the beams. The amplitude and phase information of the object can be analyzed from the complex hologram. The proposed work is based on transmission type microscopic tissue imaging based on phase shifting interferometry and its reconstruction by angular spectrum method. The proposed method is evaluated by computing the Peak Signal to Noise Ratio (PSNR).

**Proposed Transmission type Microscopic Imaging PSI:** The proposed work is meant to record the hologram of transmission type microscopic tissue imaging based on phase shifting interferometry. The post operative collected specimen after processing is embedded in paraffin block. The paraffin block is cut into thin microscopic sections using microtome and fixed on a glass slide.

The microscopic tissue is placed as sample and a microscopic objective (MO) is used to magnify the microscopic tissue. The beam splitter splits laser beam into two parts—the reference beam and the object beam. One mirror is mounted with a Piezo Electric Transducer (PZT) which provide appropriate phase shift to the reference beam. The reflected object beam is again reflected by mirror and made to fall on microscopic sample. The MO helps to yield a magnified version of the sample. On the second beam splitter both the object beam and phase shifted reference beam are superposed and the corresponding interference pattern is observed in CCD which can be transferred to a PC.

The complex amplitude of the object light is referred to as the complex hologram because the amplitude distribution of the object light in the object plane is retrieved from by performing digital back-propagation. The reconstruction can be performed by angular spectrum method.

**Simulation Results:** To monitor the quality of the resulting reconstructed image of the hologram, the Peak Signal to Noise ratio between images is measured, which is defined as

Mean Square error, where  $I_o(m,n)$  and  $I_r(m,n)$  represents reconstructed and input image, M,N is the size of the image and  $R$  is the maximum fluctuation in the input image data type. The PSNR value is used to measure the quality of image after reconstruction and is found to be 12.03.

**Conclusion:** The proposed work implemented the hologram generation and reconstruction of microscopic sample tissue images by phase shifting interferometry. Phase-shifting interferometry provides a convenient method for computer analysis of interference patterns. The PSI technique can eliminate the influence of zero-order light and twin image, thereby improves the quality of the reconstructed images at the output.

**Keywords:** Phase-shifting interferometry, holographic interferometry, multiple holograms, phase shift, reconstruction.

05-12

### ENHANCED PEDESTRIAN DETECTOR USING FIRST ORDER AND SECOND ORDER AGGREGATED CHANNEL FEATURES

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**Background:** Pedestrian detection is an active research area in computer vision field due to its significant role in

driverless cars, traffic surveillance using CCTV, anomaly detection in public spaces etc. Performance of a detection algorithm heavily depends on the discriminative nature of features extracted from the images. Aggregated channel feature (ACF) detector which uses low-resolution channels extracted from the first derivative of the images as features and AdaBoost as the classifier is widely accepted pedestrian detector due to its simple framework, better accuracy and computational speed. State of the art pedestrian detectors based on ACF framework, either adds more channels for feature extraction or they will apply some filters on existing channels.

**Method:** This paper introduces a new set of features termed as Second Order Aggregated Channel Features (SOACF) which used the second derivative of the image for feature extraction. Further, a new detector is proposed which employs both the first order channels of ACF and second-order channels of SOACF together. This was made possible by a merging algorithm based on weighted non-maximum suppression, which effectively merge the results of two separate AdaBoost classifiers trained using ACF and SOACF.

**Results:** The proposed detector achieved a miss rate of 24.56% on Caltech dataset against 28.10 % miss rate of baseline ACF detector. Similarly, for KITTI dataset, the miss rate of the proposed detector is 16.92% whereas for ACF detector, it is 18.52%. Also, in comparison with topmost pedestrian detector based on ACF methodology, the proposed detector is 100 times faster without any parallel computation.

**Conclusion:** This work proposes a new feature set SOACF based on the second derivative of the image. Also in this work, a new detector is proposed which make use of both ACF features and SOACF features by a merging algorithm based on weighted non-maximum suppression. The proposed detector achieved much better result than the baseline ACF detector and also has got high computational speed in comparison with state of the art detectors based on ACF.

**Keywords:** Pedestrian detection, Aggregated channel features, AdaBoost classifier

05-13

#### MODE CHOICE ANALYSIS OF WORKERS: A CASE STUDY FROM KOCHI CITY

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**Background:** Mode choice analysis is a method of arriving at a decision on which mode is chosen by a particular commuter to travel, under a set of circumstances. Influence of built environment characteristics, along with personal, household and activity-travel variables on an individual's daily activity-travel pattern is focused by recent researches.

**Method:** Data is collected from Kochi Municipal Corporation by direct interview method. Final data based is used for exploratory data analysis and modelling. Activity based approach, under disaggregate modelling methods is used in the present study. Multinomial logit modelling is used for mode choice analysis of workers for Home-Work-Home pattern.

**Results:** Disaggregate model shows that personal, household, activity-travel and mode characteristics can influence the mode choice behaviour of workers. From the model it is also evident that different residential location characteristics considered also have significant effect on the mode choice decision.

**Conclusions:** The model can be a good input to further transportation policy analysis, which can derive the appropriate policies such as to reduce congestion and increase the mode share of sustainable modes like walk, cycle and public transport.

**Keywords:** Activity based approach, Mode choice behaviour, Multinomial logit model, Residential location characteristics, Developing country



05-14

### STUDY OF USE OF INDUSTRIAL WASTE MATERIALS FOR DEVELOPMENT OF AERATED MASONRY BLOCKS

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**Background:** Aerated masonry blocks can be used as an alternative to conventional concrete blocks, which possess high density which in turn results in increase in self-weight of the whole structure. Owing to its sustainability, low thermal conductivity and use of less mortar joints, now a days aerated masonry blocks has become a wide popularity. In Addition to the above advantages, aerated concrete can also incorporate cement replacements with fly ash, waste rubber particles from retread and tyre manufacturing industry, shredded plastic etc., which can lead to the consumption of waste products which are otherwise leads to environmental pollution.

**Method:** This research work determines the suitability of aerated concrete incorporating industrial waste products like rubber particles and PVC granules for the development of masonry blocks. This is done by determining compressive strength and density. The target strength to be attained is fixed between 5 MPa and 10 MPa and density below 1600kg/m<sup>3</sup>. The water- cement ratio is 0.45. The aerated concrete is developed by using Aluminum powder as air entraining agent. The aggregate content is omitted throughout the study.

**Results:** The cement is replaced with 20% of Fly ash. The optimum Aluminum content is found to be 0.5% by weight of cement which density and compressive strength which got increased on addition of PVC granules by weight of cement upto 75% and then decreases. In case of rubber powder incorporated aerated concrete, density and compressive strength decreased considerably.

**Conclusions:** This study reveals the use of industrial waste products in aerated concrete for developing masonry blocks which can make the construction more sustainable and economical. The use of PVC incorporated aerated masonry blocks exhibits more enhanced properties.

**Keywords:** Aluminum powder, Aerated concrete, Fly ash, rubber powder, PVC granules, density, compressive strength

05-15

### PARAMETRIC RESPONSE ESTIMATION OF DIAPHRAGM WALL BEHAVIOURS FOR OPTIMAL SYSTEM CONFIGURATIONS

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**Background:** Recent upsurge in economic development necessitates need for more material space in urban areas. The growing demand is to utilise underground space more productively. Deep excavations and selection of appropriate support facilities have substantial impact on economy, time and performance. Hence, reliable estimates of excavation related responses are vital.

**Method:** This paper presents the results of parametric analysis performed on diaphragm walls to comprehend the effects of influencing factors like ground characteristics and support configurations. Diaphragm walls were analysed as plain strain problem using Plaxis 2d. Wall sections were modelled as elastic plate element and soil masses were simulated as elastic plastic material under Mohr-Coulomb failure criterion.

**Results:** Values of lateral deflections, bending moments, normal forces and shear forces were computed for all possible combinations of influencing factors of diaphragm wall system. The results are represented in comparative charts and tables so that effective combinations of wall and support criteria for any field conditions can be perceived easily.

**Conclusions:** Wall behaviours studied under different field conditions and support characteristics emphasize the necessities of accurate response prediction models. The results presented in terms of comparison charts and safety factors can assist a designing engineer to choose optimum design parameters for any proposed diaphragm wall project.

**Keywords:** Deep excavation, Diaphragm wall, Parametric analysis, Wall response

05-16

### MECHANICAL PROPERTIES OF CHICKEN FEATHER FIBRE REINFORCED NATURAL RUBBER BIOCOMPOSITES

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**Background:** Chicken feather fibre (CF) is commonly described as a waste by-product and they are contributing to environmental pollution due to the disposal problems. The composite reinforcement application of the CF offers much more effective way to solve the environmental concerns compared to the traditional disposal methods (burning and burying). The CF as a composite reinforcement has certain desirable properties that includes; lightweight, high thermal insulation, non-abrasive behaviour and excellent hydrophobic properties. The present study is the development of a new class of composites with the CF waste as filler in natural rubber (NR) to solve the environmental problem and to develop cheaper filler for NR composites.

**Method:** Biocomposites of NR reinforced with CF were prepared using dicumyl peroxide (DCP) as vulcanizing agent. Composites with two series of CF were studied. i.e., raw (RCF) and alkali treated (ACF) fibres. Surface modification of the fibre was done by alkali treatment to improve the interfacial adhesion. The influence of fibre loading and chemical modification on the mechanical properties of composites was analysed. The composites were characterised by using FTIR and scanning electron microscopy (SEM).

**Results:** The mechanical properties such as tensile strength, tear strength and tensile modulus were found to be improved by the incorporation of CF in all forms. A fibre loading of 25phr has been found to be optimum for the best balance of properties. Better properties are shown by the composites with ACF. SEM studies support the results of mechanical properties. FTIR analysis confirms the interfacial adhesion of CF in the NR matrix.

**Conclusion:** Blends of natural rubber with acrylonitrile butadiene rubber (NBR) are used for many product applications like oil seals, hoses and automobile bushes etc. Hence a method of utilization of waste chicken feathers as reinforcing agents in NR offers a good ecofriendly modification. There are many other areas where the applications of these materials are to be tested and utilized.

**Keywords:** Chicken feather fibre, Natural rubber, Dicumyl peroxide, Mechanical properties

05-17

### ROBUST HAND POSTURE RECOGNITION USING SVM CLASSIFIER WITH GABOR AND DWT FEATURES

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**Background:** Hand gesture recognition has got key attention of researchers due to its popularity in varied fields such as human machine interaction, robotics, medical therapy, sign language communication etc. This paper presents a static hand gesture recognition method using image features and multiclass support vector machine (SVM) classifier by addressing its application for the communication of people with speaking and hearing difficulty. The method works by extracting the visual features of the hands from the images of gestures.

**Method:** The method includes the hand segmentation, feature extraction and recognition phases. Hand segmentation extracts the hand palm region from the input image by eliminating the irrelevant pixels and body parts from the background. Then, the combination of the feature values obtained through Gabor and DWT (Discrete Wavelet Transform) descriptors are used to form the feature vector. Further reduction with PCA (Principal Component Analysis), selects the most discriminative feature values. The classification of the hand postures are done with multiclass SVM.

**Results:** The proposed method has been tested on the publicly available Jochen Triesh hand posture dataset. The sample images of the ten different static hand gesture classes with uniform background are used for the experiment. The dataset has been divided into two equal sets as training and validation sets. The obtained result has been compared with a previous work on the same dataset. The analysis shows that the proposed method is very effectual for static hand gesture recognition.

**Conclusion:** This work utilises the support vector classifier with image features extracted through Gabor and wave-

let decomposition for robust hand posture recognition. The method has been tested on the Jochen Triesch dataset and achieved better recognition accuracy.

**Keywords:** Hand Gestures, Sign Language, Visual Features, Gabor, Wavelet, Principal Component Analysis, Support Vector Machine.

05-18

### **A COMPARISON OF PERFORMANCE OF MARGIN INFUSED RELAXED ALGORITHM AND SUPPORT VECTOR MACHINE ON THE TASK OF WORD SENSE DISAMBIGUATION FOR MALAYALAM**

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**Abstract:** Word Sense Disambiguation (WSD) for Malayalam is a challenging task due to the characteristic features of the language. In this paper, we presenting a comparative study of two sequential Algorithms viz. Margin-infused Relaxed Algorithm (MIRA) and Support Vector Machine (SVM). The System makes use of the contextual feature information along with the parts of speech tag feature in order to predict various WSD classes. We have used CRF++ for implementing the MIRA algorithm and Yamcha for implementing SVM algorithm. A small hand labeled Malayalam dataset of lexical sample examples were used and had a decent accuracy score on initial experiments. The results show the superiority of MIRA over SVM and are just little lower than the highest results achieved for this task. However, a further analysis and experiments on large standard sense-tagged data are necessary to make any significant claims on the models to disambiguating Malayalam word senses for lexical sample tasks. With more improvements, there is very good potential and the possibility for these models to be effective on the Malayalam language.

**Keywords:** Word Sense Disambiguation(WSD), Margin-infused Relaxed Algorithm (MIRA), Support Vector Machine (SVM).

05-19

### **EVALUATION OF GROUNDWATER QUALITY AT CHAVARA, KOLLAM DISTRICT, KERALA USING GIS AND MODFLOW**

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Groundwater is a vital source of water. Groundwater contamination occurs when man-made products such as gasoline, oil, chemicals, etc. get into the groundwater and cause it to become unsafe and unfit for human use. Kerala Minerals and Metals Ltd. (KMML) located at Chavara, Kollam district is one of the major industries in Kerala. It is the only integrated plant with Mineral separation, Synthetic Rutile plant with acid regeneration facility and Titanium dioxide pigment production plant in a single complex. People around this industrial area is mainly depend on ground water source, particularly the open wells for their domestic purposes. It was reported that groundwater and surface water around the KMML was affected due to effluents from the industry. In this project spatial distribution of ground water quality and groundwater flow pattern were studied for KMML industrial area. Water samples were collected from all around the taluk, and the spatial variation of each parameter was studied using GIS (Geographical Information System). The contaminant distribution of a large area was obtained with the help of few samples in the location. The surface water-groundwater interaction was simulated by using the MODFLOW model. MODFLOW was used to describe the movement of groundwater of constant density through porous material.

**Keywords:** Geostatistical methods, Groundwater pollution, Geographical information system, MODFLOW.

05-20

### SYNCHRONOUS GENERATOR EMULATION IN POWER ELECTRONIC CONVERTERS FOR IMPROVING THE GRID INERTIA

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**Background:** Dependence on renewable energy based distributed generators (DGs) has been growing rapidly in the recent years to relieve the burdened conventional utility grids and to reduce the environmental impacts of centralised thermal generation (based on coal or oil). Besides, researchers expect to achieve even higher penetration of DGs in the coming years. With the growth in renewable energy penetration, the amount of renewable energy interfaced to the grid via inverters is also ramping up. However, the interconnection of inverter-based DGs and utility grids has its challenges to be addressed. Unlike the conventional power plants, DGs reduce the total inertia of the system as they do not have any rotational inertia and damping properties.

**Method:** One feasible solution is to emulate the DGs as synchronous generators by adding virtual inertia using energy storage. The power electronic converter is controlled using a control algorithm based on the mathematical model of a synchronous machine. In this paper, Reduction in grid inertia is addressed by using a synchronverter based control framework to replicate the dynamics of a synchronous generator. A simulation study is carried out in the grid-connected mode in MATLAB/Simulink platform under different grid conditions. Simulation results are verified using experimental results.

**Results:** Simulation results and experimental analysis of the grid-connected synchronverter proves that it has the potential to improve the dynamic frequency response and the grid inertia. The resulting voltage and current waveforms were almost sinusoidal with considerably low distortion. The synchronverter was able to perfectly respond to and track the voltage and frequency changes in the grid similar to a synchronous generator. The frequency and voltage profile were maintained as the synchronverter independently controlled the active and reactive power.

**Conclusions:** Hence, it is evident from the results that the synchronverter was able to replicate the dynamics of synchronous generators to the desired level and improve the overall stability and inertia. The emulation of synchronous generator behaviour in power electronic converters helps in improving the grid inertia with the increasing penetration of renewable energy sources.

**Keywords:** Grid inertia, synchronverter, virtual synchronous machine

05-21

### CHARACTERIZATION OF DC MAGNETRON SPUTTERED COPPER THIN FILM ON ALUMINIUM TOUCH SURFACE

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**Background:** Care Assisted Infections (HCAI) introduces problems like prolonged hospital stay, additional financial burden and excess death. Since, copper is registered by US Environmental Protection Agency (EPA) as the only solid antimicrobial metal, which could be used in hospital touch surfaces.

**Method:** In the present work, copper has been deposited on the aluminium substrate by DC magnetron sputtering method at different target powers. Prior to the coating, the substrate has undergone double zincation process. The coating has been characterized by XRD, SEM, TEM, scratch hardness test and microhardness test.

**Results:** From the TEM micrographs, the grain size is found to be decreased from 49 nm to 18 nm on increasing the deposition power from 50 W to 150 W. Along with the decrease in the grain size, the mechanical properties like scratch hardness and microhardness of the coating has been increased. The preferred growth along [111] direction observed in XRD analysis is responsible for the increase in the hardness of the coating apart from the presence of the nano-grains. The SEM image of the coating shows the nodular morphology which enhances the surface area.

**Conclusions:** The antimicrobial copper thin films deposited on double zincated aluminium possess excellent mechanical properties due to its microstructural characteristics. Moreover, the nano-twins help to increase the scratch hardness

and microhardness of the coating. The film has special features like nodular morphology, the nodules being made up of extremely fine grains.

**Key words:** Sputtering, Copper coating, Microstructural characterization, Nano-grains

05-22

### WHEN NATURE MEETS TECH: AUGMENTED REALITY FOR REBUILDING TOURISM AND HOSPITALITY

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**Background:** Tourism, especially Kerala tourism, has been widely recognized as a major tourist attraction for domestic and international visitors in many destinations. Numerous uncovered and enchanting hidden beauty of the places in many parts of Kerala. The divergence and personalization for tourists in demand and novel tourism approaches and deployments are expected to attract tourists. Therefore, an efficient and personalized service for tourists has become an essential issue in the development of new technological resources while rebuilding Kerala. Inspired by recent developments of virtual reality, an AR model for rebuilding tourism and hospitality in Kerala is proposed in this paper.

**Method:** Augmented reality is the research area that deals with the class of problems to enhance the reality of mobile users with virtual objects. Augmented reality in tourism has a great potential to enhance traveler's experiences and is generally experienced via smart phone camera. AR can be incorporated to develop mobile guides to tourist as key representatives of destinations playing a significant role on tourist satisfaction and re-visit intention. In this paper, we propose a novel sightseeing info system, through augmented reality and recommender engine using the information of the sensors which can offer sightseeing info based on the Context of Interests (CoI). COI info and contents triggered by signal from sensors are downloaded and overlapped on the real image on smart device to recognize virtual reality.

**Results:** Application architecture was simulated on the Android system using Java. Hence, the Java Virtual Machine (JVM) and Java Development Kit Application Programming Interface (JVM API) libraries and tools form the core technology. Higher layers include OpenGL ES 2.0 for graphics and the arc42-android-sdk-master Software Development Kit (SDK) to provide AR support. Execution of the AR algorithm for tourism information system has been evaluated by conducting various investigations on a variety of sites.

**Conclusions:** An AR model for rebuilding tourism and hospitality in Kerala is proposed in this paper. Unlike the existing tourism websites for Kerala, a new idea is proposed where an integration of the real world and the virtual world using high tech cameras with technology of augmented reality is presented and tested using different sites. Further enhancements suggested are- more sophisticated contents such as 3D objects and mobile augmented reality for flood visualization. The new idea of enhancing a Kerala Tourism enabled with AR technology, will in any way increase the revenue of the state, though it incurs not lesser initial expense.

**Keywords:** Augmented Reality, Recommender Engine, Kerala Tourism, Context

05-23

### HIGHLY TOUGHENED NANOSTRUCTURED SELF ASSEMBLED THERMOSETS - AEROSPACE AND AUTOMOBILE APPLICATIONS

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**Background:** Epoxy resin is one of the promising thermosetting materials which play an important role in the field of nanotechnology and modern polymeric materials. But cured epoxy resins are highly brittle and have poor fracture toughness because of their extreme cross-linked structures when compared to other engineering thermoplastic polymers. To overcome these limitations, amphiphilic block copolymers have been used as modifiers in epoxy resin.

**Method:** This approach consists of the epoxidation of Poly butadiene (PB) block in the SBS (poly (styrene-b-butadiene-b-styrene) block copolymer and further mixing with DGEBA (Diglycidyl ether of bisphenol A). 4, 4' diamino diphenyl methane (DDM) was used as the hardner and later it was cured at certain intervals of time by using different

temperatures. Morphological, Spectral, Dynamic Mechanical and mechanical properties have been investigated.

**Results:** Epoxidation of SBS block copolymer and degree of epoxidation was confirmed by Fourier transform infrared spectroscopy (FTIR) and Nuclear magnetic resonance spectroscopy (NMR). The incorporation of epoxidized block copolymers in epoxy result in the formation of highly ordered and supertoughened nanostructured spherical blends. The morphologies of the blended polymers were confirmed by using field emission scanning electron microscopy (FE-SEM), transmission electron microscopy (TEM), and atomic force microscopy (AFM). Left shifting of loss modulus and Tg of the blended system can be observed through Dynamic mechanical analysis (DMA). Finally, the toughness of the blended systems was analyzed through fracture toughness measurements.

**Conclusions:** In this work, we have successfully fabricated a supertough highly ordered nanostructured spherical blend system. This as synthesized nanostructured thermosets will be expected as an excellent toughened material for floor adhesives, aerospace, automobile and other industrial applications.

**Keywords:** Epoxy, Block copolymer, Supertough, Nanostructured thermosets, Self assembled

05-24

### GEOPOLYMER: A SUBSTITUTE FOR PORTLAND CEMENT AND SOLUTION FOR DURABILITY ISSUES OF CONCRETE

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**Back Ground:** Portland cement is a versatile binding material used world over in construction sector. Its universal availability, economy and water resistance made it a popular binding material. The plasticity of concrete in the wet state and high compressive strength in the hardened state make it the most desired building material of civil engineers. Statistics says that annual per capita consumption of concrete worldwide is one tone. Whatever the merits Portland cement have the demerits now weigh over them. The auto biography of cement proclaims that it liberates one tone of carbon dioxide while producing one tone of cement. Around 65% of greenhouse gas liberated is carbon dioxide of which 7% is contributed by cement industry. Cement is also a high energy intensive product. Its embodied energy (EE) is around 4.53 MJ/kg. On the other hand thermal power plants have become an unavoidable evil to meet the energy demands of the world. Since coal is abundant on earth compared to crude oil, it has become a common fuel in all thermal power plants expelling large quantity of fly ash as waste material. Due to the increasing production of iron, slag has also become another waste material. The use of these waste materials will not only save energy but will reduce carbon dioxide emission also; if it is used as a substitute for cement.

The strength and durability of concrete are the two major criteria to define a high performance concrete (HPC). Now techniques are available to achieve high strength concrete (HSC). Achieving required durability is the major challenge faced by the construction industry especially due to exposure condition. A host of environmental and pollution factors adversely affect the durability of concrete resulting in heavy economic losses, safety and serviceability aspects. Use of Geopolymer as a binder material in substituting cement is the best option to enhance the durability of concrete structures.

**Method:** The alkali activated inorganic polymer, popularly known as Geopolymer is derived from alumino-silicate based materials like F-class Fly ash, Ground granulated blast furnace slag (GGBS), Metakaolin, Rice husk ash etc.; activated up on by an alkaline solution like sodium silicate and sodium hydroxide (8 to 16 Molar). The economically feasible solution is using a combination of Fly ash and GGBS as alumina-silicate material and using sodium silicate alone or a combination of sodium silicate and sodium hydroxide as an alkaline activator solution. If we use fly ash alone heat curing at 60° to 90° C is desirable. However if a combination of fly ash and GGBS with a mixture sodium silicate and sodium hydroxide as activator solution is used, it can set and harden at ambient temperature. This is more practical.

**Result:** By using different combinations of Fly ash and GGBS as well as different mixed proportions of alkaline solution; sodium silicate and sodium hydroxide can evolve Geopolymer binder possessing different characteristic features suitable for different applications such as making Geopolymer concrete, Geopolymer grout for encapsulating cement concrete elements by spraying or guniting. Pressure grouting to fill the voids within the concrete mass by impregnating is another option. When a combination of Fly ash and GGBS is used as source material and sodium silicate alone as activator solution, it can set at ambient temperature, but may take around 72 hours. The slow setting process prevents thermal cracks and the Nano-sized particles impart lesser permeability, better durability and strength in the long run. The Si-O-Al bond in Geopolymer is more strong and stable than C-S-H bond in cement. Sodium silicate possesses corrosion inhibition property on steel reinforcement. Use of sodium hydroxide in combination with sodium silicate

as activator solution can impart early strength and can set at ambient temperature but may lead to carbonation effect.

**Conclusion:** Geopolymer binder can be used as a substitute binding material at par with Ordinary Portland Cement. It can be used to make high performance concrete having higher strength and better durability. By using Geopolymer as the building binding material we have the other advantages such as conservation of water, saving in energy, reduction in carbon dioxide emission, conserving lime stone and making use of waste material.

**Keywords:** Geopolymer, Geopolymer concrete, Durability of concrete, High strength concrete, High performance concrete, Grouting, Guniting, Pre-cast concrete

05-25

## DESIGN, CONSTRUCTION AND APPLICATION OF VARIABLE DUTY CYCLE OPTICAL CHOPPER

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**Background:** Optical choppers are optomechatronic devices used for controlled modulation and attenuation of light beams. Presently available optical choppers do not have options to vary the duty cycle and are very costly. Present work is an attempt to design and construct a cost effective optical chopper with a variable duty cycle and study its effect on the thermal lens signal.

**Method:** The optical chopper wheels are designed to vary the duty cycle from 0 to 50% by using two chopper wheels of 50% duty cycles. A pulse width modulator based circuit is used to control the speed of a 12 V 100 rpm DC motor. Optical signals for different duty cycles are recorded by using an oscilloscope. The variation in thermal lens signal of water with duty cycle is analysed by using thermal lens spectroscopy.

**Results:** The output optical signals for different duty cycle is verified from the oscilloscope. Thermal lens signal at 50% duty cycle shows an initial decrease due to self-defocussing, caused by the decrease in refractive index at beam centre. This initial decrease is followed by a gradual increase in the signal due to the rebuilding of the refractive index caused by the molecular movement within the medium. This rebuilding will create an error in the thermal lens parameters. But at 10% duty cycle the thermal lens signal of water matches with the standard one.

**Conclusion:** The optical chopper with variable duty cycle is designed and constructed in a cost effective manner. The signals of the constructed optical chopper are recorded using an oscilloscope. As an application, the effect of duty cycle on thermal lens signal is studied with water. At 10% duty cycle the effect of photothermal reaction and diffusion can be neglected and the accurate thermal lens parameters can be obtained. Thus optical chopper with variable duty cycle can be used for eliminating unwanted signals in thermal lens spectroscopy.

**Keywords:** Optical chopper, Variable duty cycle, Thermal lens spectroscopy, Thermal lens signal.

05-26

## STRUCTURAL AND OPTICAL CHARACTERIZATION OF SOL-GEL SPIN COATED ZnO THIN FILMS

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**Background:** Transparent electronics is an emerging technology for the next generation optoelectronic devices. Transparent Conductive Oxides (TCOs) are the key stone of transparent electronic devices. ZnO is atypical example for TCOs as it is inexpensive and also shows better electrical and optical properties. Spin coating is comparatively low-cost, simple and widely used technique for deposition of thin films and it offers the best possibility for preparing small and large area coatings. Due to these advantages, spin coating is preferred over other available deposition techniques.

**Method:** In the present work, ZnO thin film is prepared by the method of spin coating. ZnO solution is prepared by adding Zinc acetate dehydrate  $Zn(CH_3COO)_2 \cdot 2H_2O$  to 2-Methoxyethanol ( $(CH_3)_2CHOH$ ) containing monoethanolamine (MEA) ( $H_2NCH_2CH_2OH$ ). Molar ratio of Zinc acetate dehydrate, the precursor and MEA, the stabilizer is taken as 1:1. The precursor concentration is maintained at 0.5 mol/L. The solution is then stirred continuously for 3 hrs at 60°C using a magnetic stirrer. Solution is again stirred at room temperature for 24 hrs to yield a clear homogeneous and transparent solution. In order to obtain the ZnO thin film, the solution is dropped on to the glass substrate which is rotated at 3000 rpm for 30 sec and preheated at 250°C for 5 mins. This helps to evaporate the solvents and organic residuals. The

process is repeated for ten times and the films are post-heated for 3hrs at 400°C.

**Results:** From the XRD results, the crystal size of the deposited ZnO thin film is obtained to be 15.84 nm. The strong preferential growth is found along c axis (002) plane suggests ZnO shows wurtzite crystal structure. From the SEM micrograph it also observed that the grain size grains are continuous and are tightly packed. From the optical transmission spectra the average value of transmission is found to be 98% and the band gap is obtained to be 3.34eV.

**Conclusion:** ZnO thin films with a better crystallite size having continuous and tightly packed grains are obtained by the spin coating method. In addition to this the film shows better optical transmittance. As the mobility of charge is large in crystalline materials, the presence of small crystalline grains can lead to the fabrication of high field effect mobility thin film transistors.

**Keywords:** Spin coated ZnO thin film, crystallite size, bandgap

05-27

### MECHANICAL, DIELECTRIC AND MORPHOLOGICAL CHARACTERIZATION OF HDPE - CHITOSAN - HYDROXYAPATITE COMPOSITES FOR ORTHOTIC APPLICATIONS

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**Background:** The use of biocomposites for medical applications offers numerous possibilities for implants design. The present investigation focuses on introducing hydroxyapatite, the inorganic mineral resembling to the bone mineral into high density polyethylene (HDPE) chitosan (CS) bio-composites having properties resembling cortical bone.

**Method:** The fabrication of the HDPE-chitosan-hydroxyapatite biocomposites were carried out through a melt mixing process using maleic anhydride as compatibiliser by a peroxide initiated process at 160 °C. The plasticizing effect of palm oil was studied on the ternary system with better mechanical properties. Mechanical studies, dielectric properties, thermal studies and morphological analysis have been carried out on the developed composites.

**Results:** HDPE-chitosan-hydroxyapatite exhibits good mechanical properties. The impact strength showed an increase upto 9.34 % of the neat HDPE till 5 wt% CS loading and thereafter was found to decrease. Studies on the plasticizing effect of the oleic acid component of palm oil in the composite with highest impact strength showed strong interfacial interaction between the filler and matrix with little change in the mechanical properties. The incorporation of hydroxyapatite to the plasticised system has been found to increase the mechanical properties of the composites. An improvement in the dielectric properties was observed with the addition of palm oil, which has been attributed to the segmental mobility, as well as the increase in relaxing dipoles in the system. The results obtained were in close proximity with the human cortical bone.

**Conclusions:** Mechanical characterisation revealed that the prepared composites show comparable dielectric and mechanical properties as seen in human cortical bone. The prepared biocomposite system offers an economical way in developing a biomaterial with excellent potential in orthotic applications.

**Keywords:** HDPE, Chitosan, Hydroxyapatite, Dielectric properties, XRD, FESEM

05-28

### FABRICATION OF FLEXIBLE, DISPOSABLE NANOCELLULOSE BASED SERS SUBSTRATES FOR TRACE LEVEL SENSING OF ENVIRONMENTAL CONTAMINANTS

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**Background:** Environmental pollution is growing at an exponential scale. The overuse of pesticides has caused serious health issues to humankind and environment. Kerala markets have shown alarming rates on the exceeding limits of pesticide usage. Strategic control over the dimension and architecture of noble metal nanostructures has led to the development of innovative techniques such as surface plasmon resonance, Surface enhanced Raman scattering (SERS), metal enhanced fluorescence, etc. of which SERS is a potent spectroscopic technique, which identifies the spectral fingerprint of molecules directly without labeling in solid and liquid state. The urge to develop sensitive and label free surface enhanced Raman active substrates is in great demand in the current scenario. SERS technique has immense



applications in point-of-care devices and for monitoring environmental contaminants.

**Method:** The present work investigates the fabrication of flexible, ultrasensitive SERS substrates with silver nanostructures reduced using TEMPO oxidized nanocellulose and trisodium citrate for the detection of various analytes such as 4-mercaptopyridine (MPY), Methylbenzene thiol (MBT), and Methylene blue (MB) and pesticides such as Thiram, etc. Nanocellulose synthesised from banana pseudo stem fibres has been used as soft template for development of highly stable silver nanostructures. The nanocellulose supported silver nanostructures were incorporated into a biocompatible polymeric substrate, poly (vinyl alcohol) by solution casting method for the fabrication of flexible, sensitive SERS strips.

**Results:** The SERS efficiency of the nanostructures and the substrates were evaluated for solid state trace level detection of MPY, MBT and MB. The regression analysis of MPY shows good sensitivity with detection limits at parts per trillion (ppt) level. Further, the synthesized nanostructures were analyzed for its sensitivity to detect Thiram, a fungicide and ectoparasiticide commonly used to prevent fungal diseases in seeds and crops. The lowest limit of detection of Thiram was found to be at parts per billion (ppb) level.

**Conclusions:** Herein we report a facile and cost effective method for the fabrication of free standing, ultrasensitive SERS substrates for the detection of pesticides and other important analytes. The nanostructures showed enhanced sensitivity to various environmental contaminants with detection limits at parts per trillion level.

**Keywords:** Nanocellulose, SERS, Silver nanostructures, Substrates, Detection Limit

05-29

### A STUDY ON DRIVING BEHAVIOURAL ASPECTS OF GOODS VEHICLE DRIVERS

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**Background:** Crashes involving heavy vehicles have been on the rise over the years in Kerala. Even though the number of heavy vehicles plying on Kerala roads are less compared to two wheelers and cars, the proportion of crashes involving heavy vehicles is a cause of concern. Faulty driving behaviour is widely regarded as the major cause of such crashes.

**Methodology:** The work is aimed at identifying the characteristics affecting aberrant driving behaviour of goods drivers. Considering the drivers' perceptions and their socio-demographic background, their behavioural variations were noted. Analysis was done based on a questionnaire survey from which behavioural data were collected from more than 1200 goods vehicle drivers. The variations in violations, errors and lapses of the driver were noted based on various factors like experience, education, vehicle type and working hours.

**Results and Conclusions:** It could be observed that the driving behaviour exhibited by drivers on road are developed through years of driving experience and is found to be affected by the socio-demographic background of the driver. Driver's age, Experience of the driver, kilometers driven per day and the type of vehicle driven were found to have high influence in driving and non-driving behaviour of the driver.

**Keywords:** Driver behaviour, Road safety, Accidents.

05-30

### PHOTONIC CRYSTALS OF CORE - SHELL COLLOIDAL PARTICLES AS APTA SENSOR FOR ENVIRONMENTAL MONITORING

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**Background:** Nowadays, pesticides have become an inevitable ingredient in modern agricultural practices. But the extensive use of pesticides can cause deleterious effects to the environment and hence to the living things. This has been a serious health concern over India and unfortunately no such indigenous, affordable, hand held sensing devices are available in the market. For this reason, development of simple color changing sensors for detection of pesticides

is essential in monitoring the levels of pesticides in the fruits and vegetables. Current methods for pesticide detection involve spectrophotometric and chromatographic techniques, which is time consuming, laborious and require expensive equipments and trained personnel. Therefore, researchers are trying to develop simple and cost effective sensors for pesticides.

**Methods:** The present work engineers a visual sensor for the rapid detection of pesticides. Responsive photonic crystals (PCs) are used as the sensing platform for incorporating pesticide specific aptamer sequences. In response to the specific binding of pesticide, the hydrogels in the photonic crystal will shrink and diffraction wavelength will shift resulting in a color change of the photonic crystal. Thus the pesticides can be detected with our naked eyes by a rapid color change.

**Results:** The PC was fabricated using PS@poly(MMA-EGDMA-AA) core-shell microspheres and it exhibited brilliant cyan color. In aptamer solution PC's color red shifted to green. But upon conjugation with pesticide, poly(MMA-EGDMA-AA) hydrogel underwent shrinking and hence the color changed to blue exhibiting a hypsochromic shifting of photonic stop band in UV-Vis spectra. Thus we have realized a simple and fast visual sensor for the pesticide, omethoate.

**Conclusion:** Core-shell based photonic crystals sensor has been engineered with polystyrene as core and poly (MMA-EGDMA-AA) as shell for the easy detection of a common pesticide, omethoate. The response was very quick and could be observed with our naked eyes. Since a simple and low-cost method have been adopted for the fabrication of photonic crystals, we are successful in realizing an economical optical sensor for selective visual detection of pesticides.

**Keywords:** Responsive photonic crystals, core-shell microsphere, pesticide, sensor

05-31

## STUDY OF SEASONAL VARIATIONS IN OPTICAL SIGNAL ATTENUATION DUE TO TROPOSPHERIC EXTINCTION

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**Background:** Free Space Optical (FSO) communication has emerged as a powerful means of communication with better performance in data handling, bandwidth and cost effectiveness. FSO communication makes use of highly coherent laser sources for transmission and reception between the Earth and satellite or inter-satellite and also for establishing terrestrial links. It finds applications in fields ranging from remote sensing to radio astronomy.

**Method:** The micro pulse lidar (MPL) with AlGaAs diode pumped Nd-YLF laser (model MPL1000 of Science and Engineering Services Inc., USA) operating at 523.5 nm at pulse energy of 10  $\mu$ J and a pulse repetition frequency of 2.5 kHz is used in the present study for data collection. The MPL was operated at Bangalore (13°N, 77°E, 960 m msl) during 2017 – post-monsoon (October- November), winter (December- February), pre-monsoon (March- May), and monsoon (June- September) and the schedule was followed without interruptions. This work is an attempt to study the seasonal variations signal attenuation due to atmospheric extinction. In the present work, the variation of extinction coefficient with altitude is studied during the four seasons.

**Results:** During all the four seasons in the region near the ground, the aerosol extinction exhibits a linear relation for the altitude upto 0.25 km. Above 0.25 km the extinction coefficient drops rapidly upto an altitude of about 5 km and saturates thereafter. It is found that during all seasons except pre-monsoon the nature of variation of aerosol extinction coefficient with altitude is found to exhibit a logarithmic relation. But during pre-monsoon, the variation of aerosol extinction coefficient with altitude is found to exhibit a polynomial relation.

**Conclusions:** During the post-monsoon, winter, pre monsoon, and monsoon the value of molecular extinction coefficient hence total extinction coefficient is found to decrease for altitude above 0.25 km. The seasonal variation of aerosol extinction coefficient depends on boundary-layer dynamics, aerosol emissions, convection, direction and motion of the wind. The difference in the nature of variation of aerosol extinction coefficient with altitude during pre-monsoon period can be attributed to the enhanced and fluctuating atmospheric temperature and humidity during this season in South India. The sharp decrease of extinction coefficient with altitude can be attributed to the lowering of aerosol concentrations compared to the region below 0.25 km. As a result their concentration and the magnitude of extinction coefficient will be higher in the lower atmosphere and the FSO system face greater attenuation due to aerosol extinction.

**Keywords:** aerosol extinction coefficient, Free Space Optical communication, seasonal variations

05-32

### COMPARISON OF DIFFERENT CONTROL STRATEGIES AND ITERATIVE METHODS USED FOR IMPLEMENTATIONS OF A PHOTOVOLTAIC EMULATOR FOR MICROGRID APPLICATIONS

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**Background:** Due to the increasing power demand, the conventional sources of energy are depleting at a faster rate. Solar energy is an environment-friendly renewable source of energy. Solar photovoltaic technology enables the direct conversion of solar energy to electricity. The field testing of solar photovoltaic systems is dependent on the ambient environmental conditions. The laboratory testing of solar photovoltaic systems require highly controlled conditions which are very difficult to achieve. A photovoltaic(PV) emulator is a non-linear power source which emulates the behaviour of a solar photovoltaic module. It is used for testing and comparing different solar photovoltaic systems.

**Method:** The control strategy of photovoltaic emulator consists of a photovoltaic model part and an iterative part. Direct referencing method and current resistance method are two methods used for implementing the Simulink model of photovoltaic emulator and a comparison of the two methods is made in this work. As the output current equation of the PV system is non-linear, root finding method involving iterations are used in this system to obtain the converged value. So, the commonly used Newton-Raphson and binary search methods are compared in this work for the photovoltaic emulator application.

**Results:** Two popular algorithms were checked for convergence for both PV model individually and for PV emulator. It was observed that the voltage and current values converge in less number of iterations when Newton-Raphson method is used than the binary search method. In addition, the current resistance model is less oscillatory and ripple free compared to conventional direct referencing model when resistive loads are used.

**Conclusions:** This work established that for a photovoltaic emulator, current-resistance model using Newton-Raphson algorithm is a better control strategy for resistive loads.

**Keywords:** Binary search algorithm, Photovoltaic emulator, Newton-Raphson method

05-33

### DATA DRIVEN DEPENDENCY PARSING OF MALAYALAM LANGUAGE

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In Natural Language Processing, parsing specify how structures are assigned to a language. Malayalam is one of the four major Dravidian Languages. The language processing of free-word-ordered, morphologically rich and agglutinative language like Malayalam, always suffer from lack of the decorous syntactico-semantic analysis, which has a great impact in Natural Language Processing pipeline. Data-driven dependency parsing gives a platform for such experiments. The concept of dependency is derived from the fact that the syntactic structure of a sentence can be treated as the binary relations between the words in that sentence. In this work, a transition-based dependency parser is used for the exploration of evaluation of the Tree-bank with 55.9k tokens, in different stages. As an initial setup 10-fold cross validation is done. The accuracy of the parser is evaluated for different complex feature models through optimization, in both learning and parsing stages. After the best optimization, there was an increase in the labeled attachment score, unlabeled attachment score and label accuracy. In Malayalam, both cases and the semantic information are needed for the proper identification of the dependency relation. Mostly, the noun with accusative case takes the dependency role as k2 but for inanimate object, the case will be nominative for the same role, k2. These confusions in automatic labeling of the Karaka roles by the parser were also estimated. The non-projective characteristic of the Malayalam language is clearly tracked in through the results. With different feature combinations, further enhancement in the results can be obtained.

**Keywords:** Malayalam language processing, Dependency parsing, Karaka rules

05-34

### SAFE AND SECURE HOMES FOR KERALA

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**Background:** Heavy rains lashed all over the state from August 9 to 15 causing huge damage in 12 out of 14 districts of Kerala. In this huge calamity the property damage cost was estimated to be around 25000 crores. Even as two months have gone by since Kerala's worst disaster in a century, the biggest challenge for the state has been to raise money for the relief and rehabilitation process. This brings in the need to look into the prospects of building more disaster resistant homes in our state for a safer future. Safety during natural calamities like: Floods, Landslides and Tsunami especially in the coastal areas of Kerala. Strength during disaster like earthquakes and forest fires.

**Method:** The perfect home has to be safe and stronger from the base to the top of the structure. Hence the factors of strength and safety has to be implemented in the structure starting from the basement to the roof of the structure. The various methods of making a building disaster resistant should be done at the foundation level, masonry walls, roofing, pavements and modern methods of constructions also other green materials for construction.

**Results:** The various methods adopted will make each and every component of the house disaster resistant and strong. Also it will increase the useful life of the structures thus paving way for a safer tomorrow.

**Conclusions:** The concept of a perfect home can be made into reality by incorporating the safety and strength aspects in all the components of the house starting from the base of the building i.e. the foundation till the top of the structure. By adopting these methods in the new house constructions and also in the houses which are being rebuilt we can look towards a safer, stronger and a much more disaster resistant Kerala in the future.

**Keywords:** Disaster Management, Disasters, Floods, Earthquakes, Safe and Strong Homes (Structures).

05-35

### COMPARATIVE STUDY OF 3D PRINTING AND CONVENTIONAL CONSTRUCTION PRACTICES

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**Background:** Today we are facing a lot of challenges in construction sector. Construction works have been increasing in developed and undeveloped countries over the past few decades. Unavailability of skilled labours and improper utilization of resources leads to cost and time over run. And Kerala has experienced largest disaster of flood and landslide. According to ADB report, the World Bank has allocated an amount of 25,000 crores for the rebuilding works of Kerala. For proper effective and timely completion of all the works we require faster and safer construction practices with optimum use of resources and this can be achieved by 3D Printing technology. 3D printing is a construction technology in which the 3D models are prepared from a digital file.

**Method:** A mainstream onsite concrete printer costs 30,00,000 INR, though prices should fall. At less than 33 feet (10 meters) in height, and with a throughput of less than 550 pounds (250 kilograms) per hour, it is limited to printing fairly small buildings. Use of specially developed cement-based mortar with the addition of special additives, including reinforcing. According to its characteristics, the mixture is similar to fibre concrete M250, strength class B20.

**Result:** By reducing the costs associated with nonstandard shapes, 3D printing gives free rein to architects and designers. The technology can turn complex designs into real structures that are beyond the capabilities of traditional builders. The autonomous or semi autonomous 3D printers require minimal human surveillance. By operating 24/7 and by reducing chances of on site issues and hence delays, 3D printers can cut construction times dramatically. Due to the additional feature of topology optimization we can use conical, hollow, or honeycomb structures depending upon the requirements.

**Conclusion:** Considering all these factors, 3D printing is a better technology than conventional practices. It ensures structural and environmental safety allowing the flexibility for a wide range of structures adding both economic and structural stability.

05-36

### MALAYALAM PARTS OF SPEECH TAGGER

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The process of assigning one of the parts-of- speech ( POS) to the given word in a sentence is called Parts-of-speech tagging. This paper presents a rule based method for parts-of-speech-tagging in Malayalam Language with suffix stripping approach. The system uses a dictionary containing root words, Uses the identified suffixes to find out the category and a set of orthographic rules to revert sandhi changes. As POS tagging is a very important preprocessing task for language processing activities, Annotated corpora serve an important tool for investigators of natural language processing. **Keywords:** Malayalam Parts-of-speech tagging, tagset, rule based, stochastic, suffix stripping.

### 06 - ENVIRONMENTAL SCIENCE, FORESTRY & WILDLIFE

06-01

#### REDISCRPTION OF THE BAGWORM MOTH *EUMETA CRAMERI* WESTWOOD (LEPIDOPTERA: PSYCHIDAE) WITH MORPHOLOGICAL AND MOLECULAR DATA FROM KERALA, INDIA

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**Background:** Bagworms were recorded as occasional pests from forest areas in Kerala but their polyphagous nature and deficient documentation from human-altered habitats present them as high potential pests in light of climate change and land use change. The study facilitates the identification of the species so as to facilitate easy identification of the species by laypersons/farmers without resorting to the help of experts.

**Method:** The bags of *Eumeta crameri* were collected by handpicking from the Host plants and details of host plants and bag attachment were recorded. Measurements of different morphological characteristics were taken. The molecular analysis of the species were done by using mitochondrial genome (Cox I) with a length of >700 bp.

**Result and discussion:** *Eumeta crameri* Westwood is the common bagworm species it has wide range of hostplants recorded from the study area especially from human habitations. It is a medium sized moth (only male) of length 19mm and females are vermiform with 8mm in length.the wing span is of 70mm. The complete redescription using modern tools since the original description of the moth will help in easy identification of this potential pest.

**Conclusion:** This study explains the characteristics of commonly occurring species of bagworm in Kerala *Eumeta crameri* Westwood and it has wide range of host plants including economically important plants.

**Key words:** Psychidae, Bagworms, *Eumeta crameri*

06-02

#### THREE-DIMENSIONAL RECONSTRUCTION OF TREES AND DIRECT ESTIMATION OF LEAF AREA INDEX OF A TROPICAL FOREST USING TERRESTRIAL LASER SCANNER LiDAR POINT CLOUD

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**Background:** Light Detection and Ranging (LiDAR) technology has the potential to offer accurate and precise three-dimensional information of forests with high spatial resolution. Terrestrial Laser scanner (TLS) can be used to obtain essential information of individual trees such as tree height, crown width and diameter at breast height. The

retrieval of Leaf Area Index (LAI) by TLS is a promising concept, due to its ability to extract structural parameters of forest canopies.

**Methods:** The present study introduces a novel method for the estimation of Leaf Area Index from terrestrial laser scanned LiDAR point cloud. The goal of the present approach is the direct estimation of LAI of tropical forests using TLS point cloud by means of a new algorithmic approach named Point Spatial Density (PSD) algorithm. Three-dimensional reconstruction of individual trees was done by the implementation of segmentation approaches from point cloud library (PCL). Reconstructed trees are then extracted individually to implement PSD algorithm so that LAI values are accurately estimated.

**Results:** Based on the number of points and the point spacing, the value of LAI is found to be varied in sparse and dense forests. Consistent correlation ( $r^2=0.98$ ) is evident while comparing the estimated LAI with in-situ measurements. There is a significant connection between number of points in the tree point cloud, points spacing and height of the trees using TLS data.

**Conclusions:** The results show that LAI can be accurately reproduced by the point spatial density algorithm approach enabling the capture of LAI of dense and heterogeneous forests with complex ecosystems, thus minimizing the cost and speed of the retrieval of multiple forest parameters using other field-based equipment.

**Keywords:** Terrestrial Laser Scanner, Point Cloud, Leaf Area Index, Point Spatial Density Algorithm.

06-03

### UHLA PROCESS FOR THE EFFECTIVE UTILISATION OF IRON OXIDE WASTE FROM TITANIUM INDUSTRY

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**Background:** Titanium products find many applications in our day to day life and it is considered as the metal of 21<sup>st</sup> century. The Kerala Minerals and Metals Ltd (KMML) is the world's fully integrated titanium dioxide manufacturing plant via chlorideroute. The Acid Regeneration Plant of factory expels acidic iron oxide with high chloride content as a solid byproduct. The hazardous iron oxide is slurried and stored in large ponds(15 acres)in the premises of factory. Slow leaching of acidic chlorides from these ponds to the surroundings cause appalling threat to the environment. The corrosive nature of high chloride content in iron oxide hampers its end use application in steel industry. The iron oxide can be made saleable by reducing the chloride level below 0.2% . Hence it is highly imperative to find a cost reductive process to significantly reduce the chloride levels in the iron oxide and enable its end use applications.

**Method:** Ultra High Lime with Aluminium (UHLA) process is an advanced lime softening process used to remove scalants from the cooling water. In this work we are trying to use UHLA process to precipitate out the chloride content of iron oxide by the addition of  $\text{Ca}(\text{OH})_2$  and sodium aluminate. After achieving the optimized parameters of the process the same is tried in large scale to check the efficiency of the process. The obtained precipitate is characterized through XRD and SEM elemental mapping.



**Results:** The characterization techniques confirm the obtained precipitate is calcium chloro aluminate comes under the category of layered double hydroxides. The optimized process works fine in the higher scale too which confirms the efficiency of process.

**Conclusion:** Ultra High Lime with Aluminium (UHLA) process was fine tuned for the removal of chloride from the iron oxide wash solution and an efficiency of 85% is reported. Intervention of cost reduction strategies are under progress by selecting cheap aluminium source and finding out potent use for the UHLA process precipitate.

**Keywords:** UHLA Process, Hazardous waste management, Layered double hydroxides

06-04

### NAKED - EYE COLORIMETRIC SENSOR FOR THE DETECTION OF CYANIDE IONS IN AQUEOUS MEDIA USING GREEN SYNTHESIZED SILVER NANOPARTICLES

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Cyanide ion (CN<sup>-</sup>) sensing is of pronounced interest due to its extreme toxicity in physiological systems, as well as environmental concerns arising from its widespread applications in various industrial processes such as electroplating, metallurgy, mining and polymer synthesis. Even though a number of analytical methods have been developed for the detection of cyanide, a simple, cost-effective and highly selective sensing method for cyanide in aqueous media is still a great challenge. The present study introduces a naked eye colorimetric sensor for the detection of cyanide ions in aqueous medium using green synthesized silver nanoparticles (AgNPs). This is the first report on the exploration of biosynthesized AgNPs as a sensing probe for the highly facile, selective and sensitive detection of cyanide in aqueous media. In this work, highly stable and monodispersed AgNPs were prepared in a completely green manner by using aqueous extract of brown marine macroalgae (seaweed) *Padina Tetrastromatica*. The bioactive metabolites in the seaweed extract itself acted as the reducing agent for Ag<sup>+</sup> ions and stabilizing agent for the formed AgNPs. Since no additional reducing and stabilizing agents were used in the synthetic protocol, it is absolutely a green chemistry approach. In addition, this method is facile, fast and cost-effective. The biosynthesized AgNPs were characterized using UV-Visible spectroscopy, High resolution Transmission electron microscopy (HR-TEM) and X-ray diffraction (XRD) techniques. The biogenic AgNPs are dark brown in colour due to the intense surface plasmon resonance absorption band. In the presence of CN<sup>-</sup> ions, the brown AgNPs solution changed to colourless accompanying the vanishing of absorption maximum at 414 nm. The selectivity and sensitivity of biogenic AgNPs towards CN<sup>-</sup> ions were also evaluated and the limit of detection was found to be 1 μM. The cyanide sensing mechanism is also suggested based on TEM analysis. Furthermore, a test strip approach is developed for real time detection of CN<sup>-</sup> ions. The proposed method has been successfully used for the determination of cyanide in water samples.

**Keywords:** Biosynthesis, silver nanoparticles, *Padina Tetrastromatica*, colorimetric sensor, cyanide ions.

06-05

### LINEAR INTRUSIONS AND NATURAL DISASTERS INCREASE SPREAD OF INVASIVE ALIEN SPECIES - A CASE STUDY FROM THE FORESTED LANDSCAPES OF CENTRAL KERALA.

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**Background:** Arrival and establishment of an invasive species into a country is well studied compared to their spread ecology within the country.

**Method:** This study looks into the various linear intrusions in the Athirapilly – Vazhachal – Sholayar forest area and their role in the spread of the alien invasive species to the forest area. The paper also looks into the preliminary study on the impact of landslides and flood witnessed in August 2018 on the spread of invasive species. Plots were laid in the forested landscape to identify the species composition, abundance and ecological history.

**Results:** From the 60 plots laid, 17 invasive species could be recorded. In forested landscapes, the invasive species were abundant and dense along the linear intrusions like roads, coupe roads and powerlines. Alien species covered a maximum of 41.5% of the ground area at linear intrusions while in the rest of the forest area the maximum coverage was 2.87%. Unlike the forest areas, the linear intrusions provide open areas favouring quick spread of alien species into forests, while they also provide high impetus to developmental aspirations of the State like providing revenue, means of travel and transport, source of power generation and forest protection. The flood and landslides have assisted in the spread of species to new locations. A number of seedlings of *Mimosa diplotricha*, *Mikania micrantha* and *Senna torra* were recorded from the flood prone areas. The landslides have led to canopy opening where invasive species have be-

come the primary occupants. The seedlings of *Mimosa diplotricha*, *Mikania micrantha*, *Merrimia vitifolia*, *Pteridium aquilinum* and *Ageratina adenophora* were recorded from the landslide areas.

**Conclusions:** We argue that unless management of invasive species is built into the construction and maintenance of linear intrusions, natural forests and plantations will be in danger of losing their biodiversity and will result in sharp decline in ecosystem services they provide.

**Keywords:** invasive species; linear intrusions; flood

06-06

### BIOREMEDIATION STUDY OF BIOSURFACTANT PRODUCING BACTERIAL BLOOM FROM OIL CONTAMINATED SITES AFTER FLOOD IN KERALA

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**Abstract:** Petroleum spillage around the world have played major role in generating the solidWastes during the tanker accidents and stocking of crude oil. The ecology of hydrocarbon degradation by microbial populations in the natural environment is analysed, highlighting the physical, chemical, andbiological factors that cause the biodegradation of petroleum and individual hydrocarbons. Therefore, The present study has shown that the indigenous Bacillus sp.,isolated from the polluted study sample (Kochi) possessed the capacity to produce suitable biosurfactant. The effectiveness of the bioremediation mediated by the biosurfactant extract was studied by finding out the germination percentage of a fast growing leguminous plant (Pisumsativum).Therefore the findings of the study revealed that the bacillus sp., isolated from Kochi possesses remarkable oil degrading properties and can be effectively employed in the bioremediation of oil contaminated soils. It can be considered as one the effective clean-up technologies of the future

06-07

### THE IMPACT OF FLOOD ON MICROALGAE ALONG THE LOWER REACHES OF PERIYAR AND CHALAKKUDY RIVERS

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**Background:** Microalgae play a significant role in the maintenance of ecology in aquatic systems through the process of primary production. The change in phytoplankton assemblages represents a good measure of the state of an ecosystem and hence it is an important group to consider as a valuable bioindicator for water quality assessment. Flood changes the biodiversity, mainly in plankton communities, responding to nutrient dilution via high water content. The hydrology after the flood has changed and this influenced the distribution of microalgae.

**Methods:** This investigation was conducted during different seasons along the lower reaches of River Periyar and Chalakkudy during 2016-2018. The stations include, Pathalam (10° 04' 17N, 76°18' 18E), Manjaly (10° 08' 35N, 76° 16' 26E), Kanakkankadavu (10° 10' 16N, 76°16' 26E), and Kathikudam (10° 15' 24N, 76° 19' 04E). The physical parameters like pH temperature, salinity estimated *in situ*. Dissolved oxygen, Chlorophyll *a* and turbidity were also measured *in situ*. Chemical variables (Nitrate, Nitrite, Phosphate and Silicate), pigment analysis, and productivity estimation were estimated as per standard methods. Sampling carried out during December 2016 to September 2018 in which post monsoon 2017, pre monsoon 2018 and two samplings were done after the flood 2018 (September and October 2018). A comparative analysis has been done with that of flood and normal samplings.

**Results:** A total of 70 species of microalgae have been identified amongst 10 species were representatives of Cyanophyceae, 31 species of Chlorophyceae, 26 Bacillariophyceae, 2 Dinophycean species and a single species from Chrysophyceae. The maximum species diversity was recorded from Kathikudam (50sp) followed by Manjali (49 species) while minimum from Kanakkankadavu (45 species). In all the stations the abundance (biomass) of microalgae diminished two week after the flood. However, there was intensive growth of diatoms species like *Melosira* and *Nitzschia* was observed in Pathalam and Manjali stations which are part of Periyar River. In Kanakkankadavu and Kathikudam Cyanophycean diversity was high which may be due to the high nutrient sedimentations.

**Conclusion:** The phytoplankton diversity lowered after flood. N:P ratio determines the growth and survival of microal-



gal composition, in general. The lowered N:P ratio obtained after the flood has influenced the sustenance of microalgae as evidenced by Pearson Correlation Analysis. The alteration in the nutrient characteristics might be due to higher habitat heterogeneity and hydrological change. We hypothesize that the alteration of the nutrient status of these two rivers was due to the hydrological change occurred by the devastating flood, which in turn lowered the diversity of the microalgae

**Keywords:** Diversity, Habitat heterogeneity, Hydrological change, N:P ratio

06-08

### AQUATIC BUGS (ORDER: HEMIPTERA) AS POTENTIAL BIOINDICATOR OF TWO DIFFERENT POND ECOSYSTEMS: A CASE STUDY

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**Background:** Ecologists studying Heteroptera have long been seeking the use of aquatic bugs for biomonitoring as well as biocontrol agents. Prior to the development of monitoring models, many studies have been conducted in the past to ascertain bug species association with environmental parameters. In our state, Kerala, no serious attempts have been made to use these aquatic insects to study the aquatic health. In this context, the present study aims at to assess the biomonitoring of aquatic heteropterans with reference to physico-chemical parameters of two different ponds of rural and urban areas of Palakkad District, Kerala.

**Method:** The water bugs were collected from two different selected ponds of rural and urban areas by using hand picking method, pond net, small sieve, etc. All the collected specimens were preserved in 70 % alcohol and identified with the help of standard taxonomic keys. A total of 16 physico-chemical parameters were analysed in the field as well in the laboratory such as water temperature, Turbidity, Electrical Conductivity, P<sup>H</sup>, Total Dissolved Solids, Acidity, Alkalinity, Total Hardness, Calcium, Magnesium, Chloride, Fluoride, Iron, Nitrate, Sulphate, and Dissolved Oxygen.

**Results:** A total of 8 families comprising 10 genera and 12 species of water bugs were observed in Pond I (Rural area); and 5 families consisting of 5 genera and 5 species were recorded in Pond II (Urban area). The aquatic bugs such as *Ranatra filiformis Fabricius*, *Diplonychus rusticus Fabricius*, *Paraplea sp.*, *Mesovelina vittigera Horvath*, and *Neogerris Parvula Stal* were found in both the ponds of rural and urban areas, but *Microneta scutellaris scutellaris Stal*, *Anisops paragrillincatus Brooks*, *Ranatra elongata Fabricius*, *Limnogonus fossarum Fabricius*, *Gerris spinolae Leithierry and Severin*, and *Hydrometra vittata Stal* were observed only in Pond-I. So, those water bugs may found only in non-polluted water and they were used to indicate the water quality. This particular group of aquatic bugs can be regarded as good bioindicator species. From the study, it is clear that the pond II has low transparency, highly alkaline in nature (pH 9.05) and somewhat polluted when compared to Pond I, which might be the result of anthropogenic activities such as bathing, washing, garbage disposal, etc. and the scarce of vegetation. The present study observed that the diversity of water bugs was greatly influenced by the physico-chemical parameters of aquatic habitat. They respond to the stress of aquatic habitat either by changing their diversity and abundance or presence/absence of these particular water bugs.

**Conclusions:** The use of bio-indicators is essential for environmental monitoring and to study the health of aquatic habitat. The water quality of ponds plays a crucial role in the maintenance of diversity and richness of water bugs.

**Keywords:** Aquatic Hemiptera, Bioindicators, Biomonitoring, Water quality.

06-09

### FOREST DEPENDENCE AND COMMUNITY WELL BEING IN PARAMBIKULAM TIGER RESERVE, KERALA

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Forest ecosystems that covers 31 per cent of the total land area, are vital refuges for terrestrial biodiversity and the effective management of these natural resources are essential as humans depend on them for their subsistence needs. *The resources derived from the forest ecosystem meet multiple needs for different sub groups of people.* On a macro

perspective, the vulnerable group comprising mainly the tribal communities depend on forest resources for meeting their employment and livelihood requirements. The Forest Dependency Index, a numeric indicator of the social and economic dependence of the community in Parambikulam Tiger Reserve highlights a high socio-economic dependence indicating the significance of the forest in the livelihood of the community residing within the Reserve. The study indicates a total forest dependence of 69.6 per cent, which is a high dependence level on the forest resources. Assessing the dependency of the community on the forest will help in creating awareness on the resource dependence and provide indicators for sustainable forest management. Moreover the policy changes from the colonial to the post-colonial period had its role to play in maintaining the forests. This paper analyses the forest dependency of the tribal communities residing within the Parambikulam Tiger Reserve, which is one of the well-protected ecological niche of Anamalai sub unit of the Western Ghats and the policy implications on the livelihood of the forest dependents.

**Keywords:** Forest Dependency Index, tribal community, socio-economic dependence, Tiger Reserve, policy

06-10

### BIODEGRADATION OF CHLORPYRIFOS PESTICIDE USING AUTOCHTHONOUS *BACILLUS* CONSORTIUM

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**Background:** Modern agriculture is highly dependent on agrochemicals in order to obtain a sustainable yield. The threat posed by the neurotoxic organophosphate pesticide, Chlorpyrifos (CP), due to its soil persistence, is highly alarming. The only possible eco-friendly and cost-effective alternative for Chlorpyrifos residue abatement from soil would be Bioremediation using microorganisms. Hence, the current study utilized a bacterial consortium assembled from autochthonous soil isolates and analyzed its Chlorpyrifos degrading ability.

**Method:** CP degrading bacteria were isolated using soil enrichment technique from CP-contaminated soil. The isolates were further screened for the CP degrading ability using GCMS analysis and the percentage of degradation was calculated. 16 different combinations of the isolates were then assembled into consortia and the GCMS analyses of the consortia, in which all the isolates survived, were done. The isolates of the consortium showing highest percentage of CP degradation were identified.

**Results:** Five morphologically distinct bacterial isolates (CP28, CP30, CP31, CP33 and CP34) were obtained after the isolation procedures. The percentage of degradation of each isolate falls in the range 65-70%. The consortium CON11, containing four isolates, showed the highest CP degradation percentage (91.9%). The individual isolates of the consortium are identified as *Bacillus amyloliquefaciens* (CP28), *Bacillus pumilus* (CP30), *Bacillus marisflavi* (CP31) and *Bacillus subtilis* (CP34).

**Conclusion:** The autochthonous bacterial consortium CON11 showed 91.9% of CP degradation compared to the individual isolates (65-70%). Thus, the consortium can effectively be used in the bioremediation of Chlorpyrifos-contaminated agricultural soil.

**Keywords:** Autochthonous bacteria, Biodegradation, Chlorpyrifos, Consortium, *Bacillus* sp.

06-11

### AN ALL KERALA STUDY CONDUCTED ON THE EFFECTS OF MOBILE TOWER AND MOBILE PHONE RADIATIONS ON HUMAN

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**Background:** There are over 35000 base stations in Kerala and our state has the largest population density in India. People using cell phones are more compared to most other states. The cell phone providers are now changing their towers from 3G to 4G (using much higher frequencies). In a very near future we are going to catch up 5G services all over Kerala. Not much relevant studies are made in our state to enlighten the dangers caused by the microwave radiations. Such careful studies will enable the governments to make laws to control the tower parameters (radiating power, tower height, antenna specifications, multiple antennas etc.) according to our own state's conditions.

**Method:** We divided the examination area into two; Core Zone (CZ), which is the area within a radius of 300 metres of any cell tower and Radiation Free Zone, outer zone (OZ) at a distance more than 300 metres from any cell tower. Power

density, electric field intensity and magnetic field intensities were measured and a survey was conducted in more than 60 houses to find out the effects of human health. Statistical tests have been conducted to conclude the assessments. The device used for measuring the exposure parameters was MECO's 9720 three axes radiation metre. The main objectives of this study are, to identify, the exposure faced by the people in Kerala, living in varying distance from the tower antenna, the ill-effects caused by the radiation in different categories and frequencies and to study the hazards caused by cell phones and phone habits.

**Results:** Ten groups were examined and 800 samples were collected from all over Kerala to discover if any relation exists between human health and the RF exposure levels. Our observation is that out of ten groups, nine of them definitely have some connection with the mobile tower exposure. Various phone habits are also studied and it is found that such mobile habits are harmful to human health.

**Conclusions:** For this study we divided the entire Kerala state into three regions; North, Central and South. The north and south regions consist of five districts each and the Central region consists of four districts. We conducted survey in different areas in each of these districts spread over both CZ and OZ zones, measured radiation levels in terms of power density (P). More than 800 samples were taken from all over these areas. Conducted statistical tests using the software SPSS. Out of the ten groups, nine found to have some serious relation with the mobile tower exposure. In the case of study on phone habit related diseases, it is found that many phone habits, namely keeping phone close to body, keeping phone near to bed while sleeping and talking in phone more than one hour per day are harmful for the human health.

**Keywords:** Mobile tower radiation, Human health, RF exposure, Radiation level.

06-12

#### **APPLICATION OF UP-FLOW ANAEROBIC BIOFILTER AND HORIZONTAL FLOW SUBSURFACE CONSTRUCTED WETLAND IN KITCHEN GREYWATER TREATMENT**

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**Background:** The wastewater of domestic origin is broadly divided into two categories, viz., greywater and blackwater. 'Greywater' is defined as the "Wastewater generated from bathroom showers, sinks, washing machine or laundry, dish washers and kitchen sinks". Discharge of greywater can result in nutrient built up in water bodies and thereby leading to eutrophication. Long term exposure to pathogenic microorganisms in greywater can cause diseases leading to mortality and morbidity. Kitchen greywater with its higher organic content and oil and grease concentration makes it unsuitable for direct discharge into water bodies. Development of low-cost decentralized greywater treatment systems is a cost-effective strategy for the management of kitchen greywater.

**Methodology:** The current study evaluates the efficiency of up-flow anaerobic biofilter (UFAB) combined with horizontal flow subsurface constructed wetland (HFSCW) in treatment of kitchen grey water. The treatment system consists of four units viz; an up-flow anaerobic treatment biofilter (UFAB), a granular activated carbon (GAC) filter and two horizontal flow subsurface constructed wetland (HFSCW) systems.

**Results:** Trial runs were carried to evaluate the performance of treatment system. Removal efficiencies of 97.5%, 93%, 87%, 70% and 78.5% were observed for oil and grease, BOD, COD, TDS and TSS during treatment. There was also an appreciable reduction in total coliform and E. coli number.

**Conclusion:** The continuous flow system developed during the study was found efficient in removal of BOD, COD, TSS, TDS, oil and grease, turbidity, total coliform and E. coli.

**Keywords:** Greywater, Up-flow anaerobic treatment biofilter, Granular activated carbon filter, Horizontal flow subsurface constructed wetland

06-13

### EFFECT OF PHYTOSYNTHESISED SILVEROXIDE NANOPARTICLES ON THE DEGRADATION OF AN ANIONIC DYE – COOMASSIE BRILLIANT BLUE

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**Background:** One of the major sources behind the increase in environmental pollution can be attributed to the broad application of dyes in various industries and imperfection in the removal of dyes. The promising potential of nanotechnology can be exploited for catalytic degradation of dyes. The present study deals with the phytosynthesis and characterization of silver oxide nanoparticles ( $Ag_2ONPs$ ) and its photocatalytic degradation efficiency on the textile dye Coomassie Brilliant Blue (CBB).

**Method:** The prepared aqueous extract of Curcuma rhizome was added to silver nitrate solution, followed by irradiation of sunlight for the synthesis of  $Ag_2ONPs$ . The bioreduction of silver ions was characterized using UV-Visible spectrophotometer, Fourier Infrared Spectroscopy (FTIR), Powder X-Ray Diffraction (PXRD), High Resolution Transmission Electron microscope (HR-TEM), and Field Emission Scanning Electron microscope (FESEM). The photocatalytic activity of  $Ag_2ONPs$  against CBB was evaluated by UV-Vis Spectroscopy.

**Results:** The UV-Visible spectra of the reaction mixture showed maximum absorption at 413.5 nm, with a single surface plasmon resonance band revealing the formation and spherical shape of  $Ag_2ONPs$ , which was in agreement with the XRD results, and TEM, FESEM micrographs. From the FTIR spectrum results, it can be attributed that the amide linkage of proteins could be likely to form a coat over the  $Ag_2ONPs$ , stabilizing them in the aqueous medium. The percentage degradation of CBB was 98.7%.

**Conclusion:** This study, presented a green, biosynthetic route for the synthesis of  $Ag_2ONPs$  nanoparticles, which exhibited a very good photocatalytic activity against molecules of dye, paving an effective and economic way to environmental bioremediation.

**Keywords:** Photocatalytic degradation, UV-Visible Spectroscopy, Rhizome extract

06-14

### A DETAILED REDESCRIPTION OF *JAMIDES CELENO* (LYCAENIDAE, INSECTA) FROM A MORPHOLOGICAL, ANATOMICAL AND MOLECULAR PERSPECTIVE

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Lycaenidae, the second largest family of butterflies is characterized by sexual dimorphism, inter specific similarity of colouration and wing markings and intra specific differences in seasonal broods leads to confusions in identification by non experts. *Jamides celeno* a very common Lycaenid was selected for morphometric, morphological and molecular study. *Jamides celeno* were collected from in and around the paddy fields of Malappuram. Preservation, morphometric measurements and wing and genitalia slide preparation was done using standard protocols. The DNA was extracted from single individual (thoracic and abdomen region) using DNA extraction kit (Origin DNA isolation kit). The extracted DNA was amplified in PCR by using insect primers and sequenced. The molecular analysis of the species were done by using mitochondrial genome (Cox I) with a length of >700 bp. The identification of species was confirmed by checking the sequence in NCBI BLAST. Morphological and morphometric observations did not show any significant differences from previous data. The antennal length has mean 7.3 and fore wingspan has a mean value of 36. The anatomical structures revealed the typical anatomy of wing venation and genitalia of a butterfly. The venation include typical veins like costa, sub costa+radial 1, radial 2, 3 and 4, median 1, 2, 3, cu1, cu2 and 1 and 2 anal in the fore wings and sub costa + radial 1, radial, medial 1,2,3, cubitus 1,2 1 anal+ 2anal, and 3 anal in the hind wings. The query sequence showed 100% similarity with *Jamides celeno* voucher and entries when compared using nBLAST of NCBI.

**Key words:** *Jamides celeno*, Lycaenidae

06-15

### A PRELIMINARY QUANTIFICATION OF THE MOTH ASSEMBLAGES IN HUMAN HABITATIONS IN AN URBAN AND RURAL AREA OF THRISSUR DISTRICT WITH EMPHASIS ON POST, PRE AND FLOOD SEASON

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Lepidoptera are widespread in habit and distribution yet studies on moths have lagged behind both in terms of taxonomy and ecology. In this paper we present the results of observations taken for 12 months (9 before the flood, one month of flood (August) and two post flood months) in an urban and rural area of Thrissur district. Moths were collected using light trap method by operating light traps from 7 pm to 10 pm. Opportunistic sightings were also recorded. A total of 27 and 47 morphs were recorded from the urban and rural areas respectively. Five families of moths were common to both study areas while three each were found only in either of the study areas. Three species were common to both the study areas. While the rarefaction curve obtained from both rural and urban areas were very steep curve, the curve obtained from the rural area showed signs of reaching an asymptote. Based on the moth assemblages sighted no specific patterns could be discerned from the dendrogram obtained from the rural region, but the months of August, September and November seemed to be similar in species composition based on the clusters formed by the dendrogram. Another interesting observation was that while the mean sightings of moths were higher for the pre-flood period when compared to the post flood and flood period in the rural area, the trend was reversed in the urban area with maximum sightings being recorded just before and after the flood in the month of August. Mean sightings in post flood period was greater than the pre-flood period but less than the flood period.

**Key words:** Moths; comparing biodiversity; pre-flood, flood and post flood period

06-16

### FATE OF PHOSPHORUS FRACTIONATION IN CORE SEDIMENTS OF MANGROVE ECOSYSTEM - MALIPPURAM, COCHIN, SOUTHWEST COAST OF INDIA

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**Background:** Sequential chemical extraction scheme is used for the fractionation of phosphorus in the mangrove ecosystem (Cochin region, Southwest Coast of India). This study helps to understand the biogeochemical cycling and bioavailability of various forms of phosphorus. Sediments were analyzed for major P species such as Iron bound P, Calcium bound P, Acid soluble organic P, Alkali soluble organic P and Residual organic P.

**Methods:** The core sediment was collected from Malippuram, Cochin, South west coast of India. The Sequential chemical extraction scheme is used for the fractionation of P in the sediment.

**Results:** Alkali soluble organic phosphorus is the dominant fraction (15-418 mg/kg) followed by Acid soluble organic P (21-226 mg/kg), Fe bound P (8.47-470 mg/kg), Ca bound P (4.59-115 mg/kg) and Residual P (13-44 mg/kg) respectively. The high value of alkali soluble-OP may be due to the flocculation and precipitation processes involving humic acids. The high organic P contribution in the sedimentary P pool may indicate high organic matter load with incomplete mineralization, as well as comparatively greater percentage of humic substance and resistant organic compounds. Second dominant phosphorus fraction is acid soluble organic phosphorus which is associated with apatite-bound phosphate and includes biochemical components such as nucleic acids, lipids and sugars. The third dominant Fe bound phosphorus is due to the high reducing nature of the mangrove ecosystem and also the presence of sulfur reduction in the sediments.

**Conclusion:** The present study reveals that mangroves act as an important sink which can trap significant quantities of P.

**Keywords:** Mangrove, phosphorus fractionation, Organic phosphorus, Humic materials, Organic matter.

06-17

### AN ANALYSIS OF FUNCTIONAL FEEDING GROUPS OF BENTHIC MACRO INVERTEBRATES IN BIOMONITORING OF PAMPA RIVER

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**Background:** Functional feeding groups are a feeding approach of an organism which provides information about the balance in food acquisition strategies. It reflects the adaptation of organisms to environmental factors. It is a measure that enhances the knowledge of trophic dynamics.

**Methods:** To evaluate the functional feeding groups (FFG) in Pampa River, benthic macroinvertebrate samples were collected from five different stations. FFG recorded were assigned by using previous literature and mouth parts morphology of benthic macroinvertebrates.

**Results:** In the study four major functional feeding groups were represented: Collector Gatherers (CG), Shredders(S), Predators (P) and Collector Filterers (CF). The most dominant functional feeding group was Collector Gatherers which constitutes 90.9% of the total population. The family Chironomidae constitutes the most abundant Collector Gatherers in the study area.

**Conclusion:** The present study propose that the use of functional feeding groups along with evaluation of nature of habitat type is effective tool to determine diversity of benthic macroinvertebrates in the river ecosystem and its importance in biomonitoring

**Key words:** Pampa River, FFG, Macroinvertebrates, Biomonitoring

06-18

### ENVIRONMENTAL IMPACT OF MINING AND QUARRYING IN NETRAVATI - GURPUR RIVER BASINS: A GEO - ENVIRONMENTAL APPRAISAL

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**Background:** Mining and quarrying for minor minerals imparts significant economic, environmental and social impacts in and around the regions where it is being carried out. The activity accounts for a significant proportion of GDP and a large share of foreign exchange earnings. The environmental impact of mining can be significant and long-lasting. The problem is severe in the small catchment rivers because such rivers are more responsive to socio-environmental changes. Sustainable mining/quarrying strategies are to be adopted to minimize the negative impacts and ecological impairments to the barest minimum. A micro level survey of literature shows that systematic studies on the impact of minor mineral extraction especially that of building materials, are meagre in Indian context. Here we report a case study the environmental impact of mining and quarrying in Netravati-Gurpur twin basins in Karnataka as an example.

**Method:** Minor mineral locations were identified using Landsat TM and Landsat TM+ images. Landuse/Land cover map has been prepared for the year 2018 to understand the present landuse. Systematic field surveys were conducted for the collection of primary data on mining and quarrying activities. The locations of mines/quarries, environmental critical areas, etc., were mapped for detailed studies. The quantity of resource extraction was estimated from number counts of the loaded vehicles moving out of the locations. Census data were used for understanding the urbanization trend. Maps and figures were prepared for understanding the spatial inter-relationship.

**Results:** The study shows that minor mineral extraction for hard rock, laterite, sand and soil quarrying is wide spread in the basin. Mining and quarrying is a very destructive activity which impacts severe environmental problems in the area. Hard rock quarrying has made marked changes in natural landscape and ecology of the region. The total production of hard rock in Dhakshina Kannada district is 0.535 million metric tons/year. Abandoned hard rock quarries are left present as wastelands. Laterite quarrying in the basin often provides a positive benefit in the region as removal of the hard laterite cap enhances water percolation and make the area good for agriculture activities. Indiscriminate sand mining can cause irreparable and irreversible damages to the river ecosystem. Analysis of the gauge data of Bantwal-gauzing station reveals that the river bed at this station is lowering in alarming rate over the years. The rate of channel incision is about 13 cm per year. The frequency of occurrence of mines increases towards urban centers. Production of aggregates in the urban centers has a strong correlation with population density and affluence of the people of the area.

**Conclusion:** Unscientific mining in the study area causes severe degradation of land and water environment of the area.

Lowering of water table, ecological impairments and impose land use changes are some of the environmental consequences noticed in the area. The study reiterates the need for sustainable mining and alternatives to the present variety of building materials that are in use in the area.

**Key words:** Mining and quarrying, Netravati-Gurpur river basin, Sustainable developments

06-19

### **IMPACT OF FORESTRY PRACTICES ON PRIMARY NATURAL FORESTS IN THE WESTERN GHATS: A CASE STUDY FROM VAZHACHAL FOREST DIVISION, KERALA**

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Natural forest degradation refers to reduction in productivity and/or diversity of a forest. Major reason in the degradation of primary natural forests in India are the 'colonial legacy' which allowed large scale clear felling for timber and conversion of forests for commercial and industrial plantations in the name of 'Forest management' and allocation of forest areas for developmental projects in tune with post-colonial 'Conservation' strategies.

The major reasons for the post 1980 forest clearances were massive conversion of forests for Dams, mining and other Industries. The remaining primary forests are not exactly primary in nature. Most of these natural forests were interrupted with timber extraction in the past such as clear felling, selection felling and selected removal of saplings. All these are the foundations for the present study to understand the History and impact of degradation in the primary natural forests taking the Vazhachal Forest Division of Central Kerala as a case study.

The history of forest degradation started prior to during 1944 with conversion for plantations and felling for timber. Observations of Abdul Kareem (2007), Bachan et al., (2014) also agree with that. Maximum timber extraction happened in the 1970-1980 period, it is followed by 1980-2016 for plantation, social forestry and silviculture purpose. The overall study using forest conversion maps from 1939 to last working plan period 2017 shows a positive correlation with the hypothesis that the forestry and non-forestry practices in natural forest area contributed significantly in degradation of primary forest. The phytosociological assessment conducted in selected locations systematically showed a serious impact of these activities in the composition of saplings.

The result of the study based on details of working plan, vegetation mapping and phytosociological assessment conclude that primary forest are degrading and it support the latest argument that the forest management policy's and forest management plans give more priority for commercial forest management than conservation of primary forests and this study is a material evidence for that argument

06-20

### **ROLE OF TERMITES IN LIGNOCELLULOSIC WASTE MANAGEMENT**

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**Background:** Lignocellulosics form the major part of agricultural wastes. Burning of this waste causes severe air pollution currently being experienced in Punjab, Haryana and Delhi. On the other hand, Lignin and Cellulose of this waste are resources to be utilized and not to be combusted. The termites have the ability to degrade lignin and cellulose and convert this to usable materials like nutrient rich soils etc.

**Methods:** An attempt was made to study the termite degradation capability and feeding preference using five lignocellulosic wastes including: three varieties of Paper, Dung, Leaves and two varieties of Grass and single variety of cardboard. Totally 10 sites in Mahatma Gandhi University Campus in Kottayam chosen on the basis of level of human disturbances (Core, Buffer and Transition) and visible termite activity. The substrates were weighed and placed on the field covered with plastic boxes (Bioreactors) and kept undisturbed for 30 days.

**Results:** All varieties of paper waste namely office waste, newspaper waste and magazine waste showed more termite activity and maximum amount of substrate consumption rate compared to other substrates. The overall termite activity on the substrates are in the order of Paper > leaves > dungs > grasses > Cardboard. Zone wise the activity was found more in Buffer, followed by Transition and core zone but the consumption rate was found more in buffer zone, then Core zone and Transition zone.

**Conclusions:** The lignocellulosic waste especially the paper and leaf litter waste along with dung and grasses can be

degraded by termites and converted in to useful products thus help in managing these wastes and at the same time reduce the pollution especially air pollution arising out of combustion of such wastes.

**Keywords:** Lignocellulose waste, Termite, degradation,

06-21

### AN INTEGRATED APPROACH FOR RAW DRUG AUTHENTICATION IN *SARACA ASOCA*

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**Background:** The global economy of international herbal products is increasing rapidly. Owing to huge market demand, many of the medicinally important plant species are subjected to over exploitation and unscientific extraction leading to the extinction of its natural resources. According to International Union for Conservation of Nature (IUCN), 15000 medicinally exploited plant species worldwide is listed under the threatened category. Non-availability of potential ayurvedic raw drugs resulted in the adulteration of the existing resources with cheap inferior quality plant materials with different medicinal principles altogether. Medicinally important plant parts are traded in powdered, dried or shredded form which is difficult to identify using the traditional taxonomic means. Global standards or protocols for the authentication of ayurvedic raw drugs are currently not recommended/ practiced. Proper identification or authentication of the potential raw drug is thus a major concern of quality assurance in the herbal drug industries.

**Methods:** An integrated method of DNA barcoding and HPTLC were tried for the authentication of the selected potential raw drug, *Saraca asoca* from its common market adulterants. Nuclear and plastid gene regions were initially tried to identify a barcode gene region to differentiate original drug from its adulterants. Different solvent systems were used in HPTLC to develop a standard chromatogram.

**Result:** The studied four barcoding region (two coding regions viz. *rbcL*, *matK* and one intergenic spacer region viz. *psbA-trnH*), and Nuclear ITS (Internal Transcribed Spacer) regions showed inter specific variation and no intra specific variation. Among the four analyzed barcodes, Nuclear ITS region showed greater interspecific variations among *Saraca asoca*, and its adulterants. In HPTLC Toluene: Ethyl acetate: Acetic acid (10:8:0.1) gives a standard chromatogram to authenticate *Saraca asoca* from its adulterants.

**Conclusion:** Nuclear ITS (Internal Transcribed Spacer) region was most effective in discriminating *Saraca asoca* from its adulterants. Similarly, HPTLC profile revealed. An integrated method involving DNA barcode and HPTLC could be used to authenticate *Saraca asoca* from its adulterants

**Keywords:** *Saraca asoca*, adulterants, Barcoding, HPTLC

06-22

### ADAPTIVE PRIVATE ALLELES IN THE GEOGRAPHICALLY DISTINCT NATURAL TEAK POPULATIONS OF KERALA

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**Background:** Genetic diversity is highly influenced by environmental gradients. Geographic barriers and environmental variables tend to alter the genetic diversity structure of populations and play an important role in the long term survival of the species in extreme environments. The presence of rare alleles specific to each population could be a means of adaptation to specific geographic conditions.

**Methods:** Three teak populations from different geographic zones of Kerala (North, Central and South) were selected. Phenology of each population was studied followed by SSR genotyping for genetic diversity and structure analysis using softwares GenALEX, Power Marker and STRUCTURE

**Results:** Nine loci showed polymorphism among three populations with a total of 82 alleles. Average observed and expected heterozygosities were almost similar (0.553 and 0.598 respectively) across the markers. A total of 52 private alleles (*Np*) were identified. Maximum rare alleles found in Konni population. High gene flow was evidenced (3.170). Konni population was genetically more distant from Idamalayar (0.567) as compared to Wayanad (0.286). Genetic variation within populations was found to be more than between populations. Three populations divided into two ancestral



sub populations based on the K value. Genetic admixture was evident in Konni and Wayanad but the genetic structure of Idamalayar was highly distinct.

**Conclusion:** Altitude based gradations with consequent changes in temperature and humidity affected the phenology of natural teak populations. High amount of genetic diversity within populations showed that the genetic distinctiveness of the populations with Idamalayar population as most distinct forming a separate cluster. A clear overlap of Konni and Wayanad population was also evident, must be related to the historical origins of the populations.

**Keywords:** Teak, Phenology, SSR, gene flow, genetic structure, genetic diversity

06-23

### SYNTHESIS AND CHARACTERIZATION OF NANO HYDROXYAPATITE DECORATED CARBOXYL FUNCTIONALIZED GRAPHENE OXIDE / ZINC OXIDE NANOROD COMPOSITE FOR THE EFFECTIVE DEGRADATION OF CHLORPYRIFOS FROM AQUEOUS SOLUTIONS

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**Background:** Chloropyrifos (CP) is a crystalline organophosphorus insecticide, is highly toxic to non-target organisms including human beings. The maximum admissible quantity of CP in individual and drinking water are 0.1 and 0.5 ppb, respectively. Therefore, it is very urgent to develop efficient technologies for the removal of organic pollutants such as pesticides from water. Photocatalysis was considered as a green and sustainable technology, has attracted considerable interest because it simultaneously tackle the energy crisis and environmental contamination by using solar energy.

**Method:** A novel nanohydroxy apatite decorated carboxyl functionalized graphene oxide/zinc oxide nanorod (nHAP@CFG0/ZnR) composite was designed and fabricated. The photocatalytic activity and adsorption performance of the nHAP@CFG0/ZnR were evaluated. The composite exhibits improved photocatalytic degradation of CP under visible light irradiation having the light intensity 100 mW/cm<sup>2</sup>.

**Results:** Nanohydroxy apatite decorated carboxyl functionalized graphene oxide/zinc oxide nanorod (nHAP@CFG0/ZnR) composite was prepared and well characterized by FTIR, XRD, SEM, XPS, Raman, DRS, PL and EIS. The band gap of the prepared photocatalyst was found to be 2.8 eV which is in the visible region. The maximum adsorption occurs at pH 3.5. The adsorption kinetic and isotherm data were described using pseudo-second-order kinetic model and Sips isotherm model, respectively. The photocatalytic degradation of CP was found to follow first-order kinetics and optimum pH for degradation was found to be 3.0. The regeneration and recyclability of the photocatalyst was examined upto five cycles that confirmed the relative stability of the photocatalyst.

**Conclusions:** A visible-light-driven photocatalytic degradation of CP was done using nHAP@CFG0/ZnR composite. The nHAP@CFG0/ZnR composite showed good reusability and stability as a promising photocatalyst for water purification. The solution pH was closely related to the adsorption of CP on the photocatalyst. Therefore, our work reveals that CFG0 and nHAP as excellent supporting material for strengthening the photodegradation performance of ZnR in the visible region. Thus nHAP@CFG0/ZnR composite can be considered as a promising material in degradation applications for the treatment of water pollution.

**Keywords:** Graphene oxide; Zinc oxide nanorod; Nano-hydroxyapatite; Chlorpyrifos

06-24

### PARMELIROID LICHENS OF KERALA, CURRENT STATUS AND NEED OF TAXONOMIC AND PHYLOGENETIC UPDATION OF THE FAMILY PARMELIACEAE

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**Background:** Kerala regions have high diversity of Parmelioid lichens. The lichen exploration of this area is still incomplete. Current study suggests an extensive survey, taxonomic and molecular phylogenetic analysis to solve taxonomic and nomenclatural problems of Parmelioid lichens, Kerala.

**Method:** The present paper is mainly based on the collections made by the second author during 1998-2005 and the literature pertaining to the Parmelioid members reported from the Kerala part of Western Ghats, India.

**Results:** Lichen exploration is still incomplete in Western Ghats regions. Many of the newly reported species in India are known to have their distribution in Kerala region also. Several among the collected species from the region exhibit endemism and two Parmelioids species are reported as extinct which were previously collected from Kerala. Kerala possess many vulnerable and rare Parmelioid members. Phylogenetic and taxonomic amendments underwent within the family Parmeliaceae causes many nomenclatural issues.

**Conclusion:** Kerala region need extensive survey of its Parmelioid lichen diversity. Taxonomic documentation using molecular phylogenetic tools may be helpful to solve current taxonomic and nomenclatural problems.

**Keywords:** Diversity, Parmelioid lichens, Molecular Phylogeny

06-25

#### ARECANUT AND COCONUT TREES, THE UNIQUE HOSTS PREFERRED BY EPIPHYTIC LICHENS IN LOWER ALTITUDE: A CASE STUDY FROM ERNAKULAM DISTRICT, KERALA

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**Background:** Epiphytic lichens are most sensitive non vascular cryptogams showing a dynamic distribution patterns and are most popular subject of indication ecology. The fundamental objective of this study is to determine if coconut and arecanut plantations, which are the extensively cultivated cashcrops in Kerala, can provide efficient micro habitat for lichen flora.

**Methods:** Survey of lichens was conducted in different parts of Ernakulam during 2018. Lichens were collected from Coconut and Arecanut trees upto an height of 2.5 m from the base and herbarium were prepared by standard methods. Species were identified with the help of various keys by observing morphology, chemical colour tests and TLC.

**Result:** Critical analysis of the 1000 specimen collected during the period showed 71 species under 29 genera belonging to 18 families were found distributed on trunks of Coconut and Arecanut trees. The family Graphidaceae dominates with 16 species under 4 genera followed by Physciaceae, Pyrenulaceae, Arthoniaceae, Parmeliaceae, etc. The genus *Pyrenula* dominated with 13 species followed by *Graphis*, *Dirinaria*, *Cryptothecia*, *Hypotrachyna*, *Caloplaca*, *Pertusaria*, etc. Among the 71 species recorded, about 18 species were found to be new report to Kerala and 4 species are new record to peninsular India.

**Conclusion:** Present study is the pioneer information about the lichens on cultivated land, there is an ample scope for further extensive studies and document correct status of lichen flora of the state.

**Keywords:** Epiphytic lichens, Arecanut and Coconut trees, Ernakulam district.

06-26

#### ANALYSIS OF ECO-PHYSIOLOGICAL AND ALLELOPATHIC EFFECTS OF TWO SPECIES OF REED BAMBOOS IN THE RESERVE FORESTS IN THIRUVANANTHAPURAM DISTRICT, KERALA.

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**Background:** Reed bamboos are thin, tall shrubby grass belonging to Poaceae family. The species belonging to *Ochlandra* are endemic to Western Ghats and provide numerous ecosystem services and thereby add to forest stability. The aim of the study was to analyse the inhibitory effect of reed bamboos on nearby vegetation.

**Method:** This work explores the reason why other vegetational growth is limited near the bamboo species. The two species selected for study were *Ochlandra travancorica* and *Ochlandra wightii* from the protected forest areas of Thiruvananthapuram district in Kerala. The area of study were visited and analyzed for vegetational growth. Primary data collection was done by taking 3 plots of size (3m\*3m) and a control site. The list of plants was documented from the plots and control areas and analysis for chlorophyll was also done with 80% acetone in spectrophotometer.

**Results:** The preliminary analysis of the reserve forest areas in Thiruvananthapuram where these bamboos are flourishing, confirms that there is some effect of these bamboos on the neighbouring plants. The Allelopathic effect can be due to the presence of some toxins or can be due to any biochemical interactions. The inhibitory effect of bamboos can be directly or indirectly affecting the growth and survival of other plants. The plants present in both the areas were

documented and compared with the control site. The sites showed scarce vegetation but the control plots were rich with different types of plants. Analysis for chlorophyll was also done and the chlorophyll content of plants in the sample sites were less when compared to the control plots. The results clearly indicate that there is an allelopathic effect of bamboo which suppresses the growth of other plants.

**Conclusions:** From the present study it can be concluded that the release of some chemicals to the plant environment by the *Ochlandra* species can be the reason for low growth of other plant species.

**Keywords:** Reed bamboos, Ecophysiology, Chlorophyll, Allelopathy.

06-27

#### ANALYSIS OF HEAVY METAL POLLUTION ON PARVATHY PUTHANAR, AN ARTIFICIAL RIVER CANAL IN THIRUVANANTHAPURAM DISTRICT, SOUTH KERALA

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**Background:** Water in Parvathy puthanar is black and polluted. Drains at several places empties into this canal. The aim of this study was to determine the heavy metals (Nickel, Cadmium, lead, Fluoride) in different water samples collected from different sites in canal and nearby ground water sources.

**Method:** Samples were collected during Pre monsoon, Monsoon and post monsoon season. For heavy metal analysis all the collected samples were prepared and digested. Atomic Absorption Spectroscopy (AAS) is a very common and reliable technique for detecting metals in environmental samples.

**Results:** All stations shows high concentration of heavy metals during pre-monsoon period due to the low concentration of water in the canal and high evaporation rate. During rain the water content in the canal increases and dilution of minerals occur. So the value of heavy metal concentration shows decreasing during AAS. The level of fluoride is very high in all stations.

**Conclusion:** The obtained result shows that heavy metal concentration is very high in both canal water and nearby ground water.

**Keywords:** Heavy metals, Parvathy puthanar, Pollution

06-28

#### TRACKING BIODIVERSITY WITH CITIZEN SCIENCE - A CASE STUDY OF eBird IN KERALA

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**Background:** In this era of advancement in science and technology, public participation in scientific research through citizen science have become an inevitable strategy. The partnership between scientist and public can definitely expand the scope and field of scientific research. eBird as a citizen science project integrates public in collection of information, researchers for analysing the data, agencies which develop policies and the managers who actively involved in conservation action. In the context of this paradigm shift in the way at which we look at science, we dissect out the current use of eBird tools and the prospects and lacunae in its working concept.

**Method:** 2018 GBBC ranked Kerala as a topmost birded state among 29 states in India reporting 60% of the birds of Kerala within four days of birding participated by 221 individual birders across the state which accounted for more than 25% of Indian contribution in GBBC. By the completion of Kerala Bird Atlas project by 2020 Kerala will be the first Indian state to have an atlas of Avifauna. Around more than 500 citizens are participating in this prestigious event along Kerala by a current completion of 78% of the wet season and 66% of the dry season.

**Results:** The credibility of e Bird has been under question due to the underlying assumption of the citizen science initiative that the people providing inputs to the platform are trustworthy. Personal bias in identification, clumped data, temporal skewness in data due to peak birding season, technical difficulties for laymen in using the platform, unhealthy competition amongst bird-watchers and free access to details of threatened/ sensitive species are some of the key issues in context of Kerala. Generation of seasonality charts, prediction of migration trajectories, heat map preparation, species distribution modelling, baseline data for quantifying population-level estimates of Data Deficient birds for aiding in the Red-Listing process, free information availability through open-access and the provision for using the platform

in vernacular languages makes this platform universal.

**Conclusion:** Citizen science as a tool in scientific research is unique because of the fact that here we are not only focussed on scientific output from the perspective of a scientist but also it addresses broader societal impacts by involving public in the research team. eBird in Kerala is only one of the examples of citizens being part of scientific process, making available large volume of data on biodiversity that would otherwise be unavailable. The potential of such huge data across different habitats over a long span of time has made statistical analyses possible like never before. By way of involving common man in such actions aimed at inventorying biodiversity, the scientific community has at large been able to drive home the message of conservation to a larger audience.

**Keywords:** eBird, citizen science, bird atlas, GBBC

06-29

### LOGISTIC REGRESSION MODEL AND TEMPORAL ACTIVITY PATTERN OF STRIPE - NECKED MONGOOSE OF SILENT VALLEY NATIONAL PARK

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**Background:** The lesser known mammals engage in significant ecological roles in the ecosystem functioning in tropical forests and their exclusion has a cascading effect on entire communities. Most of the Protected Areas of the country in general and Kerala in particular do not have many comprehensive inventories of the small carnivores especially Stripe-necked Mongoose *Herpestes vitticollis*. Even though *Herpestes vitticollis* is endemic to Western Ghats in India and Sri Lanka its distribution along Western Ghats is not yet studied well. No studies have done on the habitat preference and prediction of the presence of this species using a model in India and very small studies are there on the temporal activity pattern of Stripe-necked Mongoose.

**Methods:** Silent Valley National Park (SVNP) was the study area. Camera trap survey was done to identify the presence of Stripe-necked Mongoose in SVNP. Twenty microhabitat parameters that are crucial for the survival of the small carnivores from each camera trap stations were used for the prediction model for Stripe-necked Mongoose of SVNP. Camera trap images were used to establish the temporal activity pattern of this species.

**Results:** Logistic regression analysis was done for predicting the presence *Herpestes vitticollis* based on 20 habitat parameters recorded from the camera trap stations. From that it was found that all the parameters like canopy height, litter depth, density of buttressed trees, climbers, shrubs, canes, distance to largest tree, width of water body, Girth of the largest tree, slope, and presence of water body, holes, rocks, fruiting tree, swamp, roots, and fallen logs except canopy cover have significant influence on the presence of Stripe-necked Mongoose. From the evaluation of logistic regression model for Stripe-necked Mongoose it is found that the percentage of correct predictions of this species is 100% in SVNP. From the analysis of temporal activity pattern of Stripe-necked Mongoose it was found that it is a diurnal species with a peak active period during 09:00hrs to 10:00hrs.

**Conclusion:** This work establishes the relationship between microhabitat parameters and presence of Stripe-necked Mongoose in SVNP. Microhabitat parameters are used to understand the habitat preference and to create the prediction model for the presence of Stripe-necked Mongoose. Stripe-necked Mongoose is a diurnal species.

**Keywords:** Stripe-necked Mongoose, Camera traps, Logistic Regression model, Temporal activity pattern

06-30

### DEVELOPMENT OF AN INDEX FOR SOIL QUALITY ASSESSMENT OF MANGROVES IN KERALA

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**Background:** Mangroves are a productive ecosystem that supports various goods and services. A quantitative assessment of the soil quality of these systems would help develop suitable management strategies or policy interventions. The present study aims to develop a soil quality index to quantitatively assess the mangrove soils of Kerala.

**Methods:** Surface soil samples (0-30 cm) were collected from mangrove areas of Thrissur, Kannur and Kollam districts of Kerala. In each of the selected sites the mangroves were classified into undisturbed, medium disturbed and disturbed based on the canopy cover. The collected soil was characterised for their physicochemical parameters and heavy met-

als using standard protocols. Soil quality assessment was done by principal component analysis (PCA).

**Results:** The calculated Soil Quality Index (SQI) of the mangrove areas ranged from 0 to 3.0 for disturbed, 3.1 to 9.0 for medium disturbed and >9.1 for undisturbed soils. Relative soil quality index of these mangrove soils varied from 0 to 27% , 28 to 80%, > 80 % for disturbed, medium disturbed and undisturbed soils respectively.

**Conclusion:** The SQI values can be used for the categorization of existing mangrove sites and mangrove species – site matching when taking up new planting. Sites with low SQI should be planted with mangrove species with high adaptation and bioremediation potential As for the existing sites, low SQI mangroves (0 – 3.0 SQI values) should be maintained through strict monitoring as further pollution in these sites could have adverse effects on the adjoin systems linked to it. Further research is needed for development of successful restoration strategies based on degradation level in these areas.

**Keywords:** Mangroves, Soil, Soil quality index

06-31

### ZOOPLANKTONS AS INDICATORS IN THE SEASONAL ECOLOGY OF THREE PONDS OF ERNAKULUM DISTRICT OF KERALA

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**Background:** Zooplanktons are feebly floating microscopic organisms of aquatic systems. They mediate the transfer of energy from producers to consumers. They are also bio indicators of water quality and serve as sensitive, inexpensive, efficient and early warning and control systems. The paper describes the ecology and bio indicator species of three ponds viz. Irumbakulam (Kadungallor) Aluva, Nelanattukulam (Sreemoolanagaram) Kaladi and Chathankulam (Allapra) Perumbavoor, of Ernakulam District.

**Method:** The physical and chemical parameters such as temperature, turbidity, dissolved oxygen and carbon dioxide, salinity, nitrates, phosphates, total dissolved solids and pH of samples were measured for monsoon and post monsoon seasons. The preserved zooplanktons were identified, numerical abundances determined and biological indices estimated.

**Results:** All the ponds in both the seasons had normal temperature, pH, salinity and nitrate values but elevated dissolved oxygen, carbon dioxide, total dissolved solids and phosphate values. Altogether, a total of 109 species, including 21 rhizopods and ciliata, 41 rotifers, 25 cladocera, 17 copepods and 5 ostracods have been identified. Statistically, there is adequate abundance, diversity, evenness and richness both pond wise and season wise. Many pollution indicator zooplanktons like *Arcella vulgaris*, *Centropyxis aculeata*, *Diffflugia oblonga*, *Brachionus spp*, *Asplanchna spp*, *Lecane spp*, *Testudinella patina*, *Platyias quadricornis*, *Diaphanosoma sarsi*, *Kurzia latissima*, *Thermocyclops hyalinus*, *Mesocyclops hyalinus*, and nauplii have been observed in Aluva and Kaladi ponds.

**Conclusions:** Physico-chemical features support abundant and diverse zooplanktons in different seasons, particularly postmonsoon. Study of biological indices and pollution indicator species reveals that Aluva pond is polluted with urban waste water runoff, Kaladi pond is polluted with risk of eutrophication and dryness in summer, whereas Perumbavoor is a non polluted pond. All three ponds fall in meso-eutrophic status range.

**Keywords:** zooplankton, kulam, physico-chemical parameters, diversity index, bioindicators.

06-32

### ECO - PHYSIOLOGICAL STUDIES IN RELATION TO HEAVY METAL CONTENT IN DIFFERENT STRATEGIC AREAS / PLANTS OF KADALUNDI VALLIKKUNNU COMMUNITY RESERVE

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The mangrove ecosystems are economically valuable and they are under increasing threat of being wiped out by rapid human encroachment and environmental pollution and it is considered to be one among the highly endangered ecosystems of the world. This work is an assessment on the effect of different anthropogenic activities on the mangrove vegetation of Kadalundi-Vallikkunnu Community Reserve (KVCR) by analyzing the heavy metal content in soil/plants and physiochemical characterization of water and soil sediments. Concentration of seven metals such as Mn, Zn, Cu,

Fe, Ni, Pb and Cd were analysed in soil sediments, water and root tissues of *Acanthus ilicifolius*, *Avicennia officinalis* and *Rhizophora mucronata* plants of the KVCR. Except Cd, all other metals were detected from these samples. Fe was detected in higher levels in all the samples. Higher content of heavy metal was recorded in *A. ilicifolius* as compared to *A. officinalis* and *R. mucronata*. Accordingly it was ascertained that, *A. ilicifolius* is a hyper accumulator of heavy metals as compared to *A. officinalis* and *R. mucronata* in KVCR region. The physiochemical properties of soil and water as well as the heavy metal content in different regions of KVCR regions are varied and might have an influential role in the species dominance in the particular region.

06-33

#### NOVELTIES FROM MATHIKETTAN SHOLA NATIONAL PARK, KERALA, INDIA

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**Background:** Mathikettan shola National Park is rich in biodiversity and plays a vital role in safe guarding wild life in the region. Being rich in floristic diversity and presence of many RET plants, there is ample scope for novelties in the area.

**Method:** Fresh specimens were collected and pickled in 4% formalin and 70% ethanol for detailed study. Photographs of habitat and habit were taken with a Sony α A55 DSLR Camera and floral details were studied with a stereo microscope (Leica EZ4HD). Illustrations were drawn by using a stereomicroscope with Camera Lucida attached. Herbarium sheets were prepared by conventional methods (Bridson & Forman, 1991). The identity of the species was confirmed with type material/ protologues and descriptions were prepared after proper diagnosis by examining wide range of specimens. The specimens of related taxa in CALI and MH were also examined. Drupe micromorphology was examined using Scanning Electron Microscope (Zeiss Gemini SEM 300 Microscope).

**Results:** The newly described species of Piperaceae, *Peperomia ekakesara* Syam & S. Nampy is morphologically close to *Peperomia heyneana* Miq., but can be easily distinguished by its glabrous, procumbent habit and having one stamen in each flower contrasting with pubescent, erect habit and two stamens in the latter. *Memecylon idukkianum* S. Nampy & Syam (Melastomataceae) is allied to *Memecylon varians* Thwaites but differs in having quadrangular branchlets, acute or obtuse leaf apex, 5–9 mm long petioles, 15–20 flowered cymes, pale green calyx with ovate lobes, white corolla, 0.5 mm long anthers and deep blue fruits. *Kalanchoe dinesii* Syam & S. Nampy is morphologically allied to *Kalanchoe bhidei* T. Cooke but differs in size, obovate to obtrullate sessile leaves, not spreading 6–8 cm long inflorescence, 1.5 mm long bracts, 3–5 mm long pedicel, widely ovate calyx lobes and greenish white corolla lobes with caudate apex. *Embelia mathikettanensis* Syam & S. Nampy is very rare plant found in the park and it is similar to *Embelia adnata* Bedd. ex C.B. Clarke.

**Conclusions:** During floristic surveys in 2014–2017, more than 500 angiosperm taxa were collected from the park. Critical field observation and microscopic study recognized four novelties: *Peperomia ekakesara* Syam & S. Nampy (Piperaceae), *Memecylon idukkianum* S. Nampy & Syam (Melastomataceae), *Kalanchoe dineshii* Syam & S. Nampy (Crassulaceae) and *Embelia mathikettanensis* Syam & S. Nampy (Myrsinaceae), which are described as new to science. The present study indicated the species richness of this region. The unprecedented flood and landslides that devastated the state of Kerala recently, had its maximum impact on Idukki district causing considerable loss to biodiversity. Thus it is imperative to protect this ecologically sensitive area with rich and natural biodiversity from both natural and anthropogenic calamities.

**Keywords:** Angiosperms, taxonomy, *Peperomia*, *Memecylon*, *Kalanchoe*, *Embelia*, endemic, IUCN

06-34

#### EVALUATION OF WATER QUALITY STATUS OF PARVATHY PUTHANAR CANAL, THIRUVANANTHAPURAM, KERALA, SOUTH INDIA

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Parvathy Puthanar is a man-made canal, runs parallel through the west coast of Thiruvananthapuram district, Kerala state. It is a portion of Thiruvananthapuram-Shoranur Canal (TS canal), and connectsthe Karamana river, Akkulam-Veli

lake & Kadinamkulam lake. The study aims to assess the current water quality status of the Parvathy Puthanar using Water Quality Index (WQI). The canal water samples were collected from ten selected sampling stations extending from Thiruvallam to Kadinamkulam (total distance of about 26 km) during December 2017 (postmonsoon season) and March 2018 (premonsoon season). The physico-chemical and bacteriological analysis of canal water were carried out following the standard procedures of APHA. Concentration of heavy metals such as Fe, Mn, Cu, Cd, Cr, Zn and Pb in canal water were determined after acid digestion by Atomic absorption spectrophotometry. Water Quality Index was calculated following the procedure of National Sanitation Foundation (NSF) WQI. For this, the values obtained for water quality parameters pH, DO, turbidity, faecal coliforms, total phosphorous, nitrates and BOD of Parvathy Puthanar were used. Results of the analysis of surface water quality of the canal water show that most of the sampling stations of the canal belong to bad and moderate category. The colour intensity of canal water ranged from 10 to 20 Hazen Units and the heavy metals Fe, Mn, Cu, Cr, Cd, Zn and Pb were detected in Parvathy Puthanar. The concentration of majority of heavy metals in canal water except Cd are within the permissible limits of BIS surface water quality standards. It reveals that the canal is facing pollution due to various anthropogenic activities such as illegal discharge of sewage from houses, offices, apartments, wastewater from hospitals, hotels, disposal of garbage, wastes from slaughter house, effluents from sewage treatment plants etc. The study suggests that Parvathy Puthanar canal can be conserved only through implementing strict laws and human participation.

**Keywords:** Coliforms, Heavy metals, Parvathy Puthanar, Pollution, Water Quality Index.

06-35

#### DETECTION OF WATER POLLUTION INDICATORS AND OTHER MULTIDRUG RESISTANT PATHOGENIC BACTERIA IN THE DRINKING WATER SOURCES OF CHENGANNUR AFTER FLOOD - A MAJOR THREAT

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**Background:** Beginning on -15 August 2018, severe flood affected Kerala, due to unusual high rainfall during the monsoon season. It was the worst flood in Kerala in nearly a century. The flood affected most of the drinking water sources of all affected places. The major source of pollution is the flood water which carried the sewage and deposited in drinking water sources.

**Method:** This work aimed for the detection, isolation and antibiotic sensitivity analysis of water pollution indicating coli forms and other multi drug resistant pathogenic bacteria from the drinking water sources of different Panchayath of Chengannur after flood. Well Water samples collected from homes were evaluated for the presence of faecal coli forms by most probable number technique. The total number of colonies was detected by standard plate count method. Antibiotic resistance pattern of the isolates were studied by Kirby Bauer agar disc and well diffusion methods.

**Results:** The result indicated that most of the water bodies were polluted with faecal coli forms and other antibiotic resistant pathogens. *E.coli*, *Streptococcus*, *Klebsiella* were isolated from the drinking water sources of which some strains were found multidrug resistant. Present study showed a notable increase in the total coli form bacteria in the well water after flood. Antibiotic resistant strains were observed from the water sample collected from various sites and this is alarming and serious threat to the human and animal inhabitants.

**Conclusion:** The study has led to conclude that the quality of water samples from different wells subjected to study was not acceptable from bacteriological standards. Hence the water needs to be treated before using for any domestic purposes. Based on the results of analysis, it is suggested that detailed routine analysis of the drinking water sources, storage tanks and pipe lines is needed. Moreover strict monitoring and awareness may be carried out for the public to access safe water for drinking and house hold uses.

**Keywords:** Bacteria, coli forms, multidrug resistant, indicator organisms, water pollution.

06-36

**SOIL HEALTH STATUS OF SELECTED LAND USE SYSTEMS IN A REGION OF  
ACHENKOVID WATERSHED, KOLLAM DISTRICT: A STUDY ON THE IMPACTS OF LAND USE AND  
MANAGEMENT**

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**Background:** Conversion of forest land to plantations such as teak, rubber, coffee, tea, cardamom, eucalyptus etc. were the main types of land use change happened in Kerala in the last several decades with respect to plantation development. Most of plantations were raised in the ecologically sensitive region of Western Ghats. But the impact of this land use conversion on soil properties and soil quality have not been carried out properly. Hence, an attempt has been made to assess the soil quality status of a selected region of Achenkovil watershed, Kollam district, part of Western Ghats comprising three major land use systems of the area- natural forest (NF), teak plantation (TP) and rubber plantation (RP).

**Method:** 42 composite soil samples (0-20 cm depth) were collected from three land use systems in July- August 2017. The physico-chemical parameters analyzed were soil temperature, moisture, soil bulk density, texture, pH, EC, soil organic carbon (OC), total nitrogen (TN), available Nitrogen (Av.N), available phosphorous (Av.P), available potassium (Av.K) , sodium and soil respiration. Soil quality index (SQI) maps were prepared using Arc GIS 9.3 software.

**Results:** The present study revealed that, most of the physico – chemical properties of soil were found either varying or declining between forests and plantation systems. Climatic factors including rainfall, temperature, soil erosion and vegetation type can be considered the main factors for these variations in soils. Excessive soil erosion has observed in the area. The soils in general had a sandy to loam texture, acidic pH, high organic carbon, and available nitrogen and potassium contents. Available phosphorus was found to be low. Soil microbial activity indicated by soil respiration rate showed declining trend in plantation systems compared to forest. Soil respiration rate was found to be having positive correlation with soil organic matter availability. SQI values were high in forest soils compared to plantation soils.

**Conclusion:** This work confirmed the hypothesis that soil quality declines when natural forests undergo massive conversions to less managed plantation systems. The predominantly monocrop plantation systems have adversely affected the soil health status of the land use systems in the study area.

**Keywords:** Soil quality index, land use change, soil respiration

06-37

**DIVERSITY AND DISTRIBUTION OF BIRDS IN MIDLAND LATERITIC BIOTOPES OF NORTHERN  
KERALA, INDIA**

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Lateritic hillocks of Kerala are often considered as ‘wastelands’ due to the scarcity of woody species and less agricultural productivity. But in reality they are landscape units having high biodiversity value and ecological significance. Birds use these lateritic biotopes as their roosting, breeding and feeding grounds. The lateritic biotopes provide ample refuge for many birds including migratory ones. Some birds use this place as stop-over sites for a short time during their seasonal migration (Passage migrants). The unique topographic setting of these lateritic hillocks, an elevated table like plateau surrounded by the wetlands and agro-ecosystem has been a very distinct land mark for the migratory birds. These lateritic biotopes constitute Lateritic vegetation, Sacred Groves, Kanams, Agro-ecosystems and Plantations. These ecological subunits provide a diverse habitat for birds. During this study, 196 species of birds were recorded. Two near Threatened and one vulnerable species were listed in the study. Four birds are endemic to Western Ghats. Birds were identified and checklist was prepared with reference to the available literature.



06-38

### MACRO-PROLIFERATION OF THE BLACK BAMBOO, *GIGANTOCHLOA ATROVIOLACEA* WIDJAJA

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**Background:** Bamboos are generally monocarpic, seed only once, at the end of long years of vegetative growth. There is no easy method available to predict when a bamboo, that we come across, may seed; and hence could not be relied for immediate propagation. There is poor supply of planting materials of this species, at present, as against heavy demand. An improvised macro-proliferation method for the Black Bamboo, *Gigantochloa atrovioleacea* Widjaja, is described here.

**Methods:** Cuttings from live clump conserved in the Bambusetum of JNTBGR were used for the propagation experiments. Pre-rooted branches and 2-node branch cuttings were planted to begin the experiment. Rooted cuttings were grown adequately in polybags and subjected to further proliferation.

**Results:** A four-month macro-proliferation schedule is developed, which ensures continuous production of handy propagules, of *G. atrovioleacea* (@2.5 tillers/ bag). This macro-proliferation method stands notable, because it remedies the planting material shortage. The method is easy to practice; saplings resulted easily portable, suitable for multiplication and replaces laborious propagation practices.

**Conclusion:** So far known, the Black Bamboo could be propagated only through vegetative means. The modified macro-proliferation method described here finds relevance in the continuous production of planting material for this high-end bamboo. The high productivity of the pre-rhizomed branches and the methodology described to obtain them are of relevance in bamboo propagation studies.

**Keywords:** Black Bamboo, Macro-proliferation, Pre-rhizomed branches, Culm cuttings

06-39

### TiO<sub>2</sub>-REDUCED GRAPHENE OXIDE NANOCOMPOSITE: A NOVEL CATALYST FOR SOLAR DECONTAMINATION OF WATER FROM DRUG POLLUTANTS

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**Background:** Diclofenac (DCF) is an extensively used anti-inflammatory drug in human and animal health care. The metabolites from DCF are highly stable and toxic and get accumulated in the environment. Hence it is included in the list of 'priority pollutants' by the European Union. Conventional waste water treatment systems are inadequate for the total elimination of DCF. In this context, Solar Photocatalysis – based Advanced Oxidation Process (AOP) using in-house synthesised nanocomposite TiO<sub>2</sub>-reduced graphene oxide (T-RGO) as catalyst is explored for the removal of last traces of DCF from water.

**Methods:** T-RGO nanocomposites of varying composition were prepared by solvothermal treatment of titanium isopropoxide and graphene oxide (GO) in isopropanol. The catalysts were characterised by various spectroscopic and physico-chemical methods. Photocatalytic experiments under sunlight and UV irradiation were made using standard procedures. The DCF concentration at various intervals of irradiation was estimated using UV-Visible spectrophotometry (274.6 nm) and total organic carbon (TOC).

**Results:** The solar photoactivity of T-RGO was established from preliminary experiments. Relevant photocatalysis parameters such as catalyst loading, RGO content in the composite, concentration of DCF, pH etc were optimised. The degradation of DCF is facile under solar irradiation in presence of T-RGO thereby establishing its potential for economic commercial application. The degradation follows Langmuir–Hinshelwood mechanism and pseudo first order kinetics. Reaction intermediates are identified by using LC/MS technique. Eventually they also get mineralized as seen from the complete disappearance of TOC. The role of graphene in the superior photocatalytic performance of T-RGO composite is experimentally verified and confirmed. Relevant mechanistic details are also discussed.

**Conclusions:** In-house synthesised nanocomposite T-RGO is identified as a highly efficient solar photocatalyst for the removal of even traces of the highly recalcitrant DCF pollutant and its metabolites from water.

**Key words:** Diclofenac, Photocatalysis, TiO<sub>2</sub>-RGO nanocomposite

06-40

**FOOD AND FEEDING HABITS OF SCHNEIDERS LEAF - NOSED BAT, *HIPPOSIDEROS SPEORIS*  
(SCHNEIDER, 1800) FROM PEECHI - VAZHANI WILDLIFE SANCTUARY**

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**Background:** Knowledge of the dietary composition can provide better understanding of the ecology and behavior of a species, and dietary information is essential for effective management of any species. Dietary analysis and understanding of feeding behavior of insectivorous bats enables to identify insect pests consumed by bats and publicizing the importance of insectivorous bats in controlling agricultural pest population can be a very powerful conservation tool.

**Method:** Fecal matter analysis using microscope was done to identify and quantify dietary components of insectivorous bats. 150 fecal pellets collected were analyzed to study the feeding habits of *Hipposideros speoris*.

**Results:** Fecal matter analysis of *Hipposideros speoris* shows that the diet includes Lepidoptera, Coleoptera, Diptera, Isoptera, Odonata, Hemiptera, Hymenoptera, Orthoptera, Neuroptera, Ephemeroptera and Araneae with different percentage volume and percentage frequency.

**Conclusions:** The dietary analysis of *Hipposideros speoris* reveals that these bats feed on insect orders which include potential pests in Agriculture, Forests and Human inhabitations. This indicates that *Hipposideros speoris* play a crucial role in insect pest suppression in Agriculture lands, Forests and Human inhabited areas.

**Keywords:** Bats, Microchiroptera, Feeding habit, Biological control

06-41

**PHYCOREMEDIATION OF PULP AND PAPER MILL EFFLUENT USING  
PLANKTOCHLORELLA NUREKIS**

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**Background:** The release of untreated wastewater poses serious environmental challenges to the receiving water bodies such as eutrophication. The pulp and paper industry uses large quantities of water and generates enormous quantity of wastewater. Bioremediation is an alternative eco-friendly technique with low economic and energy input. Phycoremediation is a type of bioremediation which use microalgae for the treatment of wastewater. This technique is an option for the remediation of cashew nut processing wastewater (CNPW) subsequently produced biomass can be used as source of renewable energy.

**Methods:** In the present study, fresh water microalga, *Plantochlorella nurekis* was isolated from Kuttanad wetland ecosystem, Kerala, India. The main objective of this study was to provide suitable concentration of PPME for the efficient treatment of nutrients in pulp and paper mill effluent. The collected PPME effluent was filtered separately and diluted to different concentrations of test solutions viz., 25%, 50%, 75% and 100%. All the experimental flasks (reactors) were placed in the culture room at 27±2°C with a constant illumination of 45 μmol photons m<sup>-2</sup> s<sup>-1</sup>. The study was conducted for 25 days in three experimental sets of reactors. The physico-chemical analysis of wastewater was carried out before the inoculation of microalgae and also at the end of the experiment.

**Results:** The results of the present study indicated that maximum cell growth of *P.nurekis* was observed on the 20th day in 75% PPME. Lowest cell growth was observed concentration with 25% and 50% PPME. The higher cell concentration was attained in the following order 75% > 100% > 50% > 25%. 75% PPME showed more biomass, lipid (22%) and nutrient removal efficiency than other concentrations.

**Conclusions:** The study suggested that among the four different PPME concentrations, 75% PPME was suitable for the production of biomass and lipid. Hence it can be concluded that the native microalgae, *P.nurekis* can be used as a potential candidate for the treatment of PPME.

**Keywords:** Phycoremediation, microalgae, PPME

06-42

## FLOOD INUNDATION ANALYSIS USING DEM AND LAND COVER MAP

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**Abstract:** In the month of august 2018 heavy monsoon rainfall triggered floods along Kerala's coast as well as in different parts of the state in the hardest hit areas along the banks of the rivers Periyar, Chalakudy, and Muvattupuzha. Floods are considered to be one of the catastrophic weather-related natural disasters. This paper presents the influence of elevation and land-use on flood inundation in Aluva, Kerala which forms a part of Periyar river basin using Geographical Information System. Flood inundation data (Ground Control Points/GCPs), Digital Elevation Model (DEM) and landcover map were used in the study. Results indicate that in the chosen study area low lying areas are at lower risk than midlands. Moreover, the flood inundation was found to be higher in the region of built-up and settlements and the minimum inundation was observed in wetlands.

**Background:** About 14.8% of the state is prone to flooding (CESS, 2010). Apparently, there is a serious dearth in the number of studies conducted to understand the vulnerability of Kerala to natural hazards especially floods. Aluva has been one of the worst affected during the recent floods. During the course of the study, around 5m flood water height was observed in Aluva and the reason for which can be attributed to unplanned land-use, illegal encroachments and wetland reclamation. With the advent of GIS based technologies spatial analysis of such environmentally unsustainable practices are made easier.

**Method:** The following datasets were used to perform the study: ASTER-Digital Elevation Model -15m resolution, Flood height ground control points from flooded sites and land-use land cover map generated from landsat image using isocluster-unsupervised classification. After extracting the DEM values using the flood water levels from GCPs, the water levels for the corresponding raster values were compared and analysed. Land use land cover map was generated from the recent landsat data using isocluster unsupervised classification in ArcGIS. Using zonal statistics tool from arcgis toolbox the average water inundation and elevation for each land cover class was estimated

**Result:** average water level in the low lying lands is higher than that in mid land. In mid-land region the frequency of water levels is the highest for the range 1-2 m while in the low-land the frequency of the range 0-1 m is the highest. From the obtained results it can be concluded that the low lying regions are relatively at lower risk than the mid land region. It is observed that regions with higher built-up intensity have maximum water inundation compared to the other regions. Whereas, in wetland regions the water inundation is the lowest

**Conclusion:** The lowest water inundation occurred in the wetland region. This can be attributed to the fact that wetlands act as water retainers that do not allow flooding to exceed beyond a certain level. This fact also emphasises on the significance of wetlands in flood control and management.

**Keywords:** Flood inundation, GIS, DEM, unsupervised classification

## 07 - FISHERIES & VETERINARY SCIENCES

07-01

### SUPPLEMENTATION OF PROBIOTIC *PAENIBACILLUS POLYMYXA* HGA4C INDUCES MORPHOMETRIC, ENZYMATIC AND GENE EXPRESSION CHANGES IN A TELEOST FISH *OREOCHROMIS NILOTICUS*

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**Background:** Probiotics have been using in human as well as other animals as food supplements for improved health status and disease resistance. The beneficial effect of probiotics on growth and immunity is a hot topic among nutritionists. The exact mechanism behind the host-probiotic interaction is not well understood. Hence, the present study was designed to evaluate the mechanism involved in the probiotic mediated health status improvement in a teleost fish *Oreochromis niloticus*.

**Method:** In this study, the fish *Oreochromis niloticus* was supplemented with two concentration ( $1 \times 10^6$  and  $1 \times 10^8$  CFU/g) of the probiotic bacterium and subjected to analyze its growth promoting effects, modulation of digestive and

antioxidant enzymes and up-regulation of growth-related and immune-related gene expression. Growth parameters such as FW, WG, SGR, FCR and HIS were calculated. Digestive enzymes in the intestine and antioxidant enzymes in the liver and the intestinal tissues were assayed. Relative gene expression using qPCR for the growth related and immune related genes were done.

**Results:** The investigation revealed that the fish supplemented with two levels of the probiotic bacterium significantly improved morphometric parameters, digestive enzymes and antioxidant status of *Oreochromis niloticus*. Gene expression studies in the fish supplemented with  $1 \times 10^8$  CFU/g showed that the probiotic bacterium could effectively modulate the expressions of growth hormone binding receptors (GHR-1 and GHR-2) and insulin-like growth factors (IGF-1 and IGF-2) in the fish. Furthermore, the probiotic bacterium upregulated Toll-like receptor (TLR-2) gene expression along with the pro-inflammatory cytokines (IL-8 and TNF- $\alpha$ ) and anti-inflammatory cytokine (IL-10) in the intestinal tissue of the fish. Intestinal MUC 2 up-regulation by the bacterium has indicated the mucosal remodeling of the host fish.

**Conclusion:** The probiotic *Paenibacillus polymyxa* HGA4C in the diet of *Oreochromis niloticus* is capable of improving morphometric growth parameters, digestive and antioxidant enzymes, and gene expression. The results have indicated the possible mechanism of action involved in the probiotic mediated growth regulation and immunomodulation in *Oreochromis niloticus*.

**Keywords:** Probiotics; *Oreochromis niloticus*; growth; antioxidant; immunity.

07-02

## NATURAL ANTIOXIDATIVE EXTRACTS FROM FRUIT PEEL WASTES FOR SEAFOOD PRESERVATION

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**Background:** Fish or seafood is considered as the highly perishable commodity due to its very nature. Higher moisture content, native enzymes and bacteria accelerate the spoilage during the postharvest period of seafood. To retard the spoilage and to ensure the perishables have a long shelf life, artificial preservatives are used and proved to be effective. Harmful levels of Illegal additives such as formalin and ammonia or its combinations with other preservatives are reported recently from domestic fish markets of India. Considering the potential health hazards due to the use of chemical additives and synthetic preservatives, natural products, particularly natural antioxidants and antimicrobial agents need to be popularized for ensuring the safety of food consumers.

**Method:** In the present study fruit peel wastes of lemon and promagrante were collected from the different fruit-juice shops in Ernakulam, Kerala. Peels were washed, dried, powdered and the concentrated natural antioxidant was extracted. The characterization of fruit peel extracts -total phenolic content, total flavonoid content and DPPH radical scavenging properties of the extracts were analyzed. Standard concentrations of extracts were applied in filleted fish and in un-deveined shrimp respectively to understand the antioxidative effects and shelf life. Changes in the biochemical parameters such as PV, TBA and pH were recorded.

**Results:** The results of the present study revealed that the fruit peels of lemon and pomegranate contain good quantity of natural extract having excellent radical scavenging activity, phenolic and flavonoid contents. The antioxidative study had given significant results in terms of pH, PV and TBA values of selected seafood items under chilled storage. Biochemical quality was better and rancidity recorded was minimum in the coated samples compared to controls.

**Conclusions:** Fruits peel that are often thrown as agro-wastes from juice shop, household usage and many other food processing industries contain natural antioxidants. Coating of seafood with natural fruit peel extracts and stored under chilled or refrigerated condition had given promising results. Synthetic or illegal preservatives presently in use need to be discouraged and natural alternatives need to be popularized for ensuring healthy and safe diets for the growing population of our country.

**Keywords:** Antioxidant, Fruit Peel Extract, Lipid Oxidation, Rancidity, Phenolic content, Flavonoid content

07-03

### EVALUATION OF RUMEN METAGENOME AND METHANE EMISSION LEVELS BETWEEN VECHUR AND CROSSBRED CATTLE OF KERALA

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**Background:** The rumen microbial community plays a critical role in methane emission from ruminants and had higher correlation with physiological parameters such as milk yield, milk composition. However, there is a lack of data comparing the composition of the rumen microbial community and methane emission levels of Vechur and crossbred cattle of Kerala. Present study was undertaken with the objective of assessing rumen microbial composition and methane emission levels of Vechur cattle and crossbred cattle under similar diet and management condition using a relatively new whole metagenomic approach.

**Method:** All the experimental animals were maintained under 50:50 (forage: concentrate) diet on dry matter basis for a period of three weeks. Whole metagenome sequencing and further bioinformatics analysis was done in two pooled DNA samples, each obtained by pooling DNA isolated from rumen liquor of five Vechur and five crossbred cattle. The concentrations of methane (percentage) in rumen gas samples collected from six Vechur and six crossbred cattle were determined using a methane analyser.

**Results:** Whole Metagenomic analysis showed that bacteria were most dominant taxonomic domain followed by archaea, eukaryota and virus in the Vechur as well as the crossbred rumen. Results revealed the existence of a core rumen microbial community in Vechur and crossbred and also the presence of distinct microbial community in each genetic group. Diversity analysis revealed that evenness and diversity indices for microbial species were higher for Vechur cattle indicating its adaptability. Significantly higher level of *Firmicutes* and lower level of *Bacteroidetes* was observed for Vechur compared to crossbred suggestive of one of the reason behind high fat yield in Vechur. Higher methanogen diversity was observed in Vechur cattle. Abundance of specific methanogen species were found to be significantly different between genetic groups. Comparison of methane emission levels between Vechur and crossbred cows reported a significantly higher mean percent of methane emission in Vechur.

**Conclusion:** Current study generated the rumen metagenome profile of Vechur and crossbred cattle of Kerala and compared the methane emission levels between them. Results confirmed the influence of genetic group on total rumen microbial species profile and methane emission levels. This also suggested an association between rumen microbes with milk fat percentage and methane mission.

**Keywords:** Rumen metagenome, methane emission, methanogen composition, Vechur cattle, crossbred cattle

07-04

### VALIDATION AND ASSOCIATION STUDIES OF SINGLE NUCLEOTIDE POLYMORPHISMS IDENTIFIED IN PROLIFICACY RELATED GENES OF GOATS USING DOUBLE DIGEST RESTRICTION ASSOCIATED DNA SEQUENCING

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**Background:** Malabari and Attappady Black goats are the two native goat breeds of Kerala which differ significantly in prolificacy. Double digest restriction associated DNA sequencing (ddRADseq) is one of the successful modern reduced representation sequencing techniques, which apply Next Generation Sequencing (NGS), for discovery of Single Nucleotide Polymorphism (SNP) markers across population. In Current study ddRADseq was applied for identification of polymorphism markers affecting prolificacy in goats.

**Method:** Double digestion of genomic DNA (1µg) was done using *SphI* and *MluI* restriction enzymes in two pooled DNA samples, each obtained by pooling DNA, isolated from whole blood of 10 highly prolific Malabari and 10 low prolific Attappady Black goats, respectively. PCR-RFLP was done in 100 Malabari and 50 Attappady Black goats for validation studies of selected variants in *BMP6* and *SERPIND1*.

**Results:** ddRADseq discovered 4140 SNPs and 126 INDELS in Malabari and 2192 SNPs and 59 INDELS in Attappady

Black goats. 25 SNPs were discovered in 20 candidate genes affecting prolificacy and another set of 11 genes were identified based on the difference in allelic distribution of SNPs between the two groups, which might have an effect on prolificacy. From candidate gene group, *BMP6* was chosen for validation and PCR-RFLP revealed all three genotypes for the variant c.614-32789C>T, thus confirming the robustness of SNPs discovered by ddRADseq. Variant c.1259T>C identified in exon three of *SERPIND1*, showed significant association with litter size, thus emphasising the significance of this novel gene in prolificacy.

**Conclusions:** Current study emphasised the relevance of ddRADseq in identifying novel SNPs in candidate genes and also promises the possibility of discovering SNPs in unexplored genes which might affect complex traits.

**Keywords:** Single Nucleotide Polymorphism, ddRADseq, Serpind gene, goats

07-05

### A COMPREHENSIVE APPROACH FOR DIAGNOSIS OF PORCINE EPTOSPIROSIS: AN UNDER-REPORTED THREAT TO HUMANS

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**Background:** Leptospirosis, a worldwide zoonotic disease is indeed a major concern in the tropical state of Kerala, which has suffered several outbreaks of the disease so far. While most animals play a major role in the transmission of the disease to human beings, rodents and companion animals are the prime subjects of study and the role of farm animals is still far from knowledge to the society. A major underdiagnosed condition is swine abortion, which may be caused by zoonotic agents such as *Leptospira* or *Brucella*. Under this circumstance, the present study was performed to develop a comprehensive diagnostic methodology for porcine leptospirosis.

**Methods:** Samples were sourced from organised and private pig farms in Thrissur district, Kerala. Serum samples (n=108) were tested using microscopic agglutination test (MAT). Samples of blood (n=108) and aborted foetus (n=7) were subjected to *lipL32* gene specific polymerase chain reaction (PCR). Two antigen detection methods, latex agglutination test (LAT) and fluorescent antibody test (FAT) were also standardised and used for the diagnosis of acute cases of porcine leptospiral abortions. Attempts to isolate *Leptospira* from positive samples were also made.

**Results:** An overall seropositivity of 37.04 per cent could be detected using MAT with serovar Pomona being the most prevalent one. On *lipL32* gene specific PCR, three whole blood samples and tissues from one aborted foetus amplified the gene producing an expected 767 bp amplicon. Antigen detection LAT and FAT could be standardised for the detection of *Leptospira* using live cultures of different serovars.

**Conclusion:** In the present study, even though PCR was found to be the most sensitive method for directly detecting the presence of *Leptospira* in clinical samples, a combined diagnostic methodology can assist researchers and diagnosticians in interpreting the prevailing cause of swine abortions. In the present scenario, this is extremely important, owing to the zoonotic potential and the existing global burden of the disease.

**Keywords:** Swine, abortion, *Leptospira*, microscopic agglutination test, polymerase chain reaction, latex agglutination test, fluorescent antibody test.

07-06

### BIODIVERSITY OF PLAKOBRANCHIIDS (GASTROPODA: PLAKOBRANCHIDAE) FROM SOUTH-WEST COAST OF INDIA

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**Background:** Plakobranchidae is the largest family coming under the order Sacoglossa of the Phylum Mollusca. The family Elysiidae was considered to be a synonym of the family Plakobranchidae, among which the genus *Elysia* comprised of 87 species worldwide. They are specialist feeders mainly feed on single species or specific macroalgae and they are living in the intertidal rocky-reef region and shallow water coral reef ecosystems.

**Methods:** The samples were collected by snorkelling to a depth of 3 m and also by hand picking. Live specimens were photographed and described in the laboratory. Smaller specimens were observed under Stereo Zoom Microscope (Leica S6D). Samples were dissected from both dorsal and ventral side of the organisms under Stereo Zoom Microscope (Leica S6D). Species were identified using standard keys, several published literatures and comparison of the radula.

**Results:** A total of seven species of sacoglossan molluscs from the family Plakobranchidae was recorded during the present study from the rocky intertidal regions of Thirumullavaram, Kovalam, Vizhinjam, Muttom and Kanyakumari along the south-west coast of India. They are *Elysia bangtawaensis*, *Elysia* cf. *hirasei*, *E. expansa*, *E. grandifolia*, *E. pusilla*, *E. tomentosa*, and *Plakobranchus ocellatus*. No authentic record of *E. cf. hirasei* from India, hence the present study adds the new distributional record from India. Except *P. ocellatus* all other species are new distributional records from southwest coast of India. Relative abundance of sacoglossans was also recorded. From the present study it is evident that the *Elysia grandifolia* and *Plakobranchus ocellatus* are the most abundant species than rest of the species of the regions.

**Conclusions:** Sacoglossans are among the least studied marine organisms with interesting chemo-ecological and pharmaceutical importance. The assessment of diversity of sacoglossan sea slugs along the southwest coast of India has been overlooked. Detailed exploration of least studied regions of west coast would reveal the presence of more unknown Plakobranchid molluscs.

**Keywords:** Sacoglossa, Plakobranchidae, *Elysia*, *Plakobranchus*.

07-07

#### EFFECT OF VARYING DIETARY PROTEIN AND LIPID LEVELS ON GROWTH AND REPRODUCTIVE PERFORMANCE OF ORANGE CHROMIDE *ETROPLUS MACULATUS* (1795)

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**Back ground:** A feeding trial was conducted to determine the suitable dietary protein and lipid levels on the growth and reproductive performance of orange chromide (*Etroplus maculatus*). This fish has potential for both food and ornamental value. Its small size, bright orange colour and black spots on the body, calm nature etc., make them attractive candidates for the tropical aquariums.

**Method:** Four protein levels (30%, 40%, 50%, 60%) with two lipid levels 9% and 15%) within each protein levels were tested through formulation of practical diets labelled as 30P9L, 30P15L, 40P9L, 40P15L, 50P9L, 50P15L, 60P9L, and 60P15L respectively and the proximate analysis was done. Broodstock performance was evaluated based on growth parameters, proximate content and egg production.

**Results:** The results showed that a significant interaction between dietary protein and lipid level was detected and influences the final weight gain and reproductive performance of fish. Numerically, growth parameter and total egg production values were higher in 50P15L diet when compared with other low protein and lipid diets.

**Conclusion:** Based on this study the dietary protein and lipid requirement for the optimized growth and reproductive performances of orange chromide to be at 50% protein and 15% lipid.

**Keywords:** Broodstock nutrition, protein, lipid, orange chromide (*Etroplus maculatus*).

07-08

#### ANTIBIOTIC RESISTANCE AND VIRULENCE FACTORS OF *AEROMONAS* SPP. ISOLATED FROM DISEASED *XIPHOPHORUS HELLERII*

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**Background:** *Xiphophorus hellerii* or sword tail is a popular ornamental freshwater fish. But its growth has been limited by diverse bacterial infections due to poor quality of water and other environmental factors. Here the antibiotic resistance mechanisms and virulence factors of fish associated bacteria can expect to have an impact on fish health Hence the study was conducted to analyze diversity of bacteria associated with *X.hellerii* and its virulence and

antibiotic resistance properties.

**Methods:** in the study bacteria were isolated from the surface, gill and intestine of diseased *X. hellerii*. The obtained isolates were then screened for its antibiotic resistance and all the isolated bacteria were identified by 16S rDNA based method. Then the isolates were screened for virulence properties both by *in vitro* and molecular methods.

**Results:** The study has resulted in the isolation and identification of 12 bacterial isolates. Antibiotic resistance analysis of all the isolates against 17 antibiotics showed its 100 % resistance to oxacillin followed by 94 % resistance to teicoplanin. The isolates were identified as *Aeromonas* spp. and upon screening for virulence factors, 3 isolates were found to be positive for more than 2 virulence properties both by *in vitro* and molecular methods.

**Conclusion:** All of these data suggest the presence and distribution of bacteria with diverse virulence factors in the aquatic environment.

**Keywords:** *Xiphophorus hellerii*, Antibiotic sensitivity, Virulence factors

07-09

### MOLECULAR PHYLOGENY OF PORCINE REPRODUCTIVE AND RESPIRATORY SYNDROME VIRUS CIRCULATING IN KERALA

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**Background:** Porcine reproductive and respiratory syndrome virus (PRRSV) belongs to the genus *Arterivirus* of the family *Arteriviridae*. In India, the disease was reported for the first time from Aizwal district of Mizoram in 2013. In North Kerala, during the year 2017, there has been a steep rise in mortality of sows and piglets due to respiratory and reproductive problems resulting in wiping out of entire groups of animals. A pioneer study was conducted to detect and elucidate the lineage of PRRSV viruses in pigs in Kerala.

**Method:** A total of 48 samples were tested for the presence of PRRSV employing reverse transcriptase polymerase chain reaction (RT-PCR) targeting the ORF6 of the virus. From representative samples, partial region of ORF7 of the virus was sequenced.

**Results:** Of the samples tested 21 (43.75 per cent) were positive for the virus. On BLAST analysis, it was seen that the sequences showed 98 per cent similarity to PRRSV sequences from China. On phylogenetic analysis, it was observed that all the PRRSV circulating in Kerala were of Genotype 2 (North American Genotype) and that they formed a separate cluster along with Chinese sequence NVDC-CQ-2008 (KP771755). It was also observed that the nucleotide sequences of the Kerala isolates were very closely related to each other. The Kerala isolates also showed similarity to PRRSV isolate MZ/IND/1/15 (KT696491) obtained in 2015 from Mizoram, India.

**Conclusions:** The results of the study indicate that PRRSV infection is present to a great extent among pigs in Kerala and that the isolates share a close genetic relationship.

**Keywords:** Porcine reproductive and respiratory syndrome virus, reverse transcriptase polymerase chain reaction, ORF6, ORF7, phylogenetic analysis

07-10

### WHOLE MITOGENOME SCANS PROVIDE EVIDENCE FOR LOCALLY ADAPTED POPULATIONS OF INDIAN OIL SARDINE, *SARDINELLA LONGICEPS* IN THE INDIAN OCEAN

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**Background:** Presence of locally adapted populations of marine fishes has been reported in some of the recent investigations using molecular markers. We investigated the possible presence of locally adapted populations in Indian oil sardines by whole mitogenome analysis as mitochondrial Oxidative Phosphorylation complex (OXPHOS) has recently been assigned functions providing adaptive potential to environmental fluctuations in many marine organisms. Indian oil sardine, *Sardinella longiceps* is an ecologically sensitive and commercially important small pelagic fish of the



Indian Ocean.

**Method:** Whole mitogenomes of fishes collected from three eco-regions (South East Arabian sea, North Arabian Sea and Bay of Bengal) were analyzed for signals of selection and adaptation by approximate hierarchical Bayesian method (FUBAR, MEME) and TreeSAAP. control region was analyzed with its folding potential, number of substitutions/rate of evolution in paired sites and Tajim's D statistics.

**Results:** Our analysis revealed the role of purifying selection as the dominant force shaping evolution of sardine mitogenomes. In spite of these, signals of diversifying selection were observed in key functional regions involved in OXPHOS and which were more prevalent in individuals collected from South East Arabian sea which may be due to the effects of complex oceanographic features in this region and these findings point towards the presence of locally adapted populations. *S. longiceps* has a characteristic control region (D-loop) with a 30bp tandem repeats unit (palindromic sequences within it) and which is under strong selective pressure. Intrastrand secondary structures with low free energy (-0.101 to -0.384 ΔG (kcal/mol)) were observed in the repeat unit, haplotypes with one repeat unit has a greater folding energy and which is the most abundant. Two and three repeat units are less abundant and which is restricted to Western Indian Ocean

**Conclusions:** these findings point towards the presence of locally adapted *S. longiceps* populations in Indian Ocean. These sites could be used for further investigations by employing them as genetic tags of locally adapted populations which have implications in conservation and management of *S. longiceps* in the Indian Ocean.

**Keywords:** Local adaptation, Oxidative phosphorylation complex, Positive selection, Purifying selection, *Sardinella longiceps*

07-11

### MOLECULAR CHARACTERIZATION OF ANTIVIRAL RADICAL - SAM PROTEIN VIPERIN HOMOLOGUE IN ASIAN SEA BASS (*LATES CALCARIFER*)

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**Background:** Viperin is a multifunctional interferon inducible gene that interfere with viral budding through inhibition of specific enzymes, and inhibiting viral genome replication through binding to viral proteins required for replication and assembly. Viperin associates with the cytosolic face of the endoplasmic reticulum (ER) until viral infection and then relocates to the cytoplasm, in lipid droplets or foci in the cytoplasm to inhibit virus replication. Asian seabass is a fish of high economic value which is susceptible to certain viral infections like beta noda virus infections. Better understanding about the antiviral immune mechanisms of *Lates* is important for disease control and improved health status of fish.

**Method:** *Lates calcarifer* was challenged with *lippopolysachride* (0.5 μg/ g of fish) and spleen tissue was dissected out. Molecular cloning of *Lates calcarifer* viperin gene (*Lc-viperin*) was carried out through PCR based amplification and the amplicon of size 1054 bp was cloned and sequenced. The sequences were aligned by multiple align software clustalW and phylogenetic analysis were carried out by using MEGA 6 software. The signal peptide was predicted by SignalP software. The domains and motifs were predicted by SMART tool and motif finder. The 3D Homology model were predicted by Swiss-model software.

**Results:** The *Lc-viperin* contain an orf of 1056 bp that codes for 351 amino acid protein (Genbank accession ID: **MH423325**). The deduced *Lc-viperin* protein has a predicted molecular mass of 40.3 kDa and an isoelectric point of 7.01. *Lc-viperin* contains a signal peptide (residues from 1-31), conserved domain of elongater protein 3(Elp3) (residues from 63 to 271) and radical SAM domain (residues from 67 to 210) which carries four motifs including the highly conserved CxxxCxxC motif (<sup>73</sup> CNYKCGFC<sup>80</sup>). The *Lc-Viperin* also contains a highly conserved C-terminal domain (resides from 221 to 351) and an N terminal amphipathic α-helix domain (residues from 9 to 42) that varies among species. Viperin is evolutionary conserved protein and phylogenetic analysis by neighbor joining method showed that these homologue proteins could be divided into fish, bird and mammalian branches. *Lc Viperin* predicted 3D Homology model of contains 9 beta sheet and helices.

**Conclusion:** In this study, we sequenced and characterized the *Lc-Viperin* in *Lates calcarifer*. Sequence analyses

suggested that the *Lc*-Viperin was evolutionary conserved in protein sequence, with functionally significant domains. Our results indicated that the *Lc*-Viperin is involved in the innate antiviral immune response in *Lates calcarifer*. Sequence and expression studies of the antiviral genes will pave new ways for prophylactic measures in *Lates calcarifer* against viral infections.

**Keywords:** Viperin, antiviral, Interferon inducible genes.

07-12

### INFLUENCE OF TOMATO, LADIES FINGER AND SPINACH ON THE UTILIZATION OF INORGANIC NITROGEN IN MEDIA BASED EBB-AND-FLOW AQUAPONICS SYSTEM

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**Background:** The biochemical engine that drives the aquaponics system is the nitrogen cycle. This symbiotically provides fertility to plants and cleans the water for fish in an aquaponics system. The advantages of linking crop production and fish production help to reducing the water usage and waste discharge to the environment and increased profit potential from the system. The nutrient-rich effluent from the fish tanks is used to fertigate hydroponic production beds. Maintenance of water quality parameters is important for the survival of both fish as well as the plant growth in aquaponics.

**Method:** This study analysed the influence of Spinach, Ladies finger and Tomato on the inorganic nitrogen utilization and water quality maintenance. Spinach, Ladies finger and Tomato were planted independently in different aquaponics unit (4 plants in one trough) and Pacu (*Piaractus brachyomus* Cuvier, 1818) as candidate fish. Analysis of Ammonium nitrogen ( $\text{NH}_4\text{-N}$ ), Nitrite Nitrogen ( $\text{NO}_2\text{-N}$ ) and Nitrate nitrogen ( $\text{NO}_3\text{-N}$ ) were measured using standard procedures in each system.

**Results:** The results showed a reduction in the nutrient concentration in all three systems after 30 days experiment. Tomato showed a slight reduction than other two in the case of  $\text{NH}_4\text{-N}$  ammonium nitrogen while the ladies finger had the lowest value in the case of  $\text{NO}_3\text{-N}$  and the  $\text{NO}_2\text{-N}$  concentration was fluctuating with all the three.

**Conclusions:** The study proved that different plants have a varying role in aquaponics in the scenario of water quality maintenance. The nutrient requirement, absorption pattern, etc. is to be optimised per plant for a better efficiency for the commercial scale aquaponic systems.

**Keywords:** Inorganic nitrogen, aquaponics, water quality

07-13

### EVALUATION OF TOTAL MIXED RATIONS CONTAINING UNCONVENTIONAL FEED INGREDIENTS IN CROSSBRED CATTLE

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**Background:** The common feeding regimen followed by farmers from good old days was to feed their livestock with concentrate and roughage as separate allowances. This method was found to be inadequate due to limited control over the proportion of concentrate and roughage intake, the selection done by the livestock while ingesting and the unavailability of feed and fodder throughout the season. Feeding of livestock with total mixed ration (TMR) found to be beneficial since it stabilizes rumen fermentation, minimizes fermentation losses, ensures better nutrient utilization and allows incorporation of various unconventional feed ingredients while formulating rations. The objective of the study was 1) Evaluation of rumen fermentation pattern and nutrient utilization of crossbred cattle maintained on various TMRs 2) To suggest suitable total mixed ration for crossbred cattle for efficient nutrient utilization.

**Methods:** The study was conducted in two phases using six crossbred animals of 9- 12 months age of either sex. Phase I (control period) - A feeding trial was conducted using TMR prepared with conventional feed ingredients and green grass for a period of one month and Phase-II – Two separate feeding trials for a period of one month each were conducted using total mixed rations containing unconventional feed ingredients such as dhanwantharam thailam residue and rape seed cake. The parameters assessed were nutrient utilization and rumen fermentation parameters. The data gathered on the various parameters, in the control trial, Trial-I and Trial- II were analyzed statistically as per Snedecor and Cochran (1994) by analysis of variance (ANOVA) technique, using the software, statistical programme for social

sciences (SPSS) version 24.0.

**Results:** The statistical analysis revealed that the crude protein, crude fiber and ether extract digestibility were significantly ( $p < 0.01$ ) higher in TMR-I & II when compared to control TMR, whereas NFE digestibility was significantly ( $p < 0.01$ ) higher in control TMR than TMR-I & II and there were no significant difference in dry matter and organic digestibility among control TMR, TMR-I and TMR-II. The rumen fermentation parameters such as pH, rumen ammonia nitrogen, rumen trichloro acetic acid precipitable nitrogen and total nitrogen were similar among animals during control, trial I and trial II periods. The rumen acetic acid concentration of animals in control and Trial I was significantly ( $P < 0.05$ ) higher than animals maintained in Trial II, propionic acid concentration was higher ( $P < 0.05$ ) in animals maintained in Trial II but no difference between animals belonging to Trial I and II and Trial I and control trial. The rumen acetate: propionate ratio was significantly higher in animals of control trial and Trial I when compared to animals maintained in Trial II. Rumen butyric acid and total volatile fatty acids were similar in animals maintained in all the trials.

**Conclusion:** On thorough examination of results, it can be concluded that crossbred cows fed with TMR containing dhanwantharam thailam residues showed improved nutrient digestibility than animals fed with TMR containing rape seed cake and control TMR without any difference in rumen fermentation parameters and hence can be recommended.

**Keywords:** TMR, Dhanwantharam thailan residue, Nutrient digestibility, Rumen fermentation parameters and Volatile fatty acids

07-14

### DEVELOPMENT OF SYNBIOTIC ICE CREAM FROM GOAT MILK

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**Background:** Synbiotic ice cream was developed from goat milk by using inulin as a prebiotic and *Lactobacillus plantarum* (UBLP-40) as a probiotic. The treatment mix was formulated to contain more than 10% fat, 8.6% milk solids not fat, 2% inulin, 15% sugar, 0.4% stabilizer-emulsifier combination and 0.1% *Lactobacillus plantarum* culture.

**Method:** Ice cream was prepared as per the procedure suggested by Akin *et al.* (2007). First step was figuring of mix. The proportionate quantity of different ingredients to meet the minimum standard for fat (ten per cent) and total solids (36 percent) as per Food Safety and Standards Act was calculated for the preparation of ice cream. Ingredients selected for the preparation of ice cream were weighed. Solid ingredients (skimmed milk powder, inulin, sugar, stabilizer and emulsifier) were mixed together and kept separately. The liquid ingredients (milk and cream) were heated with stirring.

**Results:** Physico-chemical, microbiological and sensory qualities of control and synbiotic ice cream were compared. Synbiotic ice cream showed higher whipping ability ( $p < 0.05$ ) than control. Synbiotic ice cream was superior in sensory qualities than control during 30 days of storage. There was no significant difference in fat, protein, meltdown time, weight per litre and sensory parameters.

**Conclusions:** Synbiotic ice cream was successfully developed from goat milk by using inulin as a prebiotic and *Lactobacillus plantarum* UBLP-40 as a probiotic. This ice cream showed higher whipping ability and superior sensory quality than control. There was no significant difference in pH, titratable acidity, total solids, fat, protein, meltdown time and weight per litre. The probiotic count could be maintained above the minimum recommended level until 30 days of storage.

**Keywords:** goat milk, synbiotic ice cream, *Lactobacillus plantarum*, inulin, quality evaluation

07-15

### SEROPREVALENCE OF LEPTOSPIROSIS IN THRISSUR DISTRICT OF KERALA – A RETROSPECTIVE STUDY

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**Background:** Leptospirosis is a transmissible disease of animals and humans caused by infection with pathogenic members of the genus *Leptospira*. It is a zoonotic disease with worldwide distribution having high endemicity in Kerala. It almost affects all the domestic and wild mammals causing severe renal and hepatic damage and leads to fatal conditions if untreated. The disease is mainly associated with season and occupation and is highly prevalent in

population with poor sanitary conditions. The present study deals with incidence of leptospirosis in Thrissur district of Kerala.

**Method:** Diagnosis of leptospirosis is based on serological and/or molecular detection methods. The present study was conducted to analyse the incidence of leptospirosis in humans and animals in Thrissur district over a period of one year (Aug 2017 – Aug 2018), based on the detection of anti-leptospiral antibodies using Microscopic Agglutination Test (MAT).

**Results:** A total of 324 serum samples were analysed in the study. Among these samples, 73 samples were found positive with a percentage of 22.53 per cent. The per cent positivity in dogs, cats, cattle, goats and humans are 17.28, 0.31, 0.31, 0.62 and 4.01 per cent respectively. It was also found that there is a noticeable increase in the incidence of clinical cases of leptospirosis during the monsoon period.

**Conclusion:** From this study, we concluded that there is a high prevalence of leptospirosis among both the human and animal population. For effective prevention of the disease, one must follow the proper sanitation and routine vaccination of pets and proper waste disposal to control the rodent population, that place a major role in transmission of leptospirosis.

**Keywords:** Leptospirosis, Zoonosis, Retrospective study

07-16

### MOLECULAR DETECTION OF INFECTIOUS BURSAL DISEASE VIRUS (IBDV) IN KERALA

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**Background:** Infectious bursal disease (IBD) is one of the highly pathogenic immunosuppressive viral diseases of poultry. The disease causes heavy economic losses to the poultry farmers throughout the world by causing heavy mortality and increasing the susceptibility to other diseases. Infectious bursal disease virus (IBDV) belongs to the family *Birnaviridae*. Infectious Bursal Disease (IBD) is a highly contagious disease of young chicken caused by IBDV, characterized by immuno suppression and mortality generally at 2 to 6 weeks of age. Two serotypes of the virus are recognized, of which serotype 1 viruses are pathogenic to chickens and are classified into six subtypes ranges from mild to very virulent. But the serotype 2 viruses are non-pathogenic. This study was conducted with the aim of molecular detection of the Infectious Bursal Disease Virus (IBDV) strains from poultry in Kerala.

**Method:** A total of 27 IBD suspected samples (bursa of fabricius) was collected. Total RNA was isolated from the tissue samples using Trizol reagent (Invitrogen, USA) as per the manufacturer's protocol. The extracted RNA was treated with dimethylsulphoxide (DMSO) before synthesis of Complementary DNA (cDNA). cDNA was synthesized from the RNA using random hexamers utilizing Revert Aid First Strand cDNA Synthesis Kit (Thermo Scientific, USA) as per the manufacturer's protocol. The samples were tested for presence of IBDV by reverse transcription polymerase chain reaction (RT-PCR) using VP2 gene specific primers.

**Result:** It was observed that eighteen (66.66 percent) samples were positive for IBDV.

**Conclusions:** The result from this study indicates that VP2 gene amplification using RT-PCR is rapid and sensitive for IBDV detection. This study will add to the scientific knowledge of the viruses circulating in poultry in Kerala. This will also help in early detection of IBD and taking effective control measures which in turn will reduce economic loss to the poultry farmers.

**Key words:** Poultry, Infectious bursal disease virus (IBDV), VP2 gene, Reverse transcriptase polymerase chain reaction (RT-PCR)

07-17

### MOLECULAR DETECTION OF ROTAVIRUS OF PIGS IN KERALA

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**Background:** One of the important health problems in suckling and recently weaned piglets is neonatal diarrhoea. Rotaviruses belonging to Group A are one of the most frequently detected viral agents associated with diarrhoea in swine. Group C rotavirus can be considered as a common enteric pathogen in both humans and animals and would be an emerging zoonotic infection in humans. Rotaviruses are classified under the *Reoviridae* family and the *Rotavirus* genus, which includes at least seven serogroups (groups A to G). Rotaviruses have a genome of 11 segments of double-stranded RNA with genes that encode six structural viral proteins (VP) and six nonstructural (NS) proteins. This study was conducted with the objective of molecular detection of the rotavirus of pigs in Kerala.

**Method:** A total of 15 diarrhoeic faecal samples (in virus transport medium) were collected from piglets in organized farms in Wayanad, Thrissur, and Palakkad districts of Kerala. Viral RNA was extracted using TRIzol method (Invitrogen) according to manufacturer's protocol. Complementary DNA (cDNA) was synthesized from the RNA using random hexamers utilizing RevertAid H Minus First Strand cDNA Synthesis Kit (Thermo Scientific, USA) as per the manufacturer's protocol. Reverse transcriptase polymerase chain reaction (RT-PCR) was used for rapid detection of rotavirus in the sample employing VP4 gene and VP6 gene specific primers.

**Result:** A total of 3 (20 per cent) diarrhoeic faecal samples were positive for VP4 and VP6.

**Conclusions:** The result from this study indicates that VP4 and VP6 gene amplification using RT-PCR is rapid and sensitive for rotavirus detection. Hence, the detection of these viruses will add to the scientific knowledge of the viruses circulating in pigs in Kerala and effective control measures like strict biosecurity measures, restriction of animal movement, vehicle sanitation *etc.* which in turn will reduce economic loss to the swine farmers.

**Key words:** Rotavirus, VP4 gene, VP6 gene, Reverse transcriptase polymerase chain reaction (RT-PCR)

07-18

### A PRELIMINARY EVALUATION OF *SAUROPLUS ANDROGYNOUS* (L.) MERRILL LEAF MEAL AS A PARTIAL REPLACEMENT OF FISH MEAL IN THE DIETS FOR PACIFIC WHITE SHRIMP, *LITOPENAEUS VANNAMEI* (BOONE, 1931)

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**Background:** Fish meal (FM) is the most preferred protein source for aquafeeds because of its nutritional superiority. However, limited availability and high demand make fish meal a costly ingredient. One factor considered to reduce shrimp production costs and increase producers profitability, is the production of feeds with reduced amount of fish meal by incorporating high quality plant protein sources, without compromising the nutritional quality of the feed.

**Method:** Eight isonitrogenous diets (30% crude protein) were prepared to contain different concentration of *Sauropus androgyneus* leaf meal (SALM) as replacement to fish meal (FM) at various levels (0% - control, 10%, 20%, 30%, 40%, 50%, 60% and 70%). Post larvae of Pacific white shrimp (PL - 15; Initial weight, 1.4±0.14 mg and Initial length, 7±0.00 mm) were stocked in 100 L plastic tubs, at a stocking density of 5 lakh / hectare, i.e, 50 shrimps/m<sup>2</sup>, for a period of 90 days. For each diet, triplicate of tanks were maintained. The growth performance was assessed by studying the parameters such as average weight gain (AWG), specific growth rates (SGR), survival rate (SR %), performance index (PI), feed conversion ratio (FCR), feed conversion efficiency (FCE), protein efficiency ratio (PER) and protein content of shrimp carcass.

**Results:** The AWG and SGR were comparatively lower at higher levels of fish meal replacement (60% and 70%). SR% was not significantly different among treatments. The PI showed no significant difference among treatments, with best PI observed in organisms offered diet with 40% fish meal replacement. All the feed utilization parameters, FCR, FCE and PER, were either improved or similar to the control diet. The protein content of shrimp carcass was significantly

lower at higher level (70%) of FM replacement.

**Conclusions:** The results suggest that up to a 40% of fishmeal can be replaced with *S.androgynous* leaf meal in diets for *L. vannamei* without adversely affecting the growth of the shrimps.

**Keywords:** *Litopenaeus vannamei*, *Sauropus androgynous* leaf meal, specific growth rates, performance index, survival rate, protein efficiency ratio, feed conversion ratio, feed conversion efficiency .

07-19

### EFFECT OF PHYTOADDITIVE COMBINATIONS ON CONTROL OF *MUSCA DOMESTICA* POPULATION IN POULTRY SHED

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**Background:** *Musca domestica* (House fly) nuisance in poultry farm and residents located near the poultry shed. House fly is a carrier for bacteria, virus and fungi and spreads many diseases to both humans and animals. Many commercial insecticides and fly repellents are used to control the fly problems in livestock sector and human dwelling areas also. Commercial insecticides lead to the presence of residual particles in both egg and meat and also develop resistance against the particular insecticides. Herbal based preparations didn't produce any undesirable influence on both egg and meat and ensure the human health.

**Method:** The fly trap filled with Rice bran (80%), Jaggery (10%), Eucalyptus oil (20ml) along with 10% Tobacco powder (*Nicotiana tabacum* ) and 10% Vasambu powder (*Acorus calamus*) and 10% Custard apple seed powder (*Annona squamosa*) and kept in ground floor near the poultry shed. During experiment time, end of the twelve hours period, quantum of trapped house flies were assessed qualitatively.

**Results:** No significant difference was observed in control areas. The significant difference were observed in Vasambu (*Acorus calamus*) incorporated groups (P<0.05). Custard apple (*Annona squamosa*) incorporated group control the house fly population in better way, when compared to Tobacco powder (*Nicotiana tabacum*) incorporated group and control groups.

**Conclusions:** The vasambu powder effectively repels the housefly in poultry shed. The custard apple and tobacco powder also repels the house fly in minimum quantity.

**Keywords:** Phytoadditives, house fly, Vasambu, Tobacco, Custard apple

07-20

### OCCURRENCE OF INTESTINAL LESIONS IN CHICKENS – A ONE - YEAR PROSPECTIVE STUDY IN PURE LINE CHICKENS

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**Background:** Chicken farming is one of the rapidly growing sectors in India which provides employment and most affordable protein rich food to millions. Chicken rearing will be suitable income generating farming even for small land holding people as in Kerala and will be helpful for people under financial distress like those affected with natural calamity. For profit, good feed conversion ratio is important which in turn require good intestinal health of chicken. Prior knowledge on different intestinal affections will be of great use in maintaining intestinal health. Hence, this study aimed to ascertain the occurrence of various intestinal affections in naturally dead chickens.

**Methods:** Post-mortem examination of 17978 chicken carcasses of 15 lines and 304 flocks including that of layer (white leghorn), broiler (PB1, PB2, Krishibro, CB), synthetic (PD1, PD2, PD3) and desi (Aseel, Nicobari and Ghagus) breeds were examined during the period of one year at ICAR-Directorate of Poultry Research, Hyderabad. After detailed gross examination, tissues of intestines with lesions collected for histopathology and for screening of microorganisms. Enteric viruses such as Chicken parvovirus (ChPV), Chicken Astrovirus (CAstV), Avian rotavirus (AvRtV), Avian nephritis virus (ANV), Fowl Adenovirus-1 (FAdV-1), Infectious bronchitis virus (IBV), oncogenic viruses such as Marek's disease (MDV) and Avian leucosis virus (ALV), necrosis inducing bacteria such as *Clostridium perfringens*

and *Clostridium colinum* and protozoa *Eimeria* sp were screened using polymerised chain reaction (PCR) with species specific primers.

**Results:** Gross intestinal lesions were noticed in 1405 (7.82%) out of 17,978 birds examined. Intestinal lesions could be grossly classified in to haemorrhagic enteritis, catarrhal enteritis, necrotic enteritis, neoplastic lesions, and miscellaneous conditions. Desi breeds that were considered to be more resistant to infections, also affected with various intestinal lesions. No significant difference observed between different breeds in intestinal affections. Catarrhal enteritis occurred more in chick age group while neoplastic intestinal affections were restricted to adults only. All viruses except IBV was identified in intestines affected with catarrhal enteritis. ChPV affection found alone in chicks affected with runting and stunting syndrome. Coccidiosis was by infestation of *E. tenella* and *E. necatrix*. *Clostridium colinum*, not common in chicken, was associated with necrotic enteritis. MDV and ALV were identified as cause of the intestinal tumours, where occurrence of MDV was more.

**Conclusion:** Intestinal affections are a major problem in chicken rearing. Multiple viral infections play a crucial role in intestinal diseases which may be taken to consideration in good rearing practices. MDV still creates problems even after vaccination.

**Keywords:** Chicken, intestinal lesions, enteric viruses

07-21

### OCCURRENCE OF ESBL *ESCHERICHIA COLI* FROM LAYER BIRDS OF ORGANIZED POULTRY FARM IN WAYANAD DISTRICT, KERALA

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**Background:** Antibiotic resistance in poultry industry remains a major public health threat, because of its irrational use in feed to improve feed efficiency. Of late, the extended spectrum beta-lactamase (ESBL) pattern among several public health pathogens is reported to increase in an unprecedented manner within the poultry industry. Antibiotic resistant pathogens from layers may enter the food chain primarily through the eggs and hence, the present study was envisaged with an objective to study the occurrence of ESBL *E. coli* recovered from layer birds belonging to an organised poultry farm in Wayanad district of Kerala using phenotypic and genotypic assays.

**Methods:** The cloacal swabs (n= 30) and egg samples (surface wash, albumen and yolk; n= 15 each) were collected aseptically from cross-bred layer birds of more than 32 weeks of age. The samples were subjected to the isolation and identification of *E. coli* following standard protocol. The recovered *E. coli* isolates were then confirmed by PCR assay employing *uidA* gene. Further, antibiotic susceptibility testing for the confirmed *E. coli* isolates was carried out using phenotypic double disc testing (Ceftazidime and Cefotaxime with/without Clavulanic acid) as well as PCR assays employing ESBL genes (*bla*CTX-M, *bla*SHV and *bla*TEM).

**Results:** Out of the 26 isolates of *E. coli* recovered from cloacal swabs, 24 were confirmed positive by *uidA* using PCR assay. However, out of 14, 2 and 1 *E. coli* recovered from egg surface washes, albumin and yolk respectively, 10, 2 and 1 tested positive for *uidA* gene from the aforesaid samples. Moreover, out of 26, 14, 2 and 1 *E. coli* recovered from cloacal swabs, egg surface washes, albumin and yolk respectively of the confirmed *E. coli* isolates 12, 8, 1, 1 were found ESBL by double disc testing from cloacal swabs, egg surface washes, albumen and yolk respectively. Besides, a diverse genotypic pattern was observed by PCR assays employing ESBL genes (*bla*CTX-M, *bla*SHV and *bla*TEM).

**Conclusion:** From the present study, it is imperative that the ESBL genes are circulating at an alarming rate within the poultry industry and warrants strict vigil. Hence, it necessitates further characterization and molecular typing using more number of samples in a 'One Health' approach with an ultimate objective to study its transmission dynamics and further to control its occurrence.

**Keywords:** ESBL, *Escherichia coli*, layer, PCR.

07-22

### MICROPLASTICS IN THE GUT CONTENT OF *PLANILIZA MACROLEPIS*, FROM POONTHURA ESTUARY: BEFORE AND AFTER THE CYCLONE OCKHI

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**Background:** Inflow of microplastics from fresh water systems to the Ocean is a recently identified environmental issue. Microplastics may enter the food chain when ingested by benthic and demersal fauna. Ockhi, the first severe cyclonic storm happened in the Indian Ocean for the last 40 years, suspected to have physical influence in the distribution of microplastics. Poonthura estuary was one among the sites in the Kerala coast most seriously hit by the cyclone Ockhi. Main rivers through Trivandrum also discharge to ocean through Poonthura estuary. The present study tried to address the possibilities of the presence, abundance and types of microplastics in the gut content of *Planiliza macrolepis* fish in Poonthura estuary before and after the cyclone Ockhi.

**Methods:** *Planiliza macrolepis* is an indigenous, detritus feeder fish widely marketed in the study area for consumption was selected purposively. Samples were collected one month before and one month after the cyclone Ockhi. Morphometric studies, followed by the Microplastic studies were conducted by following standard protocols of Avio et al., (2015). The separated microplastics were observed under a microscope and sorted and total number of each type of microplastics was counted. Thermo Fisher Scientific Nicolet iS50 FT-IR Spectrophotometer was used for Polymer identification of the abundant type microplastic.

**Results:** Length, breadth, body weight and weight of digestive tracts in post Ockhi fish samples increased in all the samples studied. The weight of microplastics +other substances and the weight of microplastics alone showed an increasing trend in post Ockhi samples. Threefold rise in the abundance of microplastics in post Ockhi fish samples compared to that of the Pre Ockhi. This pointed to the physical influence of Ockhi for the distribution of microplastics. The study could identify microfibre, microfragment, microfilm and micropellet types of microplastics in fish samples, which is alarming. The abundant type was microfibre, while foam type was totally absent. FTIR spectra studies revealed that the polymer type of the abundant microfibre is the polyamide Nylon.

**Conclusions:** Pre and Post Ockhi samples showed the presence of microplastics in fish. Post Ockhi samples showed higher microplastic abundance and weight compared to Pre Ockhi samples. This revealed that the cyclone Ockhi has a significant physical influence in the distribution of microplastics in the study site. Major types of microplastics identified include microfibre, micropellet, microfragment and microfilm. Abundant type is microfibre. Microfoam is totally absent. Presence of microplastics in fish body is alarming. FTIR studies revealed that the Polymer type of the abundant type microfibre is Nylon. The main sources of Nylon in aquatic systems are synthetic clothing. Microfibres get released into the drains while washing the synthetic clothes. Hence, along with plastic carry bag banning and green protocols, there is a need for sensitizing the society to abstain from the excessive use of clothes made of synthetic fibres.

**Keywords:** Estuary, Microfibre, Microplastics, Nylon, Ockhi

07-23

### IMPACT OF FREQUENCY OF TRANS - VAGINAL OOCYTE RECOVERY AND REPEAT BREEDING ON YIELD AND QUALITY OF OOCYTES

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**Background:** Repeat breeding is one of the most common causes of infertility in cattle; failure of fertilization and early embryonic mortality are the two major causes of repeat breeding. Transvaginal oocyte recovery (TVOR) is a non-invasive technique for harvesting oocytes from live animals. The present research work was designed to assess the effect of reproductive status (normal and repeat breeding) and the frequency of TVOR on oocyte yield and quality in crossbred cattle of Kerala.

**Method:** A total of 12 normal and 12 repeat breeding crossbred cows were selected for the study and were subjected to TVOR for a period of two months at once weekly or twice weekly intervals. All the visible follicles above 3 mm



diameter were aspirated. Quality of oocytes was assessed based on the number of layers of cumulus cells and characters of ooplasm. Nuclear maturation was assessed using Hoechst 33342 stain and oocyte viability by Fluorescein Diacetate (FDA) stain.

**Results:** There was a significant increase in the number of follicles aspirated, number of oocytes retrieved, yield of culture grade, matured, fertilized and cleaved oocytes from twice weekly TVOR when compared to once weekly collection. However, no association was observed between frequency of collection and oocyte quality. A significantly higher number of oocytes retrieved, yield of culture grade, matured, fertilized and cleaved oocytes was observed in normal breeders when compared to repeat breeders. Oocyte quality and viability was also found to be higher in normal breeders.

**Conclusion:** It can be concluded from the present investigation that twice weekly TVOR provides maximum yield of oocytes than once weekly TVOR. Also oocyte yield, quality and viability in normal breeders are significantly higher than repeat breeders.

**Keywords:** Transvaginal Oocyte Recovery, TVOR, Repeat breeding, Oocyte quality

07-24

### OCCURRENCE OF *CAMPYLOBACTER* SPP. IN A PIG FARM IN THRISSUR DISTRICT

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**Background:** *Campylobacter* is a well recognized leading cause of bacterial foodborne diarrhoeal disease worldwide. An ubiquitous organism, this zoonotic pathogen is frequently isolated from poultry, animal and environmental samples. *Campylobacter jejuni* and *Campylobacter coli* are recognized as the most frequent causes of acute diarrheal diseases in humans with symptoms usually ranging from mild to serious infections in children and the elderly, and long-term sequels such as Guillain-Barre syndrome, reactive arthritis and irritable bowel syndrome. Despite being an important zoonotic disease, the prevalence of *Campylobacter* is largely unknown in many parts of India.

**Method:** A total of 25 samples, comprising of 20 rectal swabs, fresh faecal samples from apparently healthy animals, two soil and one water sample were collected from a private pig farm in Erumapetty in Thrissur district. Of the 20 rectal swabs collected, 15 were from adult pigs including two boars, and five were from piglets. Swabs were collected aseptically using Cary-Blair medium (Himedia); and water (one sample), soil (two samples) and faecal samples (three samples), including two diarrhoeic samples were collected in suitable aseptic containers and transported immediately to the laboratory under chilled conditions. Samples were processed for isolation by culture and multiplex PCR for species confirmation. Bacteriological culture was performed in accordance with OIE (2017) to detect *Campylobacter* spp. using blood free enrichment broth and modified charcoal cefoperazone deoxycholate selective agar plates (mCCDA) and incubated at 42°C for 48 h. *Campylobacter*-like colonies were purified and identified to species level by multiplex Polymerase chain reaction (PCR). DNA isolated from both the enrichment broth after 48 h and from colony cultures were subjected to multiplex PCR.

**Results:** Based on isolation by conventional culture method, the overall occurrence rate of *Campylobacter* spp. from rectal swabs was 90% (18/20). Direct PCR assay showed the overall occurrence rate of *Campylobacter* spp. to be 95% (19/20) from rectal swabs. While most of the isolates were identified as mixed infections with both species (*C. jejuni* and *C. coli*), a few *C. coli* were also seen. The organism is a cytochrome oxidase positive, microaerophilic, curved Gram-negative rod exhibiting corkscrew motility and is carried in the intestine of many wild and domestic animals, particularly avian species including poultry. Thermophilic *Campylobacter* spp. have been isolated from the intestinal tracts of a wide variety of healthy and diseased warm-blooded animals, including poultry, swine, and captive and free-range wild animals. *Campylobacter*s are much more sensitive to hostile conditions than other major food pathogens. Thirteen of the 15 rectal swabs from adult animals including the two boar samples and all the 5 piglet samples were found to be positive by the conventional culture technique. All the 20 rectal swabs following enrichment except one, including the five piglet rectal samples were positive for 16SrRNA by PCR. Thirteen of the 20 rectal swab samples were positive by PCR for the *C. jejuni* specific mapA, *C. coli* specific ceuE and virulence specific cadF genes, indicating co-infection with both the species (*C. jejuni* and *C. coli*), while 1/20 samples had ceuE and mapA genes only. Five of the 20 samples were positive for the ceuE and the cadF genes. All samples were positive for the colony PCR. Of the three faecal samples, only one of the diarrhoeic samples was positive by culture method, while both diarrhoeic samples were positive for *C. coli* by PCR. The water sample was negative for *Campylobacter*. Low-level of biosecurity, mixing of feed with chicken waste as was observed in the farm and mixing of age groups could be attributed to be the reasons for the higher incidence of *Campylobacter* in the farm.

**Conclusions:** The overall occurrence of *Campylobacter* in pigs (95 %) in this study was higher. It is predicted that

intensification of animal production systems and increased urbanization will result in a further increase in the incidence of this infection and a change in the epidemiology in animals and humans. To reduce the risk of *Campylobacter* infections among consumers, control measures and intervention strategies should be adopted to reduce prevalence of *Campylobacter* in foods and associated environment. Future interventions targeting a reduction in the prevalence of *Campylobacter* in farmed animal populations worldwide will become increasingly important.

**Keywords:** Campylobacter, Occurrence, Pigs, PCR

07-25

### VACCINATION FAILURE AND OUTBREAK OF INFECTIOUS BURSAL DISEASE IN AN ORGANIZED POULTRY FARM

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**Background:** Infectious bursal disease (IBD) is a highly contagious acute viral diseases of young birds which causes immunosuppression by damaging bursa of Fabricius and causes significant economic losses in poultry industry. IBD can be prevented by regular vaccination strategy, but sometimes vaccination failure occurs and results in outbreak of disease in the vaccinated birds.

**Materials:** Sixty birds were presented to the Department of Veterinary Pathology from the University Poultry and Duck Farm, Mannuthy for postmortem with the history of huge mortality of about 400 birds after 28<sup>th</sup> day booster dose of IBD vaccine during February, 2018. Detailed postmortem was done and gross lesions were recorded. Tissues showing gross lesions were collected in 10% neutral buffered formalin for histopathological examination. Pooled tissue samples of bursa of Fabricius, spleen and liver from birds were collected for molecular analysis.

**Results:** On detailed postmortem examination ninety percent of birds showed enlarged, swollen bursa of Fabricius and thigh and breast muscle haemorrhages, some of the birds showed haemorrhages in the proventriculus-gizzard junction. Microscopically bursa revealed shrinkage of follicles, lymphocytic depletion in follicles, interfollicular connective tissue proliferation. Pooled tissue samples of bursa, spleen and liver from the dead birds were screened by PCR for 480 bp of VP2 gene of infectious bursal disease virus. Samples were positive for predicted amplicon size of 480 bp in 1.5 per cent agarose gel of virus.

**Conclusion:** Based on the lesions and molecular confirmation, vaccination failure and subsequent disease occurrence attributed to the huge mortality of the birds. Vaccination failure might be due to single or combination of factors like improper administration of vaccine virus, antigenic differences among the different strains, insufficient potency of the live attenuated vaccine virus, interference between the residual maternally derived antibodies and the vaccine virus etc. The economic impact of the disease in poultry farming is due to immunosuppression leading to vaccination failure and death due to secondary infections.

**Keywords:** Infectious Bursal Disease, vaccination failure, immunosuppression.

07-26

### A MORPHOMETRIC STUDY OF SPECIES OF *AMBLYPHARYNGODON BLEEKER, 1860* (TELEOSTEI: CYPRINIFORMES: CYPRINIDAE) FROM THE RIVERS OF WESTERN GHATS, KERALA.

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**Background:** A perusal of literature on genus *Amblypharyngodon* clearly shows that the distinguishing characters of the different species are rather confusing because of their close resemblance and over lapping morphometric characteristics. The present work, therefore, is aimed at providing some basic information about the taxonomy of the genus, based on landmark based morphometrics involving three population of *Amblypharyngodon* from Pathanamthitta, Kottayam (Vaikom) and Thrissur considered as *Amblypharyngodon* species1, species2 and species3 respectively.

**Method:** Altogether 48 morphological characters, 33 body characters and 15 head characters were taken from each specimen of fish. Principal Component Analysis was performed involving the data on body and head characters of the three species of *Amblypharyngodon*. All the analysis were carried out using the statistical package PAST (version 2.17C).

**Results:** A closer examination of the analysed data as well as the study of the scatter plot, clearly indicate the discrimination of the three species based on some specific morphometric characters.

A comparison of morphological data taken from the specimens of *Amblypharyngodon* from Pathanamthitta and Thrissur, revealed close resemblance in many characters with those of *A.chakaiensis* (= *A.melettinus*), whereas the specimens from Vaikom shared some characters with *A.microlepis*.

**Conclusion:** The present observations based purely on traditional and truss morphometric characters reveals that the specimens of *Amblypharyngodon* from Pathanamthitta and Thrissur represent 2 populations of *A.melettinus* and those from Vaikom could be treated as a distinct population of *A.microlepis*.

**Keywords:** *A.melettinus*, *A.microlepis*, *A.chakaiensis*, Morphometrics and PCA

07-27

## BIOFILM DEVELOPMENT ON MUNDACKAL BEACH, KOLLAM, KERALA

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**Background:** Marine Biofouling is an undesirable accumulation of microorganisms, plants and animals on submerged substrates. Biofilms play an important role in the settlement of macro algal spores and larval forms results in Biofouling. Understanding the biofilm communities are very useful in the development of marine antifouling techniques.

**Method:** For the analysis of microfoulers on the hull of vessel HANSITA, five randomly placed quadrates (20x 20cm) were taken from the hull of the dredging vessel during monsoon, post monsoon and pre monsoon period.. The microfoulers were collected from the selected sites of hull and removed with the help of nylon brush. Water samples were collected from the study area and analyzed the physico-chemical parameters like temperature , pH , dissolved oxygen , salinity as per the methods of Grasshoff et al, 1983. To study the community structure diversity indices like species richness, evenness, Simpson dominance, Margalef's richness, Shannon diversity index were calculated by using PAST 3.09 Software.

**Result:** A total of 16 taxa of microfoulers were collected from the hull comprising, Ochrophyta, Dinoflagellata and larval forms. *Conscinodiscus sp.* constitutes the highest and lowest by *Thalassionema sp.* number throughout the year .Larval forms were observed only in monsoon season. Temperature (29.5), pH (8.2), Salinity (35‰) showed highest value during pre monsoon. Dissolved oxygen values varied from 3.81ml to 4.9 ml. Shannon Weiner diversity was maximum value (2.66) during pre monsoon.

**Conclusion:** The faunal elements exhibited distinct seasonal trends in abundance with fluctuating temperature, dissolved oxygen and salinity. Simpson's Dominance index showed a few organisms were dominant. Species richness, Simpson dominance, evenness, Margalef's index and Shannon- Wiener index was higher during pre monsoon and lower on monsoon period. The species abundance was higher during post monsoon period. Micro fouling also initiates the settlement of larvae of invertebrates and spores of macro algae.

**Keywords:** Bio film, micro fouling, diversity indices

07-28

## LEPTOSPIROSIS IN CATTLE IN FLOOD AFFECTED AREA IN THRISSUR DISTRICT – A CASE REPORT

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The present study deals with the isolation of *Leptospira interrogans* serovar Icterohaemorrhagiae from a case of mastitis in a cow from a flood affected area in Thrissur. A milk sample was brought to the Department of Veterinary Microbiology, College of Veterinary and Animal Sciences, Mannuthy from a veterinary hospital in Varakkara, Thrissur for culture and sensitivity testing. The sample was blood mixed and rose in colour. This can occur in case of leptospirosis and hence, subjected to isolation trial. It was inoculated into EMJH semi solid medium and liquid medium at 37°C. Serum and urine sample was also collected. The serum sample was subjected to Microscopic Agglutination

Test (Faine *et al.*, 1999). From the urine sample, DNA was extracted and Polymerase Chain Reaction using *lipl32* gene specific primers were done. The sample was found to be positive for antibodies against *Leptospira interrogans* serovar Icterohaemorrhagiae in MAT and from urine, isolation of could be made which was evident by the formation of dinger's ring. An amplicon of 756 bp indicating the *lipl32* gene could be observed in the urine sample. The study indicates the significance of prompt diagnosis of the dreadful zoonosis in milch animals which can be excreted through milk and urine from which human beings may get infection.

07-29

#### EFFECTS OF SALINITY AND WATER QUALITY PARAMETERS ON THE BREEDING AND LARVA REARING OF BLACK MOLLY *POECILIA SPHENOPS*

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**Background:** The objective of this study was to investigate the effect of salinities and water quality parameters on (i) the breeding and fry production of black molly (ii) the body weight, total length increment and percentage of survival of black molly in laboratory condition.

**Method:** Black mollies were left for two weeks to spawn at different salinity regimes (0, 3 and 6 ppt). Newly hatched fry from the breeding experiment were placed in 10 L experimental aquaria with three different salinity regimes (0, 3 and 6 ppt) at stocking density rate of 2 fry per litre. Ten fry were sampled randomly at every two weeks interval for their growth performance and also for the percentage of survival on daily basis. Water quality parameters were measured once a week.

**Results:** There were no significant differences ( $p > 0.05$ ) in the number of fry production at water salinity of 0, 3 and 6 ppt. The highest number of fry production was at 6 ppt followed by 0 and 3 ppt. Body weight increment for black molly fry at water salinity of 6 ppt was the highest (0.205 g) followed by 3 (0.203 g) and 0 (0.200 g) ppt. Fry reared in 6 ppt recorded the highest (2.77 cm) total length increment as compared to 3 (2.70 cm) and 0 (2.57 cm) ppt. Percentages of survival for black molly fry ranged between 84 to 100%.

**Conclusion:** Black molly can breed successfully in salinity 6 ppt. However, salinity has no significant influences on the number of fry production. The growth performance and percentage of survival of black molly fry are much better when cultured at 3 and 6 ppt. The information obtained from the present study would be useful for better management and commercial production of this fish species in captivity.

**Keywords:** Black molly, Breeding performance, Growth, Survival, Fry

07-30

#### CANINE MAMMARY TUMOUR: HISTOPATHOLOGICAL VARIANTS

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**Back ground:** Histopathology is considered as the gold standard for diagnosis of canine mammary tumours. Like human breast cancer, mammary tumour is a common occurrence in dogs. Surgical removal is the most commonly adopted approach for the treatment of canine mammary tumour. Nevertheless, histopathological diagnosis of the the tumour is inevitable to assess the malignancy of the tumour and to adopt further course of treatment.

**Method:** Samples from dogs having tumour growths, presented at Kerala Veterinary and Animal Science University Veterinary hospitals at Mannuthy and Kakkalai were collected in 10% neutral buffered formalin (10% NBF). After fixing in 10% NBF for 24 hours, the tissues were cut into pieces of 2mm thickness and were processed and embedded in paraffin. Sections of 4-5 $\mu$  thickness were cut from the paraffin blocks and were stained with haematoxylin and eosin and observed under the light microscope for histopathological changes.

**Results:** Histopathological examination of the stained tissue sections revealed that out of the thirteen tumour tissues, two were benign and 11 were malignant. Majority of the tumours were malignant which had higher mitotic figures and significant nuclear and cellular pleomorphism. Benign tumours were diagnosed as fibroadenoma and the malignant variants included ductal carcinoma, solid carcinoma and mixed mammary tumour. In the present study, three cases of comedocarcinoma, characterized by the presence of necrotic area in the centre of neoplastic aggregates, are also

reported which has poor prognosis.

**Conclusion:** The work establishes the importance of histopathology for early diagnosis and classification of canine mammary tumours which is a key to the success of clinical therapy as modalities of treatment may vary with the type and stage or grade of the tumour.

**Keywords:** histopathology, mammary tumour, malignant, comedocarcinoma

## 08 - HEALTH SCIENCE

08- 01

### DECIPHERING THE MOLECULAR EVENTS REGULATED BY TRYPTANTHRIN IN MELANOMA

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**Background:** Traditional Indian medicine formulations against various skin ailments such as psoriasis, eczema and dermatitis use different parts of the plant *Wrightia tinctoria* as a main ingredient. Studies conducted in our lab have shown that DW-F5, an active fraction of dichloromethane extract of the leaves of *Wrightia tinctoria* exhibits exceptional cytotoxicity towards malignant melanoma both *in vitro* and *in vivo*. Further characterization has led to the identification of tryptanthrin as one of the active components of DW-F5.

**Methods:** MTT assay, Western blotting, Transfection, *In vivo* models

**Results:** Tryptanthrin, induces apoptosis in melanoma cell lines while being non-toxic towards normal immortalized melanocytes. The cytotoxicity of tryptanthrin in different melanoma cell lines were in concordance with the expression levels of MITF-M protein, where MITF-M protein is the master regulator in melanoma progression. Tryptanthrin successfully inhibited the activation of MITF-M by inhibiting the phosphorylation at serine 73 residue. *In vivo* studies carried out in NOD-SCID mice showed that tryptanthrin causes significant tumor reduction and invasion.

**Conclusion:** Our *in vitro* and *in vivo* results indicate that tryptanthrin is a potential chemotherapeutic agent against malignant melanoma which mediates its anti-melanoma activity by inhibiting the activation of MITF-M, the master regulator of melanomagenesis and progression.

**Keywords:** Melanoma, Tryptanthrin, MITF-M

08- 02

### ALGINATE DIALDEHYDE - GELATIN HYDROGEL SUBSTITUTE FOR MENISCAL REPAIR – A BOON TO ATHLETES AND LABOURERS

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**Background:** Meniscal tears are the most common knee injuries found among athletes and people in labor-intensive occupations. Medial meniscal tear occurs more frequently than the lateral meniscal tear and meniscectomy is an optional therapy but ultimately results in cartilage degradation. Hence alternate approaches are becoming imperative for this unmet clinical need. In this work alginate dialdehyde (ADA) - gelatin (G) - (ADA-G) hydrogel scaffold has been proposed as a substitute to assist the repair of torn meniscus under trauma conditions in perspective of clinical orthopedic applications.

**Methods:** Alginate dialdehyde was prepared by periodate oxidation of sodium alginate. An injectable formulation of ADA-G hydrogel with a working time of 4 minutes was prepared by reacting 15% aqueous solution of ADA and 20%

aqueous solution of G (15ADA20G) in the presence of borax as a catalyst. This hydrogel was characterized by Fourier Transform Infrared (FTIR) spectroscopy, Scanning Electron Microscopy (SEM), and Micro-Computed Tomography (Micro-CT). Cytocompatibility of fibrochondrocytes-seeded on ADA-G hydrogel was evaluated by live dead assay and actin staining. Tissue integration *ex vivo* with ADA-G in the pig meniscus tear explant was observed by SEM and simultaneously with paraffin sections stained with safranin O/fast green staining.

**Results:** FTIR depicted the characteristic aldehyde peak at 2925 cm<sup>-1</sup> and hydrogel with peaks at 1604 & 1544 cm<sup>-1</sup> suggesting the formation of Schiff's base. Swelling at 37°C in PBS showed that 15ADA20G possessed handling and swelling properties. The developed injectable ADA-G hydrogel exhibited comparable characteristics of swelling (85%), porosity (36-60µ) with an average pore size of 48µm and mechanical properties (270KPa). Phase contrast images, SEM micrographs and actin staining depicted adhesion, profuse proliferation, and distribution of fibrochondrocytes on the 3D hydrogel supporting its cytocompatibility. Application of hydrogel at the pig meniscal tear *ex vivo* showed good integration with the host meniscal tissue by SEM. Further, it is evident from histology that the hydrogel remained in the vicinity of the meniscus tissue in close proximity to the tear even after 3 days in culture.

**Conclusion:** The developed self-healing, degradable and injectable 15ADA20G hydrogel favored the growth of fibrochondrocytes on the non-cytotoxic hydrogel niche. The *ex vivo* application of 15ADA20G at the pig meniscus tear explant indicated structural support and stability to the delicate meniscal tear. The making of the hydrogel is simple, economical (MADE IN INDIA CONCEPT) and easily applicable in the health care system. This may serve as a suitable biomaterial to support, enable and mend sutured menisci tears in Orthopaedic reconstructive surgeries to prevent further tears and hasten rehabilitation. Future studies may involve the proof of concept of the 15ADA20G hydrogel at the rabbit meniscal tear defect model in real situation – its safety and efficacy.

**Clinical Relevance:** To develop a surgeon-friendly meniscal substitute to repair meniscal tears - an unmet clinical need of the hour.

**Keywords:** meniscal substitute, hydrogel, fibrochondrocytes, cytocompatible and meniscal repair

08- 03

#### DEVELOPMENT OF A NOVEL HUMAN TISSUE DERIVED SKIN SUBSTITUTE AND PRE CLINICAL EVALUATION IN ANIMAL WOUND MODELS

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**Background:** Large sized acute and chronic wound regeneration is a major concern worldwide. The present study describes the development and preclinical evaluation of an absorbable skin substitute/graft. The components chosen are completely human tissue derived and comprises of decellularised amniotic membrane (AM), pharmacopoeia grade fibrin (FIB) and umbilical cord derived hyaluronic acid (HA) having specific roles for wound healing and skin regeneration (AMFIBHA). The developed graft is non-immunogenic, hemostatic, biomimetic with growth factors, cytokines and adhesive proteins and is completely absorbable upon skin regeneration.

**Method:** The developed substitute (AMFIBHA) was characterized using different physicochemical evaluations in terms of porosity, surface wettability, swelling and water vapour transmission rate for skin tissue engineering. The dermal fibroblast proliferation and extra cellular matrix (ECM) regulation on AMFIBHA was analysed using long term *in vitro* culture for 20 and 40 days (d). The *in vivo* wound healing efficiency was evaluated for 28 d in rabbit burn model and porcine diabetic model.

**Results:** Physicochemical properties of the artificial substitute (AMFIBHA) match native skin characteristics. Significantly higher fibroblast growth and ECM deposition as compared to bare FIBHA and AM indicated ability to regenerate dermal tissue. The kinetics of ECM production in 20 to 40 d suggests regulated ECM deposition. The animal experiments demonstrated hemostatic, suture-less adhesion of the substitute to the wound bed without any immediate physical deformation of the scaffold. Upon histopathological examination, epidermal regeneration was complete with basal cell layers and hyalokeratin layers. Excellent dermal regeneration with collagen organization, angiogenesis and skin appendage was observed.

**Conclusions:** The developed combination product is an excellent skin substitute for suture-less application as established in *in-vitro* long term studies and *in-vivo* wound models, which may be recommended for limited clinical trial.

**Keywords:** Amnion, Fibrin, Hyaluronic acid, Skin substitute.

08- 04

### MYOCARDIAL CALCIUM- CALMODULIN-DEPENDENT PROTEIN KINASE II- DELTA (CaMKII- $\delta$ ) SIGNALING REGULATION THROUGH Nrf2/HO-1 SIGNALING PATHWAY BY CLOVE OIL, EUGENOL

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**Background:** CaMKII is a major mediator of cellular calcium signaling. CaMKII-  $\delta$  splice variant in the heart severing as a research tool associated with cardiovascular physiology and pathophysiology. Chemotherapeutic stress related myocardial impairment is a recognized adverse event of chemotherapy. Arsenic trioxide ( $As_2O_3$ ) is a well- known chemotherapeutic drug for acute promyelocytic leukaemia, but it induces cardiotoxicity in many patients.  $As_2O_3$  induced changes in cellular redox status have a profound impact on cell signaling and alters gene expression systems. The aim of the current study was to investigate the possibility of CaMKII-  $\delta$  signaling modulation by redox machinery to prevent myocardial alterations under chemotherapeutic stress.

**Method:** Male Wistar rats were orally co-treated with eugenol for thirty days. After experimental period blood and the heart tissue was collected for various analyses. Serum cardiac markers Troponin-I, inflammatory indicator C-reactive protein and electrolytes (Calcium, potassium, and sodium) concentrations were measured. The heart tissue was excised for histopathological examination, and plasma were prepared to detection catalase, glutathione peroxidase, and superoxide dismutase. Reverse transcriptase analyses of Nrf2, HO-1 and CaMKII- $\delta$  were conducted.

**Results:** Membrane peroxidation product malondialdehyde (MDA) level in the plasma of experimental rats induced by arsenic trioxide was significantly ( $p < 0.05$ ) increased. Arsenic trioxide (4 mg/kg body weight) treatment significantly markedly reduced blood antioxidant status. But co-treatment with eugenol (5 mg/kg body weight) maintained all the parameters near to normalcy. CaMKII- $\delta$  expression level was up-regulated while Nrf2 and HO-1 expressions in the cardiac tissue were significantly low during arsenic trioxide administration. Meanwhile, Nrf2/HO-1 activity was enhanced in experimental rats fed eugenol along with arsenic trioxide. Moreover, co-joint therapy with eugenol maintained normal CaMKII-  $\delta$  mRNA expression pattern. In addition to this, the current study revealed a strong positive correlation between cardiac markers level with membrane peroxidation rate. In addition, we observed that the process of lipid peroxidation directly linked with altered serum cardiac markers Trop-I and CRP levels. Serum electrolytes calcium and sodium level was positively correlated with MDA. Our findings suggest that lipid peroxidation level in the myocardium correlate with both cardiac markers and electrolytes. These biochemical modulations through Nrf2 linked HO-1 molecular signaling pathway induction and further inhibition of CaMKII- $\delta$  expression in myocardium by eugenol.

**Conclusion:** We arrived at the conclusion that, eugenol preserves Nrf2/HO-1 mediated redox balance and inhibits the oxidative activation of CaMKII- $\delta$  by arsenic trioxide.

**Keywords:** Arsenic trioxide, CaMKII- $\delta$ , Eugenol, HO-1, Nrf2

08- 05

### EXPLORATION OF NEW PHYTOCHEMICAL ENTITIES FROM *HYDNOCARPUS WIGHTIANA* BLUME: EVOLVED AS POTENT ANTICANCER HITS INDUCING MITOCHONDRIA MEDIATED APOPTOSIS THROUGH CYT C RELEASE

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**Background:** Cancer prevails to be the second leading cause of mortality globally. Cancerous cells are fingerprinted with uncontrolled proliferation and often exhibit resistance towards conventional treatment approaches. Employment of cytotoxic chemotherapeutic drugs is one of the purposeful therapeutic ways in clinical practice. So there is an alarming need for the development of new phytochemical entities (NPCEs) as potent and selective anticancer agents. Co-ordinated semi-synthetic strategies for the modification of bio-active phytochemicals serve as a great platform for generating hit molecules. Hydnocarpin (Hy), a flavanoid isolated and purified from *Hydnocarpus wightiana* Blume, promotes moderate cytotoxicity in cancer cells. It was studied that guanidinium rich poly- (propylene imine) dendron

conjugated hydnocarbin exhibited enhanced cytotoxicity and anticancer properties. Therefore, strategic inclusion of heterocyclic analogues on to hydnocarbin is one of the rationale behind novel NPCEs towards drug design and engineering due to their versatility and selective nature of the platform.

**Method:** We have carried out the synthesis of a library of hydnocarbin-isoxazole/isoxazolone derivatives with an objective to select an ideal candidate for the bed side application. Later in-depth investigations for the lung adenocarcinoma and metastatic melanoma specific cytotoxicity and the underlying molecular mechanisms were ruled out using detailed *in vitro* and *in silico* approach. As a new insight, we have utilized surface-enhanced Raman spectroscopy (SERS) in order to evaluate the DNA fragmentation and molecular dynamics associated with the synthetic analogues on cancer cells.

**Results:** Successfully synthesized a library of hydnocarbin-isoxazole/isoxazolone derivatives using 3+2 cycloaddition and one pot multicomponent approach. Synthesized derivatives exhibited excellent cytotoxicity selectively towards cancer cells and impressive docking scores were obtained for some of the Bcl2 family proteins. The selected candidates showed promising anticancer properties which has been validated via various apoptotic and anti-metastatic assays. *In vitro* mitochondrial membrane potential assay and caspase assay validated the intrinsic mode of programmed cell death. Raman peaks abstracted from the cytoplasmic area of compound treated cells displayed many unique peaks attributed towards Cyt c such as 775, 1106, 1470 and 1510  $\text{cm}^{-1}$  which corresponds to heme breathing, C-S stretching, C=N stretching and bending mode of C-N(H)-C respectively. Also, Raman spectral analysis of the isolated DNA clearly illustrated the compound induced DNA damage with typical signatures with the O-P-O backbone rupture during DNA double strand breakage and laddering process.

**Conclusions:** Selected NPCEs executed excellent cytotoxicity preferentially towards lung adenocarcinoma and malignant melanoma cells through the execution of programmed cell death pathway with a favorable ADME profile. Also the synthesized compounds effectively retards the crucial steps of metastatic cascade and colonization of neoplastic cells. The selected candidates promote mitochondria mediated intrinsic apoptosis through the release of cyt c. The subtle dynamics with cyt c and unique signs for DNA fragmentation was illustrated by utilizing the excellent specificity and selectivity of SERS. The outcome of the study revealed two NPCEs as Hit / advanced Hit for lung adenocarcinoma and malignant melanoma.

**Keywords:** Phytochemical, Hydnocarbin, Isoxazole, Isoxazolone, SERS, Cytochrome c

08- 06

### WHERE DO WE LAG? : ACHIEVING ELIMINATION OF MOTHER TO CHILD TRANSMISSION (EMTCT) OF HIV IN INDIA

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**Background:** EMTCT is the most realistic goal achievable in the fight against HIV/AIDS. This study aims to explore where we lag in achieving EMTCT and compare various factors of countries that have achieved EMTCT with that of India, Gujarat and Kerala.

**Methods:** Qualitative methods included Key Informant Interviews, In Depth Interviews and data triangulation at PPTCT unit of a tertiary care hospital of South Gujarat. Quantitative study was done using interviews of 200 HIV negative pregnant women. The results were compared with published literature of different study settings to arrive at conclusions.

**Results:** Majority of the women tested in PPTCT were in late pregnancy. The major themes generated for delayed HIV testing were migration, negligence and ignorance among ANC, lack of communication and counseling, unregulated private sector and unmonitored public sector. Violation of rights to consent was seen in about 98% of cases. Higher education improved women's knowledge about HIV ANC services.

**Conclusion:** Low focus on primary prevention, unregulated public and private sectors ANC care, poor community participation, documentation and tracking systems and missed opportunities in PPTCT counseling are major pitfalls in achieving EMTCT. Kerala, being a highly literate state has overcome many of these and needs to focus now on integrating public private sectors, condom promotion activities, improving PPTCT services and safeguarding human rights.

**Keywords:** EMTCT, HIV, Key Informant Interviews, human rights



08- 07

### PHENOLIC CHARACTERIZATION OF HOT PRESSED AND FERMENTED VIRGIN COCONUT OIL AND COMPARATIVE ASSESSMENT OF THEIR ANTI-INFLAMMATORY POTENTIAL

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**Background:** Virgin coconut oil (VCO) is the natural, unrefined edible oil obtained from the fresh coconut kernel (*Cocos nucifera*), which is rich in medium chain saturated fatty acids. Besides these fatty acids, presence of phenolic antioxidants such as ferulic acid, caffeic acid, syringic acid, catechins are also reported in VCO. However, based on the mode of preparation, different types of VCO are available, which includes hot pressed VCO (HP-VCO) and fermentation processed VCO (F-VCO). HP-VCO has been less studied but has medicinal use in Ayurvedic system of treatment. The present study compared the phenolic constituents of HP-VCO and F-VCO using LC-MS –Q-TOF as well as their anti-inflammatory potential in mice models of dextran and formalin induced inflammation.

**Methods:** Fresh grated coconut kernel was mixed with its water and squeezed into viscous slurry. This mixture was then incubated for 48h at 45°C to yield F-VCO. Hot pressed VCO was prepared by boiling the coconut milk in a boiler at a temperature of 80-90°C. Polyphenol in the oils were extracted and estimated using Folin- Ciocalteau Method. Phenolic composition of the oil was determined by LCMS-Q-TOF method. Female Swiss albino mice weighing 25–30 g was used. Chronic inflammation was induced by Formalin in right hind paw of animals. The drug administration were continued once daily for 5 consecutive days. The paw thickness was measured using Vernier calipers for 5 consecutive days after intra-planar injection of formalin. Acute inflammation was induced by dextran. After administration of drug, on 5<sup>th</sup> day, acute inflammation was induced by intra-plantar injection of dextran. The paw thickness was measured using Vernier calipers and recorded every hour up to 5th hour. The percentage of inhibition was calculated using standard formula.

**Results:** The total polyphenol contents isolated from HP-VCO was higher than that of F-VCO. Further, LC-MS-Q-TOF analysis revealed the presence of simple phenolic acids such as syringic acid, p-coumaric acid, ferulic acid and kaempferol in F-VCO; whereas ferulic acid, hydroxytyrosol, glycosides of kaempferol, myricetin and vanillic acid were identified in HP-VCO, which are of higher molecular weight. Dextran induced acute inflammation was efficiently reduced by F-VCO and with a higher extent by HP-VCO. Similar to the edible oils, their phenolic fractions were also effective in reducing inflammation induced by Dextran. HPVCO, FVCO and their phenolic contents effectively reduced the inflammatory changes induced by formalin on the hind paw of Swiss albino mice.

**Conclusion:** In the present study, LC MS analysis revealed the presence of low molecular weight phenolic acids as major constituents in FP-VCO while HP-VCO contained high molecular weight phenolic glycosides. Since hot pressed method involves heating at 100°C, polyphenols might have complexed with other molecules and released. This molecular difference in polyphenolic composition could be responsible for the comparatively higher anti-inflammatory efficacy shown by HP-VCO.

**Keywords:** Virgin coconut oil; anti-inflammatory activity; polyphenols

08- 08

### ELECTROCHEMICAL SENSING OF METHYLMALONIC ACID: FUNCTIONAL BIOMARKER OF VITAMIN B-12 STATUS.

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**Background:** Deficiency of vitamin B-12 leads to the increased concentration of MMA through the non-formation of blood cells. MMA and homocysteine are valuable for early detection of mild cases of vitamin B-12 deficiency. Vitamin B-12 concentration in blood serum could be analysed by radioimmunoassay. Hence the MMA concentration can be used as a maker for the vitamin B-12 level for the effective biological process. In addition, MMA is also a good maker for monitoring the success of the treatment.

**Method:** In the present work, a molecularly imprinted graphene oxide/gold nano particle co polymerised with allyl

trimethoxy silane –grafted- allylamine (AA) / 2-aminoethyl methacrylate hydrochloride (AEMA) polymer (*GO/AuNP-co-ATMS-g-AEMA/AA*) which is conducting in nature by bulk imprinting method to quantify and sensing MMA from the blood samples in selective manner. The sensitivity was checked by modifying the glassy carbon electrode (GCE) surface with MIP, electro chemical studies conducted with cyclic voltammetry (CV) and differential pulse voltammetry (DPV)

**Results:** The direct electron transfer between the electrode and cholesterol to form cholesterol oxidase leads to an increase in current from the modified GCE. On comparing with other cholesterol sensor it showed several advantages with wide linear range, low detection limit, good reproducibility and stability. This modified GCE was successfully applied to cholesterol detection in real samples, as this is having satisfactory correlation with well-established analytical method. The optimum pH was 7.4 and the response time within the 8 minutes is found to be optimum which also confirms the suitability of the biosensor in the analysis of blood samples.

**Conclusions:** Fabricated sensor profits the inherent properties of GO, AuNP, AEMA and AA constitute a matrix suitable for the arrest of MMA though the H-bonding stabilization with the molecularly imprinted site. When MMA captured by the membrane, it develops a closer proximity between the MMA and the sensor could result faster and accurate response. Concentration of MMA obtained from the present method was paired with 15 clinical samples using HP GC/MSD method both the values gave good linear correlation with regression coefficient value 0.967.

**Keywords:** Graphene oxide; Gold nano particles, molecular imprinting polymers; methyl malonic acid; cyclic voltammetry; differential pulse voltammetry.

08- 09

#### A HIGH THROUGHPUT SCREENING METHOD TO DETECT T CELL IMMUNE RESPONSE

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**Background:** Kerala has the 2<sup>nd</sup> highest rate of mortality due to cancer in India. The first line of cancer treatment is surgery combined with chemotherapy and radiotherapy. Although there are continuous technological advancements in early detection and treatment, cancer is still a big threat to our society as the survival and prognosis is gloomy. Immunotherapy is a new class of cancer treatment which exploits the body's own immune system to recognize and kill cancer cells.

**Methods:** PBMCs were isolated and cryopreserved from 100 healthy donors. HLA was typed by long range PCR using gDNA. Cryopreserved PBMCs functionality was assessed for surface markers viz CD3 PE, CD8 PerCp, CD14, CD16, CD45RO, CD56, CD57 and CD19 FITC by flow cytometry. T cell functional assay with INF $\gamma$  read out was done with peptides derived from flu antigens and tumor associated antigens.

**Results:** The viability was between 50-60 %. The retrieved PBMCs immune cell repertoire from the 20 donors were found to be functionally effective. All the 20 PBMCs showed a response to CEF pool indicating the earlier exposure to flu antigens. The immune response produced by CEF pool was robust compared to MELA and WT 1.

**Conclusion:** We have optimized a protocol to successfully isolate, freeze, cryopreserve, characterize, HLA typed and created a PBMC repository. And we have validated a PBMC assay which can be used as a high throughput screening assay to validate the immunogenicity of different cancer derived antigens and thereby aid in potential cancer vaccine development.

**Keywords:** Immunotherapy, cancer vaccine, PBMC assay, T cell activation, CEF Pool, MELA, WT1,

08- 10

#### *HIBISCUS ROSA SINENSIS* L. ANTHOCYANINS MODULATES DIABETIC DYSLIPIDEMIA IN STREPTOZOTOCIN INDUCED DIABETIC RATS

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**Background:** Diabetes mellitus is a heterogeneous group of metabolic disorder results in the derangement of carbohydrate, lipid and protein metabolism. The present study evaluates the effect of anthocyanins present in the *Hibiscus rosa sinensis* flower petals in diabetes-induced dyslipidemia.

**Materials and methods:** Male Sprague Dawley rats were fed with high energy diet for 60 days. Diabetes was induced by single intraperitoneal injection (30mg/kg) of streptozotocin. Diabetic rats were administered *Hibiscus rosa sinensis* anthocyanins (HA) extract orally (50 mg/kg body weight) for 60 days. Results were compared with diabetic rats provided with the standard drugs [metformin (100mg/kg+ Atorvastatin (10 mg/kg)]

**Results:** Diabetic rats administered HA showed a significant decline in serum glucose, glycated hemoglobin, toxicity markers and significantly increased the level of plasma insulin. Altered levels of serum lipids, lipoproteins, and activities of glucose and lipid metabolizing enzymes in tissues were significantly modulated upon the administration of HA in diabetic rats. Histo pathological examination of liver revealed the protective effect of HA in diabetic rats.

**Conclusion:** This study clearly indicated that supplementation of HA could significantly regulate hyperglycemia and lipid metabolism in streptozotocin induced diabetic rats.

**Keywords:** Diabetes mellitus, *Hibiscus rosa sinensis* anthocyanins, Dyslipidemia

08- 11

### PROFILE OF GUT MICROBIAL DIVERSITY FROM HUMAN SUBJECTS IN KERALA - HEALTHY VERSUS DIABETIC

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**Background:** An adult human can carry about 2 kg of microbes in their gut which consist of at least 1000 species of bacteria which harbors about 3 million genes. The recent studies revealed that two third of the gut microbial population is unique to each individuals. The gut microbiome plays an important role in digesting certain food that are usually resistant to digestive enzymes, ensuring better nutrition, serve as a potential source of vitamins and also in reinforcing our immune system. Several studies revealed that the gut microbial community in individuals with life style diseases like obesity, type 2 diabetes etc., showing remarkable difference when compared to healthy ones, clearly indicating their influence on health and diseases.

**Methods:** The present study relies on the culture independent metagenomic approach to elucidate the diversity of gut microbiome in human subjects in Kerala. Using the pooled metagenomic DNA isolated from fecal samples of 30 individuals (15 healthy and 15 diabetic), the gut microbial diversity was elucidated by targeted next generation sequencing of hyper variable regions of 16S rRNA gene.

**Results:** The alpha diversity analysis depicted that the bacterial diversity significantly reduced in diabetic condition compared to healthy ones. The prominent bacterial groups observed are Firmicutes, Bacteroidetes, Proteobacteria, Cyanobacteria, Actinobacteria and Gemmatimonadetes. In general the most prominent genera observed are *Prevotella*, *Faecalibacterium*, *Ruminococcus*, *Klebsiella*, *Lachnospira*, *Bacteroides*, *Balutia*, *Dorea*, *Dialister*, *Coproccoccus*, *Bifidobacterium* and *Clostridium*. In healthy population the following phyla Nitrospirae, Chlorobi, Fibrobacters, Proteobacteria, Verrucomicrobia, Acidobacteria and Cyanobacteria were enriched while in diabetic condition the bacterial phyla Bacteroidetes, Firmicutes, Actinobacteria, Chloroflexi and Gemmatimonadetes were enriched.

**Conclusions:** This pilot study provided an insight into the general characteristics of gut microbiome in the Kerala population. Considering gut microbiome as a marker for health and disease, the study will definitely aid in initiating further studies to decipher the pathophysiological role of the gut microbiome in various disease conditions as well as their role as probiotics in rejuvenation and also in evolving new strategies especially in the treatment of life style diseases.

**Keywords:** Gut microbiome, Next generation sequencing, 16S rRNA gene, bacterial diversity, life style disease.

08- 12

### AN “EX VIVO” ENGINEERED HUMAN TUMOR MODEL FOR RAPID AND REAL - TIME CANCER DRUG DISCOVERY

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Cancer drug discovery is a cost intensive enterprise starting from in vitro screening of compound libraries followed by testing of lead compounds in diverse model systems including preclinical models followed by clinical trials. For each stage, there are well described models with varied levels of complexities. The failure rate is extremely high as the

lead compounds move from one phase to the next. Because of this, much attention has been given to ensure increased specificity and sensitivity on the initial screening and preclinical models to reduce the failure rates. The conventional preliminary screening involves in vitro cytotoxicity assay in a panel of cancer cell lines that is followed by hollow fiber assay and preclinical testing in relevant animal models. As the cytotoxicity assay utilizes lab grown cells as monolayer culture with least relevant to the in vivo tissue architecture of the tumor, methods were developed to utilize 3D sphere models as tool for drug discovery. Even though they are better models of drug screening than monolayer cultures, mostly they represent with single cell clusters and the 3D architecture is not equivalent to the intact tumor tissue. Additional drawback of this model is expansion of self-renewing fractions or induction of self-renewal with acquisitions of complex drug resistance pattern. Because of this xenograft and patient derived tumor models are considered as best drug efficacy testing platforms in cancer drug development as they have in vivo mimicking tumor microenvironment and vasculature. A serious disadvantage of xenograft models is their low throughput and cost and labor factors so that large scale screening is impossible.

In the last decade significant advancement were made in growing most of the solid tumors as patient derived tumors immunocompromised mice that allow screening of compounds with potential personalized medicine. However, a disadvantage is the time factor, cost effectiveness and requirement of large number of animals for a massive screening. As an alternate method, we describe here a very powerful approach to grow human tumors in immunocompromised mice to be used as a screening platform. We engineered the human cancer cells as a sensor for cell death and so that large number of compounds can be screened in a rapid manner within 48 hours in moderate throughput fashion. In addition to the compound screening, the method has potential application in identifying best drugs specific to the tumor enabling best therapeutic decisions with minimum toxicity to the patients if adapted with patient derived tumors.

08- 13

### STAR FRUIT AS A POTENTIAL ANTIOXIDANT

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**Background:** The generation of oxygen free radicals during cellular metabolism and by certain environmental factors and lifestyle, appears to play a critical role in the ageing process. High dietary intakes of antioxidant vitamins and phytochemical are helpful for better maintenance of physiologic function and a lower prevalence of many degenerative conditions in older adults. The free radical pathology is associated with many of the chronic disease that are common among older adults, e.g., cancer, heart disease, and degenerative eye disorders such as cataracts and macular degeneration. The plant derived compounds such as flavonoids, tannins, proanthocyanidins, phenols etc. having the strong antioxidant activity. so researchers are eager to find the antioxidant remedies from the natural sources and without causing any harmful effects. The present study aims to evaluate the antioxidant activity of star fruit by different methods.

**Method:** Antioxidant activity of star fruits were evaluated by spectrometric techniques such as DPPH and ABTS methods using Ascorbic acid standard

**Result:** Star fruit has got high amounts of phenols and flavonoid content and has showed highest DPPH and H<sub>2</sub>O<sub>2</sub> radical scavenging activity when compared to standard Ascorbic acid.

**Conclusion:** The water extract of star fruit was prepared and investigation showed marked antioxidant activity by DPPH method and hydrogen peroxide scavenging method when compared to standard Ascorbic acid. On the basis of the results, it is concluded that star fruit has got high amounts of phenols and flavonoid content and has showed highest DPPH and H<sub>2</sub>O<sub>2</sub> radical scavenging activity. I C 50 values confirms the results. These antioxidant rich fruits can be used as a functional nutraceuticals for preventing oxidative stress induced diseases.

**Key words:** Antioxidant activity, star fruit, DPPH scavenging activity, H<sub>2</sub>O<sub>2</sub> method

08- 14

### ENGINEERED BONE FOR LOAD BEARING APPLICATIONS

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**Background:** Management of Critical defects in load bearing areas are one of the intriguing challenges in orthopaedics. The donor site morbidity and lack of adequate supply still remains the drawbacks of autologous bone grafts. Thus, alternate engineered bone graft materials are required to address challenges in the treatment of critical sized bone defects. Method: A novel porous Bioceramic scaffold of dimensions (6mm × 10mm), was designed and characterised for load bearing application. Physico chemical characterisation techniques used were FTIR, XRD, and Compressive Strength. *In vitro* experiments for assessments of cell viability and osteogenic differentiation was performed using Human mesenchymal stem cells which were seeded on the scaffolds at a density of  $5 \times 10^4$  cells. *In vivo* bone regeneration were evaluated by implanting the scaffold in a critical size defect in a load bearing ovine model for five week period. Histopathology studies of explanted samples were carried out to confirm the bone regeneration.

**Results:** The mechanical characterisation results revealed that the Bioceramic scaffold has strength comparable to cortical bone. *In vitro* results demonstrated that the Bioceramic scaffold supports cell proliferation and osteogenic differentiation. *In vivo* ovine implantation and subsequent histopathology results on explanation, confirmed the “*De novo*” bone regeneration and closure of critical sized defect.

**Conclusions:** The bioceramic scaffold supports mesenchymal stem cell proliferation and osteogenic differentiation *in vitro* and could enhance the bone regeneration in critical size defects, *in vivo*. The Bioceramic scaffold would hence provide a potential solution to address the challenges of critical bone defects in load bearing regions.

**Keywords:** Bone, Bioceramic, *in vivo* models

08- 15

### HEART MURMUR FOR DEFECT IDENTIFICATION – A FFT AND WAVELET STUDY

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**Background:** Cardio Vascular diseases are a major cause for the increasing mortality rate in India. Recently in India 52% of the death is due to cardio vascular diseases and heart disease death rise in India by 34% over 16 years. The unhealthy life style and irregular food habits of human beings resulted in an increase in the cardiovascular diseases. The analysis of heart murmur can give information about the performance and conditions of the heart. The blood flow within the heart, blood volume, and pressure govern the functioning of heart valves. Any malfunctioning of the valves can alter the smooth blood flow which can be identified by analyzing heart murmur.

**Method:** The acquisition of new methods for the diagnosis of diseases is always important since they can contribute to the development of health science. Fast Fourier Transform (FFT) is a powerful mathematical technique that finds applications in the medical and biomedical field where analysis of signals is carried out in the frequency domain. In the present study, the abnormality in the heart murmur due to reversal of blood flow from left ventricle to left atrium caused by disruption in mitral valve, termed as Mitral regurgitation (MR), is analyzed by comparing with the normal heart murmur using FFT and Wavelet technique.

**Result:** The defective heart can be identified by wavelet and FFT analysis of heart murmur. The FFT analysis of normal heart shows two frequencies corresponding to lub and dub sounds whereas the heart murmur MR shows multiple frequency components. The wavelet analysis scalogram spectrum of normal and defective heart murmur gives

information regarding the frequency and the time when it appears. The analysis of MR heart murmur through FFT and wavelet offers a sensitive surrogate technique for earlier identification of cardiac disorder. Greater frequency spread in the wavelet analysis.

**Conclusion:** The study reveals that significant information can be obtained from frequency analysis of heart murmurs. The analysis of MR heart murmur through FFT and wavelet offers a sensitive surrogate technique for earlier identification of cardiac disorder. greater frequency spread in the wavelet analysis.

**Keywords:** Heart murmur, Mitral Regurgitation, Fast Fourier Transform, Wavelet Transform

08- 16

### CHEMOTHERAPEUTIC LOADED POLYSACCHARIDE - METAL NANOFORMULATION FOR ANTI - GLIOMA THERAPY

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Glioma is the most aggressive type of brain tumor having a poor prognosis with the existing therapeutic strategies due to the selectivity of the blood-brain barrier (BBB) over conventional chemotherapeutics that restrict the therapeutic effect. Considering the costly development procedures for the novel drug formulations, the repositioning of existing chemotherapeutics with suitable modifications are recommended. Despite all efforts, not a single formulation has been approved for an efficient repositioning of conventional chemotherapeutics for anti-glioma therapy. Herein, a novel nanoformulation (PGD) has been designed using the PST001, a galactoxyloglucan extracted from the seed kernel of *Tamarindus indica*, capped over gold nanoparticles and encapsulated with doxorubicin. The PGD nanoformulation exhibit cytotoxic effects on glioma cells, faster cellular uptake, retains for longer duration in plasma than free drug and have higher distribution in the brain. The present PGD nanoformulation is well-appreciated for the repositioning of conventional broad-spectrum chemotherapeutics for anti-glioma therapy.

08- 17

### EXPRESSION OF PD - L1 IN TRIPLE NEGATIVE BREAST CANCER: A POTENTIAL BIOMARKER FOR IMMUNOTHERAPY

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**Background:** Triple negative breast cancer (TNBC) is the most aggressive breast cancer subtype, and there is no targeted therapy. The programmed cell death protein 1 (PD-1) and its ligand PD-L1 have critical roles in tumor immune surveillance. PD-1 is an immune checkpoint protein expressed in mononuclear immune cells. PD-L1 is a trans-membrane protein expressed on a wide variety of cells including immune cells, epithelial and vascular endothelial cells. We studied the role of PD-L1 expression in patients with triple negative breast cancer (TNBC) by immune histo chemistry and correlated with clinico-pathological parameters.

**Methods:** PD-L1 immunohistochemistry was performed on formalin fixed paraffin embedded tissue samples. The prevalence of PD-L1 expression was correlated with various clinico-pathological parameters. Pearson  $\chi^2$  and t-student test were used to compare the survival of patients with positive PD-L1 expression and those with negative PD-L1 expression.

**Results:** Of the 163 TNBC cases evaluated for PD-L1 expression, the number of cases with any tumoral cell staining was 65 (39.88%). Among them 33 (51%) showed strong PD-L1 surface expression. Some cases had PD-L1 expression in both tumoral cells and stromal cells. Although there was a range of expression of PD-L1, no significant correlation with the level of expression and overall survival or disease free survival observed. There was also no other association with important clinico- pathological variables as well.

**Conclusions:** High levels of PD-L1 expression suggest the role of PD-L1 as a potential biomarker for immune checkpoint blockade therapy in TNBC patients.

**Key words:** Breast cancer, TNBC, PD-L1, Overall survival.

08- 18

### THREE DIMENSIONAL CELL CULTURE SYSTEMS FOR *IN SITU* CYTOCOMPATIBILITY EVALUATION OF SELECT PHYTOCHEMICALS FOR NEURAL TISSUE ENGINEERING APPLICATIONS

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**Background:** Neuronal repair following a brain injury was considered challenging till recently due to the concept that adult neural regeneration is improbable or delayed. Three dimensional cell culture systems are better biomimetic tissue models over 2D cell culture systems by providing better simulation of *in vivo* biological environment. In this context, the main objective of our study is to construct an extracellular matrix based three dimensional annulus - core cell culture system for cytocompatibility evaluation of select phytochemicals with tissue regenerative properties.

**Methods:** A three-dimensional migration assay model was set up using Rat tail vein Collagen I hydrogel seeded with  $1 \times 10^5$  L929 fibroblast cells/ml in an annular tissue simulant model (1cm diameter) consisting of Collagen gel incorporated with select tissue regenerative phytochemicals. Cellular proliferation and migration into the phytochemical-laden inner core was analysed qualitatively by the Calcein AM- Ethidium homodimer staining and confocal imaging. Physico-chemical characterisation of the hydrogels was assessed by Scanning Electron Microscopy, NMR spectroscopy and rheology measurements.

**Results:** L929 fibroblasts proliferated and migrated chemotactically in collagen-cross linked hydrogels. The physico-chemical characteristics, gelation time, rheology parameters of the hydrogels were found to be favourable for the cell survival and proliferation within this gels.

**Conclusion:** This study proves that this collagen annulus -core three dimensional gel construct could be an ideal *in situ* cytocompatibility evaluation platform, which could be further developed with different type of cells and phytochemical combinations for neural tissue engineering applications.

**Keywords:** Three Dimensional hydrogels, neural tissue engineering, phytochemicals,

08- 19

### EVALUATION OF ANTI INFLAMMATORY ACTIVITY OF *KOKILAKSHAM KASHAYAM* ON RAW MACROPHAGE CELL LINE

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**Background:** Pathophysiological events involve the production of pro inflammatory cytokines, tumour necrosis factor (TNF- $\alpha$ ) and interleukin (IL-1 $\beta$ ) by cells like monocytes, macrophage and dendritic cells. Several biochemical components such as lipid, protein, DNA and RNA also show variation in diseased condition. *Kokilaksham kashayam*, an ayurvedic herbal decoction is being traditionally used for the treatment of chronic inflammatory condition. The aim of this study is evaluation of effect of *Kokilaksham Kashayam* on production of pro inflammatory cytokines by RAW 264.7 macrophage cell line.

**Methodology:** Raman spectroscopy studies and inhibition of proinflammatory cytokines were carried out in the macrophage cell line RAW 264.7. TNF- $\alpha$  and IL-1 $\beta$  were quantified using ELISA whereas Raman spectral analysis was carried out in WITec alpha300RA (WITec GmbH, Ulm, Germany) confocal microscope.

**Results:** Raman spectral analysis revealed that all peaks characteristic of proteins, nucleic acid, lipids and carbohydrates were observed to be intensified upon LPS stimulation and were brought down upon *Kokilaksham Kashayam* extract pretreatment. The levels of proinflammatory cytokines were also lowered in the pretreated macrophage cells.

**Conclusion:** This part of work establishes the anti-inflammatory potential of *Kokilaksham kashayam* extracts revealing the therapeutic potential of bioactive molecules of the herbal decoction on chronic inflammatory conditions.

Key words: *Kokilaksham kashayam*, Raman Spectroscopy, Proinflammatory cytokines, RAW 264.7

08- 20

### SEX HORMONES INFLUENCE PAD4 ENZYME ACTIVITY

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**Background:** Peptidylarginine deiminase catalyses the reaction called citrullination. This enzyme plays a major role in human physiology. Among the different PAD isoenzymes, PAD4 is present mainly in neutrophils and it helps in mediating the defense strategy of neutrophils called NETosis. Apart from this, PAD enzymes are also shown to have relationship with the endocrine system as the enzyme activity was influenced by certain endocrine factors. Therefore, the present study was aimed to investigate the influence of sex hormones and PAD4 enzymes in neutrophils. Since this enzyme is significant in mediating the antimicrobial functions of neutrophils, the present study also look into the hormonal regulation of PAD enzyme in the presence of a bacterial stimulant (denoted as SCS).

**Method:** Freshly isolated human neutrophils were pretreated with either estrogen or testosterone in the presence or absence of SCS. The PAD enzyme activity was then determined at various time intervals according to Senshu *et al.* (1989) method with slight modifications.

**Results:** In the absence of SCS, PAD4 activity was significantly increased in the presence of estrogen and testosterone. However in the presence of SCS, the activity of the enzyme was significantly decreased in estrogen treated and testosterone treated cells. Cells treated with testosterone showed an increased PAD activity than estrogen treated cells.

**Conclusion:** Sex hormones have independent effect on PAD4 enzyme activity.

**Key words:** Neutrophils, peptidylarginine deiminase, estrogen, testosterone, bacterial stimulant

08- 21

### ENHANCEMENT OF THE ANGIOGENENIC POTENTIAL OF A PORCINE CHOLECYST DERIVED SCAFFOLD BY COATING WITH CELL ADHESION MOLECULES FOR DIABETIC WOUND HEALING APPLICATION

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**Background:** The host laboratory has prepared a porcine cholecyst derived scaffold (CDS), by a non-detergent/enzymatic method for wound healing applications. However, the potential of CDS for diabetic wound healing application has not been explored. Preliminary *in vitro* investigations indicate that the CDS does not promote the growth of vascular endothelial cells or keratinocytes. Considering that the ability of a tissue engineering scaffold to promote angiogenesis is an essential biomaterial property which contribute to diabetic wound healing, this study attempted to modify the CDS by coating with cell adhesion molecules.

**Methods:** The CDS was modified with cell adhesion molecules such as gelatin, fibronectin or CCN1 through method by EDC-NHS chemistry using 1-Ethyl-3-(3dimethylaminopropyl) carbodiimide and N-hydroxysuccinimide. Then, human keratinocytes and human umbilical vein endothelial cells were seeded on the modified scaffold. The viability, adhesion and proliferation were evaluated.

**Results:** The coating of the molecules on CDS with gelatin, fibronectin and CCN1 facilitated the enhanced growth of human keratinocytes in comparison with an unmodified scaffold. The coating also promoted the adhesion, viability and proliferation of human umbilical vein endothelial cells.

**Conclusion:** It was concluded that the coating of CDS with cell adhesion molecules may be a useful strategy for enhancing the potential of CDS in healing of diabetic wound.

**Keywords:** Angiogenesis, Diabetic wound healing, Extracellular matrix, Porcine cholecyst derived scaffold, Human umbilical vein endothelial cells and Human keratinocytes



08- 22

### A NEW INSIGHT ON EARLY DIAGNOSIS OF ALZHEIMER'S DISEASE BIOMARKERS BY LABEL BASED SERS IMMUNOSENSOR

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**Background:** Early detection and follow-up monitoring is critical for improving the physical, emotional and financial impacts of the Alzheimer's Disease (AD). Present medical providers do not routinely assess the cognitive health of their patients, leading to delayed Alzheimer's occurrence and post diagnostic care. Central nervous system (CNS) diseases represent the largest and fastest growing area of unmet medical need in low resource countries.

**Methods:** We have investigated on a label based, highly objective, ultrasensitive surface enhanced Raman scattering (SERS) modality in which iron-cored gold nanostar and gold nanoparticles were utilized as SERS substrates which turned out as a SERS based immunosensor to evaluate the presence of AD biomarker i.e. beta amyloid ( $A\beta_{42}$  protein).

**Results:** An efficient SERS based nanoprobe was employed for the specific detection of beta amyloid biomarker prominent in SH-SY5Y neuroblastoma cell line. The nanoprobe was characterized and the cytotoxicity of the construct confirmed the non-toxic nature of the nanoprobe in the neuronal cells used for further assays with suitable control. The nanoprobe efficiently localized the beta amyloid inside the cells which was confirmed by the ultrasensitive, fast SERS spectral analysis and imaging technique.

**Conclusion:** An ultrasensitive SERS based sandwich assay has been successfully demonstrated for an efficient detection of beta amyloid proteins in Alzheimer's Disease. Iron oxide nanoparticles may facilitates giving a contrast in Magnetic resonance imaging (MRI) which can also be utilized along with SERS for a dual SERS-MRI platform. With the inspiring *in vitro* preliminary results, we have initiated the collaborative plan with Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST), Trivandrum for the next level study with our SERS-nanoprobes in clinical samples (blood plasma) in order to differentiate Normal, Mild Cognitive Impairment (MCI) and Alzheimer's Disease patient samples.

**Keywords:** Surface enhanced Raman spectroscopy, Alzheimer's Disease, beta amyloid, label based

08- 23

### STUDIES ON EMBELIN FLUORO DERIVATIVE AS POTENT B - RAF INHIBITOR IN MELANOMA

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**Background:** B-RAF is a frequently mutated protein found in many cancers including melanoma. The important function of B-RAF is normal cell growth and survival. Most of known B-RAF mutations are V600E mutations. Vemurafenib is the currently used fluorine based drug used for V600E mutations but this drug has side effects, so current work focus on the semi synthetic derivative from naturally occurring hydroxyquinone, embelin.

**Method:** This work explains the synthesis of fluoro embelin derivative by TFA as catalyst and structure was confirmed by various spectral techniques. Molecular docking studies was conducted using Discovery studio 4.0 software and results were compared with standard drug vemurafenib. MTT assay, western blot analysis were conducted.

**Results:** The structure of the derivative was confirmed by Mass, and NMR. The docking studies showed the exact binding affinity of the derivatives with mutated B-RAF protein. MTT assay in melanoma cell lines showed good results. Western blot analysis showed that B-RAF expression level was reduced on the addition of the sample.

**Conclusion:** This work established the computational and wet lab method used for identifying a potent lead molecule for B-RAF mutated melanoma.

**Keywords:** B-RAF, Vemurafenib, Discovery studio 4.0, Embelin

08- 24

### EFFECT OF *ROTULA AQUATICA* LOUR IN AMELIORATION OF INFLAMMATION, OXIDATIVE STRESS AND RENAL DAMAGE ASSOCIATED WITH ACUTE PYELONEPHRITIS IN WISTAR RATS

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**Background:** Acute pyelonephritis is a common bacterial infection of kidney which was characterized by chronic renal inflammation. Current treatment strategies mainly focused on to antibiotic therapy. The recurrent infection and drug resistance create a major problem in treatment of acute pyelonephritis. The present study evaluates the efficacy of ethyl acetate fraction of *Rotula aquatica* Lour (EFRA) in ameliorating the inflammation, oxidative stress and renal damage associated with acute pyelonephritis.

**Methods:** The antioxidant enzyme status, GSH content, malondialdehyde (MDA) level, nitrate level, reactive oxygen species (ROS) level and renal toxicity markers were evaluated. The mRNA level expression of kidney injury molecule-1 (KIM-1), nuclear transcription factor kappa B (NF-κB), tumor necrosis factor-alpha (TNF-α), interleukin-6 (IL-6), Neutrophil gelatinase associated lipocalin (NGAL), Tamm Horsfall protein (THP) and Toll-like receptor 4 (TLR-4) genes were analyzed using RT-PCR.

**Results:** The result of our study reveals that EFRA have the capability to enhance antioxidant enzyme status and reduce the elevated biochemical parameters to normal level. The mRNA level expression of KIM-1, NF-κB, TNF-α, IL-6, NAGL and TLR-4 genes were downregulated by EFRA treatment. The expression of THP was upregulated during the EFRA administration.

**Conclusion:** The present study proves the efficacy of EFRA in ameliorating the inflammation, oxidative stress and renal damage associated with acute pyelonephritis. The EFRA could be used as an effective drug to treat acute pyelonephritis.

**Keywords:** Acute pyelonephritis; *Escherichia coli*; Inflammation; Oxidative stress.

08- 25

### A STUDY TO EVALUATE THE ASSOCIATION OF LIPID PEROXIDATION LEVELS AND OTHER RISK FACTORS IN THE DEVELOPMENT OF CORONARY ARTERY DISEASE (CAD)

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Coronary artery disease (CAD) is a multifactorial fatal disease with no known cure- highly predictable, preventable, and treatable. We have been identified a wide range of risk factors for coronary heart disease have been like BMI, obesity, cigarette smoking, alcohol abuse, hypertension, and diabetes mellitus. But no systematic study was available in literature to correlate the major risk factors with CAD severity. Hence we made an attempt to correlate the different risk factors of CAD with the control subjects.

**Materials and methods:** One hundred and fifty angiographically proved patients and hundred, age and sex matched controls were included in this study. Patients with cancer, liver, and kidney diseases are excluded. Detailed demographic and anthropometric data were recorded using proforma and clinical data from clinical records. Similar data were collected in the case of age and sex matched controls and the values are compared. **Result:** There is significant variation in the risk factors of CAD patients compared to the normal subjects. The lipid peroxidation levels of the patients was significantly higher than that of the normal controls and the levels of enzymatic antioxidant, and non enzymatic antioxidant were significantly lower than that of the normal counter parts.

**Conclusion:** From these findings we can conclude that the CAD patients with these risk factors have increased oxidative stress and decreased antioxidant status. So coronary artery disease is associated with greater than normal lipid peroxidation levels and with an imbalance in antioxidant's status.

**Keywords:** Coronary artery disease (CAD), Multifactorial disease, Risk factors, BMI

08- 26

### CHOLECYST-DERIVED-GRAFT ASSISTED HEALING OF EXPERIMENTAL MYOCARDIAL INFARCTION IN A RAT MODEL

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**Background:** Coronary artery disease due to obstruction of end arteries leading to myocardial infarction causes death in about one-third people over 35 years of age. Cardiac tissue engineering aims to repair the infarcted myocardium using cells, scaffold and growth factors. The present study explores the potential of an epicardial-graft (EG) fabricated out of decellularised porcine cholecyst to heal induced myocardial infarction in a rat model.

**Method:** Sub-acute myocardial infarction (MI) was induced under general anesthesia in six Sprague Dawley rats by ligating the left anterior descending coronary artery. MI was indicated by blanching confirmed through visual examination by a veterinarian. In three animals, the EG was implanted over the site of MI within 15 minutes after the blanching and the animals were allowed to recover from the anesthesia. After 14 days of observation, the rats were euthanized by CO<sub>2</sub> inhalation and heart was explanted. The nature of the healing reaction in the myocardium of the EG-assisted and non-assisted reactions were compared in histology sections stained with Haematoxylin & Eosin, Masson's Trichrome and Herovici's stains.

**Results:** The induction of MI was successful in the rats as evidenced by gross blanching of the myocardium within two minutes after ligation. Subsequently, the histomorphology confirmed the MI. Further, the EG-assisted healing was characterised by minimal collagen deposition and increased angiogenesis.

**Conclusions:** This work indicates that decellularised porcine cholecyst is a potential biomaterial for fabricating epicardial-graft for assisted healing of infarcted myocardium.

**Keywords:** Myocardial infarction, coronary artery ligation, remodeling

08- 27

### CATECHIN MODULATES AUTOPHAGY AND APOPTOSIS IN MIN6 CELLS EXPOSED TO HIGH GLUCOSE CONCENTRATION

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**Background:** Apoptosis (Type I cell-death) and autophagy (Type II cell-death) are the two different forms of programmed cell death, and both these cellular physiological processes play significant role in the progression of diabetes. The present study aims to evaluate whether catechins exert any modulatory effect on autophagy and apoptosis in MIN6 cells exposed to high glucose concentration.

**Materials and methods:** MIN6 cells were grown in low glucose medium and the medium was replaced with high glucose (40mM) stress induced medium. After inducing glucose toxicity cells were treated with 50  $\mu$ M and 100  $\mu$ M concentration of catechin. Apoptosis was determined by Acridine orange (AO) and ethidium bromide (ETBR) double staining. Autophagy was analyzed using autophagy kit by *flow cytometry*.

**Results:** Our results suggested that catechin could attenuate oxidative stress; modulate the apoptotic signals and it can protect pancreatic  $\beta$ -cells from apoptotic damage under hyperglycemic condition. From our results it can also be observed that treatment of cells with nontoxic concentrations of catechin has significantly reduced the autophagy flux induced by HG. Thus catechin could protect cells against glucotoxicity induced apoptosis and can also reduce autophagic induction triggered by high glucose concentration.

**Conclusion:** Our observations suggest that catechin possess significant modulatory effect on autophagy and apoptosis in MIN 6 cells exposed to high glucose concentration.

**Key words:** autophagy, apoptosis, MIN6 cells

08- 28

### AN EVALUATION OF DRINKING WATER QUALITY OF dug wells IN KOLLAM DISTRICT

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The people of Kerala, who depend on well water, face the problem of water contamination throughout the year and water scarcity during summer which results from anthropogenic activities. Assessment of water quality is very important for knowing the suitability of water for various purposes. Hence a detailed investigation was planned on the quality and the factors related to the deterioration of water quality in the present study area viz Kollam district. Samples were collected from eight stations for physio-chemical analysis. Standard methods were used for analyses. Mean values of these parameters were determined using Microsoft excel. The results were compared with BIS standards. It was revealed that many wells were positive for coliform content indicating high risk. The drinking water quality was found to start deteriorating after the onset of monsoon. People dependent on this water are often prone to health hazards due to use of polluted drinking water. The results of the study help in enhancing awareness of health hazards of contaminated water among the individuals as well as in drawing attention of health regulatory authorities.

08- 29

### COGNITIVE EFFECTS OF ENDEMIC FLUOROSIS-A COMPARATIVE STUDY

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**Background:** Fluoride has beneficial effects on teeth at low concentrations in drinking water, but excessive exposure to fluoride in drinking water can give rise to a number of adverse effects including detrimental neurological effects. This study aims at investigating if there is a link between fluorosis and the cognitive function of school going children.

**Methods:** This cross sectional Study was conducted in collaboration with the the Fluorosis Control Programme, Department of Health services, Alappuzha district. School going children aged 8 – 10 years studying in Govt.LPS, Kalarcode, Alappuzha district with confirmed endemic fluorosis were picked up. Normal healthy age and sex matched children without fluorosis were selected from the same school. Both groups were subjected to neuropsychological assessment with Raven's Standard Progressive Matrices and MISIC digit span subtest.

**Results:** A total of 40 children with confirmed fluorosis were selected by simple random sampling and an equal number of age and sex matched normal children were also selected. Majority of study subjects in both groups were females (55%) and were 9 years of age (75%). The mean age of the children was 8.95.

30% of the children without fluorosis had Grade I (Intellectually superior) and Grade II (Definitely above the average in intellectual capacity) Raven's SPM grades as compared to 15% of those with fluorosis. None of the children without fluorosis had scores in the Grade V (Intellectually impaired) category whereas 20% of the fluorosis affected children belonged to the same. The mean digit span (backward) was found to be significantly higher in the normal children than those with fluorosis. An increase in Raven's SPM grade was observed with increase in Dental fluorosis Index

**Conclusion:** This study establishes a significant relationship between the presence of fluorosis and impaired cognition in children. Severity of dental fluorosis is significantly associated with the grade of cognitive dysfunction. Measures to reduce fluoride intake by defluoridation of drinking water might prevent cognitive dysfunction in children.

**Keywords:** Children, fluorosis, cognitive function, neuropsychological test

08- 30

### CYTOPROTECTIVE ACTIVITY OF AMALAKI RASAYANA IN UV IRRADIATED HUMAN DERMAL FIBROBLASTS

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**Background:** In Ayurveda, *Rasayana* therapy has been proposed as a remedy for *Jara* (i.e., ageing and ailments associated with it) and rejuvenation of the body. *Amalaki rasayana* (AR) is an important *rasayana* formulation, prepared from the fruits of *amla* (obtained from the source plant *Emblia officinalis* and inserting it (fruits) into a specially created hollow cylindrical stem, taken from the plant *Butea monosperma*).

**Methods:** UV irradiated human dermal fibroblasts (HDF) from juvenile foreskin (Himedia, India) cells were treated with varying concentrations of Amalaki Rasayana and incubated for 24, 48, 72 and 96 hours and cytoprotective activity was evaluated by direct observation via phase contrast microscope, MTT assay and LDH assay. Results were compared with untreated control, UV alone treated HDF and UV irradiated vitamin C treated HDF.

**Results:** Statistical comparison of different groups with two way ANOVA showed treatment with *Amalaki Rasayana* in UV irradiated human dermal fibroblasts had significantly reduced cytotoxicity, profoundly increased the cell survival and maintained more or less intact morphology of HDF when applied in concentrations of 6.25 µg/mL and 12.5 µg/mL (P<0.001) and subsequent incubation up to 96 hours.

**Conclusion:** *Amalaki Rasayana* has comparable cytoprotective activity with vitamin C in UV irradiated HDF in concentration ranges 6.25 µg/mL to 12.5 µg/mL. This could be attributed to phenolic and other bioactive compounds present in the *rasayana*, which might have reduced the lethal oxidative stress imparted by UV on human dermal fibroblasts.

**Keywords:** *Amalaki Rasayana*, cytoprotection, senescence, ageing, MTT assay, LDH assay, Human Dermal Fibroblasts

08- 31

### A TRIO MODEL NANOTECHNOLOGICAL APPROACH FOR CANCER MANAGEMENT: GRAPHENE BASED PLASMONIC POLYMER ASSEMBLIES FOR MULTIMODAL IMAGING AND THERAPY

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**Background:** Theranostics, a unified form of diagnosis and therapy, plays a central role in personalized cancer treatment applications. Novel diagnostic formulations constructed on multifunctional hybrid nanomaterials have been developed as an efficient platform for the precise treatment and concordant visualization of disease with high sensitivity to elucidate disease from morphological variations to physiological mechanisms. Several research groups have paid considerable attention in developing such nano-theranostic agents towards the efficient management of serious diseases such as cancer.

**Method:** This work employs the innate properties of graphene based plasmonic polymer assemblies to perform multifunctional theranostic applications. This has been illustrated through bimodal imaging modalities (fluorescence and surface enhanced Raman scattering (SERS)) and tri-modal therapeutic regimes (chemotherapy, photothermal therapy and photodynamic therapy). The efficacy of the nanoconstruct was demonstrated through *in vitro* and *in vivo* experiments as well.

**Results:** Fluorescence and SERS imaging analysis of the as-designed theranostic nanoplatform showed target specific internalization to the cancer cells via receptor mediated endocytosis. The nanoconstruct achieved great therapeutic outcome via the synchronous administration of phototherapies along with chemotherapy. The promising potential of the nanoagent was further evident from the *in vivo* experiments which showed significant tumor reduction when compared to the control animals.

**Conclusions:** The as-designed nanostructured is played enhanced photo absorption properties which amplified light responsive imaging and therapeutic efficacies, which could offer a promising outcome in translational research.

**Keywords:** Cancer, Theranostics, Multifunctional, Nanoagents

08- 32

### BIMODAL FLUORESCENCE-SERS ENCODED NANOCOCTAIL FOR THE MULTIPLEX DETECTION OF LUNG CANCER BIOMARKERS

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**Background:** Comprehensive profiling of multiple protein targets plays a critical role in the deeper understanding of specific disease conditions associated with high heterogeneity and complexity. Recent research has shown that no single targeting motif is sufficient to provide adequate information required to fully characterize or identify a specific disease condition. Thus, the development of highly sensitive techniques that can specifically recognize multiple biomarkers in a simultaneous fashion are greatly desired for the early diagnosis and management of diseases.

**Method:** The present work is based on the fabrication of programmable nanoparticles that feature an “on-off” switching transition between fluorescence and surface enhanced Raman scattering (SERS) for the multiplex detection of lung cancer biomarkers. The diagnostic efficacy of the nanoprobe was investigated under *in vitro* conditions using fluorescence and Raman microscopic analysis.

**Results:** Semi-quantitative evaluation of biomarkers through both the modalities (fluorescence and SERS) revealed ≈ 15, 8 and 1.2 fold increase in the respective EGFR, CK and Nap levels in the cancer cells against the normal ones. The bimodal approach achieved specific recognition of single as well as multiple biomarkers in a complex biological setting through multi-color image guided spectral tracking. Evaluation of sputum samples showed the potential of our probe in discriminating cancer patients from healthy ones.

**Conclusion:** We believe that this proof-of-concept will provide a blueprint for the diagnosis and differential staging of lung cancer into various histological subtypes based on the differential expression of the antigens, which may provide huge impacts in future clinical practices.

**Keywords:** Nanotag, Diagnosis, Lung Cancer, Bimodal, Clinical specimen

08- 33

### PROGNOSTIC SIGNIFICANCE OF ADDITIONAL CHROMOSOMAL ABNORMALITIES IN CML PATIENTS

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**Background:** Chronic Myeloid Leukemia is a hematopoietic stem cell malignancy, characterized by the presence of Philadelphia (Ph) chromosome, resulting from the translocation t(9;22)(q34;q11), leads to BCR-ABL fusion gene. Clinically CML consisted of 3 distinct phases; Chronic Phase (CP), Accelerated Phase (AP) and Blast Crisis (BC). Clonal evolution or emergence of Additional Chromosomal Abnormality during the course of CML is considered as trait of disease progression and it implies poor prognosis.

**Methods:** Conventional and molecular cytogenetic analysis was performed for the identification of chromosomal aberrations. Harvesting and GTG banding were performed as per the standard procedure. Karyotypes were described according to ISCN, 2016. FISH was done using the locus specific probe for BCR /ABL and AML/ETO fusion genes. Results: Among the 60 cytopathologically confirmed CML patients, the detection of Ph chromosome was observed in 52 patients. FISH showed a positive signal pattern for all the 60 cases, including the cases without division in conventional cytogenetics. A higher occurrence of ACA, 71.42% (5/7) within advanced phases were observed, while in chronic phase its incidence came up to 3.33% (2/53) merely. The highest treatment response to TKI was observed in the patients within chronic phase irrespective of occurrence of ACA. In CML-AP and BC patients with ACAs displayed adverse treatment response to IM therapy.

**Conclusion:** The frequency of ACA is higher in the advanced phases of CML. An adverse effect was observed in the prognosis of the advanced phase patients with ACAs. Hence the grouping of the patients according to their ACA with the treatment response in each phase is a requisite for the effective management of CML patient.

**Key words:** Chronic Myeloid Leukemia, Additional Chromosomal Abnormality.

08- 34

### IMPORTANCE OF COVENTIONAL CYTOGENETICS IN PEDIATRIC B LYMPHOCYTIC LEUKEMIA

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**Background:** Acute lymphoblastic leukemia (ALL) is a malignant proliferation of lymphoid cells blocked at early stages of differentiation. It is the most common type of cancer in children. It accounts for one-fourth of all pediatric malignancies. Numerical and structural chromosomal abnormalities are frequently found in the hematological malignancies. Some of the abnormalities have important role in prognosis prediction.

**Methods:** The present study included 100 pediatric patients with BLL, who had attended the Pediatric Oncology out-patient clinic of the Regional Cancer Centre, Trivandrum. Conventional cytogenetic analysis was performed in all cases to find chromosomal aberrations in each case. Fluorescence In Situ Hybridization (FISH) technique was used to confirm the presence of BCR-ABL fusion gene in the study group.

**Results :** When conventional cytogenetic analysis was carried out among the 100 cases, 44 cases showed normal karyotype (46, XX or 46, XY) analysis could not be done in 20 cases because of inferior quality of metaphases. Numerical abnormalities were found in 29 cases. The numerical abnormalities observed included polyploidy (2 case), high hyperdiploidy (24 cases), hypodiploidy (1 case), trisomy 9 (1 case), 46,XY, -20,+mar (1 case). Structural abnormalities were found in 5 cases. The structural abnormalities included the presence of Philadelphia chromosome [t(9;22)(q34;q11)] in 4 cases and one case showed rare structural abnormality and the karyotype of the case was, 46,XY,8 p-. Numerical and Structural abnormalities were showed in 2 cases included presence of Philadelphia chromosome [t(9;22)(q34;q11)], high hyperdiploidy and polyploidy. FISH (Fluorescence in situ hybridisation) was done as a molecular confirmation of the translocation, t(9;22)(q34;q11) in the patient group. Presence of BCR-ABL fusion gene was observed in 6 cases.

**Conclusions:** Many of the chromosomal aberrations found in the study group plays a specific role in the prognosis prediction of the patients with leukemia. The use of conventional and molecular cytogenetic studies will be helpful in more effective risk stratification among children with leukemia. More specific treatment to each risk group will reduce unnecessary side effects of treatment in low risk patients and also improve the survival of high risk patients, thus will improve overall treatment outcome among the patients.

**Keywords:** Acute Lymphoblastic Leukemia, Fluorescence In Situ Hybridization, Cytogenetics, Risk Stratification.

08- 35

### IN SILICO PREDICTION AND THREADING BASED EPITOPE MAPPING OF LEPTOSPIRAL SURFACE ADHESION PROTEIN LSA46

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**Background:** Leptospirosis is one of the neglected diseases caused by the spirochete, *Leptospira interrogans*. The common treatment available for the disease is the usage of antibiotics such as Penicillin, cephalosporin, amoxicillin etc. and also as a mode of management of the disease several peptides as vaccines has been developed. The currently available vaccines are not serovar specific so there is a need for a well conserved vaccine candidate which can show cross protection against number of serovars of pathogenic Leptospire. Lsa46 is a surface exposed outer membrane protein plays a major role in colonization in host tissues. Lsa46 acts as laminin and plasminogen binding protein which enables the protein to easily enter into host cells inducing infection. The major target for the development of vaccine in current era is focussing on surface exposed outer membrane proteins, as they can induce strong and fast immune response in hosts.

**Method:** In the present study, physiochemical parameters of Lsa46, subcellular localization, secondary structure analyses, antigenicity, conserved domain analyses etc. were analyzed through computational tools and online web servers. The secondary structure of the Lsa46 were predicted by threading based method in ITASSER server and validated by Ramachandran plot analyses. The B cell epitope prediction showed 4 major sequential B cell epitopes of Lsa46 and all these epitope score were found to be of a higher value. The protein peptide interaction was performed by molecular docking studies using Discovery studio.

**Results:** The highest scored epitope and the ligand, human IgG show a stable docking score of 20.86. The dynamic simulation studies carried out with the molecular docked complex gives a binding energy of - 147515.3Kcal/mol.

**Conclusions:** All results of the present study help to elucidate the structural and functional characterization of Lsa46 and a deep insight for epitope based design. Wet lab analysis is required to clarify the scientific validation of the predicted epitope as an ideal vaccine candidate. Also pre-clinical and clinical findings are required based on the bioinformatic approaches used in this study for a validating it scientifically.

**Key words:** Leptospirosis, Lsa46, epitope based vaccine design, Molecular docking

08- 36

### PREVALENCE AND ANTIBIOTIC SUSCEPTIBILITY OF TRADITIONAL MEDICINAL PLANTS ON PATHOGENIC BACTERIA USING AGAR WELL DIFFUSION METHOD

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Interest and support for the conservation and development of medicinal plants is increasing in all parts of the world. This is due, in part, to a growing recognition given to the role of medicinal plants in the provision of culturally relevant and affordable health care in creating sustainable livelihoods and in the vital conservation of biodiversity. This has also drawn the attention of the world community towards the need for creating mechanisms to ensure sustained development of the sector and to allow sharing of information between countries, organizations and agencies. Long before mankind discovered the existence of microbes, the idea that certain plants had healing potential, indeed, that they contained what would currently characterize as antimicrobial principles, was well accepted. Since antiquity, man has used plants to treat common infectious diseases and some of these traditional medicines are still included as part of the habitual treatment of various maladies.

**Materials and methods:** Medicinal plants represent a rich source of antimicrobial agents. The different part used to include root, stem, flower, leaf, twig exudates and modified plant organs. The selected plants for the present study are *Curcuma aromatica*, *Loranthus ferruginous*, *Piper betle*, *Momordicacharantia*, *Simarouvaglauca* and *Psidiumguajava*. The study carryout to find the antibiotic activities of selected native medicinal plants. The study consists of culturing the microbes in the nutrient medium and identifies the bacterial species using standard biochemical procedures and analyzes the action of potential antibacterial properties of medicinal plants. The bacterial species identified as *E.coli*, *Klebsilla pneumonia*, *Shigella species*, *Salmonella species*, *Staphylococcus*, *Streptococcus* and *Vibrio cholerae*. Agar well diffusion method used to identify the sensitivity of bacterial species.

**Result and discussion:** The study shows that *E.Coli*, *Klebsiella pneumonia* bacteria's show highly sensitive in *Curcuma aromatica*. *Shigella*, *Staphylococcus*, *Salmonella* species shows resistance in *Piper betle*. *Vibrio cholera* shows resistance in extracts of *Momordicacharantia* plant. *Streptococcus* shows resistance in *Simarouvaglauca* and *Momordicacharantia*. The medicinal plants like *Loranthus ferruginous*, *Psidiumguajava* shows a positive resistance towards the microbes. The relevance of the study narrate that the herbal medicines are safer and less damaging to the human body than synthetic drugs. The use of modern drugs brings about side effects which are sometimes more dangerous than the disease itself.

**Keywords:** antibacterial properties,multiple antibiotic resistance,agar well diffusion method

08- 37

### REPRODUCTIVE HALTH OF WOMEN IN COASTAL AREAS OF THIRUVANANTHAPURAM

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**Background:** Reproductive health is considered as one of the major problem faced in the public health sector across the globe. Health of the women is one of the key indicators in determining the quality of life of a nation. Kerala is one of the states having the highest quality life in the country. Coastal community always has a number of unattended



problems with them, especially the women population in the fishing community that form a different segment from the general population

The coastal area is an untouched population in many developmental studies the popularization of science is in its infancy in thus part of the state. Base line service in the coastal area in the Thiruvananthapuram, itself-shows alarming results about the reproductive health level of awareness among women Population. To them, science is purely based on the customs and believes that they follow and the superstitions that they have. Awareness on reproductive is of health is significant importance of the reproductive age group, especially young mothers regarding the dangerous of unhygienic practices

**Method:** Surveys are used to collect the base line information of the samples this was collected by using an interview schedule comprising the personal, socio economic status, life style and activity pattern of the samples. Both primary and secondary data will be collected for research. In order to check the feasibility of the tools prepared, a pilot study will be conducted among 5 women belonging to the coastal area of Vizhinjam, Thiruvanthapuram. Collected data was statically analysed and interpreted using appropriate statistical technics.

**Results:** The base line information of the samples includes data related to their age, details of family members etc. from this it was identified that 70% of the respondent belongs to the age group of 25-35 years. 65% of them have more than 3 members in their family 60% of them couldn't, completed their 10<sup>th</sup> standard. According to the economic status fisher women are very poor and marginalized. 89% of them preferred government hospital for their delivery and 90% of them taken iron folic acid and vitamin supplements throughout their pregnancy periods. The abortion rates are very rare among the respondents and miscarriage was seen between the fisherwomen due to their lack of knowledge

**Conclusion:** The findings regarding the reproductive profile of the women in coastal Areas where quite disheartening needed urgent address miscarriage were found to be very common in fisher women at it was quiet shocking to know that they are not bothered about health issues and related complication after a miscarriage. Hence awareness about the reproductive health care is very much important which can surely bring positive attitudinal changes among the woman in coastal areas.

**Keywords:** Reproductive Health, Miscarriage, Menstrual Hygiene, Unattended population

08- 38

#### ASSESSMENT OF ANTIOXIDANT, ANTIMUTAGENIC AND ANTIHEMOLYTIC POTENTIAL OF *CYNOMETRA TRAVANCORICA*, A SUBSTITUTE OF *SARACA ASOCA* IN ASOKARISHTA

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**Background:** *Cynometra travancorica*, endemic to Western ghats of Kerala and Karnataka, is used as a substitute of *Saraca asoca* in an Ayurvedic formulation known as Asokarishta used in the treatment of several gynaecological disorders. The biological properties of this plant have not been reported so far.

**Method:** Antioxidant potential of methanolic extract of *C. travancorica* was evaluated by DPPH and hydroxyl radical scavenging assays. Total phenolic content was estimated by using Folin – Ciocalteu reagent. Efficacy of the extract to inhibit sodium azide and 4-nitro-o-phenylenediamine induced mutagenicity in *S. typhimurium* strain TA 100 was evaluated by Ames test. Potency of the extract in inhibiting AAPH induced erythrocyte hemolysis and lipid peroxidation was determined. GSH content in AAPH challenged erythrocytes was estimated. SDS-PAGE technique was performed to separate the isolated erythrocyte membrane proteins.

**Result:** Extract of *C. travancorica* yielded IC 50 values of  $4.68 \pm 0.26$  and  $1.75 \pm 0.35$   $\mu\text{g/mL}$  in DPPH and hydroxyl assays. Total phenolic content was estimated to be 116.36 mg/g calculated as gallic acid equivalent. Extract (1 mg/mL) showed 48.2 and 53.3 % inhibition against  $\text{NaN}_3$  and NPD induced mutagenicity in strain TA 100. Extract prevented the erythrocyte hemolysis and lipid peroxidation with IC 50 values of 17 and 59  $\mu\text{g/mL}$ , respectively. Extract treatment restored the depleted GSH content and also protected the membrane proteins from oxidative damage caused by AAPH.

**Conclusion:** *C. travancorica*, rich in phenols exhibit potent antioxidant, antimutagenic and antihemolytic properties.

**Keywords:** *C. travancorica*, antioxidant

08- 39

### CLINICO-EPIDEMIOLOGIC AND ENVIRONMENTAL FACTORS IN YOUNG ONSET PARKINSON'S DISEASE: A PROSPECTIVE STUDY

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**Background:** Clinical features and the response to treatment in Young Onset Parkinson's Disease (YOPD) differ from Idiopathic Parkinson's disease. It remains controversial if they are cases of Parkinson's disease starting at a younger age or a different disease. Studies on monozygotic twins and quadruplets have suggested that heredity plays little to no role in Parkinson's disease. Meanwhile, multiple environmental factors are increasingly being identified as the probable aetiological factor in YOPD

**Method:** Prospective case series study conducted in inpatients, in Dept of neurology of a tertiary care centre in South India. Patients admitted between September 2015 and August 2018 analysed. All clinical features are noted in study proforma. Epidemiologic factors were noted. Environmental factors were noted based on standard proforma. Chemical analysis of possible environmental factors done in Regional soil analytical laboratory, under govt. of Kerala, Trivandrum . Family members were clinically tested and family history is recorded in 3 subsequent generations

**Results:** 34 cases were included in the study 18 cases (52.9%) were females. Mean age was 43.12yrs ( $\pm$  4.1yrs). Tremor was the most common presenting symptom – 22 in 34 cases (64.7%). Hypokinesia [34 in 34 cases (100 %)] was the most common clinical feature. Family history of movement disorder was noted in 6 Cases (17.6%). In all of the cases basal ganglia structures were normal. Akinetorigid group was 12 out of 34 cases (35.3%) . Fatty liver with deranged liver function was noted in 29.1%. Two patients had multiple lipomatosis. Dental fluorosis noted in 41.7%. Pesticide exposure was present in 23.5% and all of these cases were tremor dominant YOPD. Elevated soil manganese in 41.1% cases, elevated soil phosphorous levels in 58%.

**Conclusions:** Majority of our patients belonged to tremor dominant variety, in contrast to akineto-rigid syndrome in western studies<sup>1</sup> . Levodopa induced dyskinesia is more common in akineto-rigid variety , in contrast to western studies: There were no radiological abnormalities detected in basal ganglia, except for incidental findings, correlated with western literature. Co-morbid condition observed are (a) Fatty liver, which has a definite relation with parkin gene in experimental animals (b) Asian variety of lipomatosis associated with parkinsonism (c) Dental fluorosis. Soil analysis shows increased concentration of manganese and acidity in the soil in the living area and the locality, which has direct correlation with YOPD. Other abnormalities in the soil, whether it is related or unrelated with disease is not known.

**Keywords:** Young onset Parkinson's disease, Lipomatosis, Fluorosis, Levodopa

08- 40

### EGFR MUTATION ANALYSIS IN NSCLC: EXON 20 Q787Q POLYMORPHISM

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**Background:** EGFR, a trans membraneglycoprotein genehas an important role in the tumor development. Mutation in exons 18, 19, 20 and 21 of the EGFR gene result in the aberration of signal transduction pathways which regulates cellular activities such as proliferation, differentiation and apoptosis, resulting in tumor formation. This study concentrates on EGFR mutation analysis in NSCLC patients.

**Materials and methods:** DNA isolation andmutation analysis of EGFR exon 18, 19, 20 and 21 were performed by PCR followed by direct bidirectional sequencing

**Results:** Forty patient samples were subjected to mutation analysis which identified exon 19 deletions and exon 21 L858R mutations. The missense variants EGFR exon 20 S768I and EGFR exon 20 V774M were also identified in one of the patients studied. In exon 20 a variant form CAG to CAA at codon 787 (2361G>A) was identified in 13 patients (32.5 %) which is a genomic variation of EGFR.

**Conclusion:** Q787Q polymorphism was found frequently in the samples studied. This needs further studies to validate the significance of this SNP as a molecular marker for NSCLC. Further larger samples are to be analyzed to correlate smoking history with the mutations of EGFR tyrosine kinase domain.

**Keywords:** Non-SmallCell Lung Carcinoma, Epithelial Growth Factor Receptor, Polymorphism

08- 41

### HESPERIDINE NANOPARTICLE INCORPORATED ELECTROSPUN SCAFFOLDS FOR WOUND HEALING APPLICATIONS

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**Background:** Tissue Engineering (TE) is an important field for the development of biological substitutes that restore, maintain and improve the tissue and organ functions. Every year, millions of people are exposed to different kinds of epidermal or skin damage by hot water, flames, accidents, and boiling oil, and these accidents result in major disabilities or even sometimes death. Although various commercially available wound dressings have been produced, a low-cost, easy-to-use and biofunctionalizable biomaterial that provides a moist environment and facilitates healing is still a target of active tissue regeneration research.

**Methods:** Synthesis of polymer coated hesperidin nanoparticles by nanoprecipitation method. Synthesized nanoparticles were incorporated into electrospun nanofibers via electrospinning. Characterised by XRD, FTIR, SEM, UV-Visible spectroscopy and DLS

**Results:** Characterization studies revealed the nanoscale properties of hesperidin nanoparticle and the synthesized nanoparticles can be successfully incorporated in to the electrospun fibers via electrospinning. Cytotoxicity study of hesperidin nanoparticle incorporated electrospun scaffolds on L929 cells revealed maximum cell viability in high concentrations. In vitro cytocompatibility results showed that the cells were more viable in hesperidin nanoparticle incorporated electrospun scaffolds than PLGA electrospun scaffolds.

**Conclusions:** The study suggests that the hesperidin nanoparticle incorporated electrospun scaffolds show more cell adherence and cell proliferation therefore it can be a good candidate for wound healing applications.

**Keywords:** Hesperidine, Electrospinning, Nanoparticle, Scaffolds

## 09 - LIFE SCIENCES

09-01

### *IN VITRO* CYTOTOXIC AND APOPTOTIC POTENTIAL OF PURIFIED TERPENOID OF *BRACHYTHECIUM BUCHANANII* (HOOK.)A. JAEGER IN MG63 OSTEOSARCOMA CELL LINES: A SEARCH

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**Background:** Osteosarcoma is the most common malignant bone tumor in children and adolescents. This aggressive cancer mostly occurs in the long bones. Therefore, novel therapeutic approaches, such as biological therapies and gene therapy, are required to efficiently treat osteosarcoma. Bryophytes are primitive non vascular species contain a pool of secondary metabolites. However, little is known regarding the therapeutic effects of bryophytes on carcinoma.

**Methods:** This study investigated the effects of purified terpenoids on MG63 human osteosarcoma cells, in addition to elucidating the regulatory signaling pathways underlying the effects of terpenoids, the caspase cascade and the antioxidant enzyme system. The MG63 cell line was treated with various concentrations of terpenoids. Cells were analyzed using MTT and flow cytometry. The migration and invasion potential using wound-healing was analyzed.

**Results:** The purity of the terpenoid fraction was checked by HPLC and FTIR analysis. Structural elucidation was completed by using NMR. Microscopic studies showed that terpenoid treated cells exhibited marked morphological features characteristic of apoptosis. The flow cytometry study substantiated terpenoid induced apoptosis in MG 63 cells. Cell cycle analysis revealed the significant increase in the number of cells arrested at the S growth phase. Terpenoid extract also resulted in DNA fragmentation in the cells. Western blot analysis was used to test for the presence of the antiapoptotic proteins Bcl2 and cleaved caspase 3 (procaspase3) and the proapoptotic protein Bax. In present study it was demonstrated that the antioxidant enzyme system was also involved in the terpenoidinduced apoptosis

**Conclusions:** Thus, the overall results confirmed the terpenoids induced apoptosis in MG63 cells.

**Keywords:** Anticancer, caspase, G2/M phase arrest, S phase arrest, DNA fragmentation, apoptosis

09-02

**EFFECTIVE AMELIORATION OF LIVER FIBROSIS BY *TETRACERA AKARA*(BURM. F.) MERR., AN ETHNOMEDICINAL PLANT VIA INHIBITING NF- $\kappa$ B SIGNALING PATHWAY AND HSC ACTIVATION- A NOVEL THERAPEUTIC APPROACH**

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**Background:** Liver fibrosis is a chronic degenerative disease, which when left untreated may lead to cirrhosis or hepatocellular carcinoma and are usually irreversible conditions lacking complete cure in modern allopathic treatment. Roots of *Tetracera akara* (Dilleniaceae) locally known as 'Nennelvalli' is used by the Kani tribes of Kerala for treating liver disorders and the present investigation aims to scientifically evaluate the hepatoprotective effect of *T. akara* against CCl<sub>4</sub>-induced liver fibrosis to reveal its mechanism of action and its bioactive phytoconstituents.

**Method:** *T. akara* crude extract and various fractions were subjected to antioxidant screening and the most potent ethanolic fraction (TA ETH) was selected for further evaluation. Fibrosis was induced in Wistar rats as per the procedure of Marsillachet *et al.*, 2009. Comparative HPTLC, HPLC and HR LC-MS analysis of TA ETH was carried out to reveal the bioactive constituents.

**Results:** In chronic liver fibrotic studies, TA ETH (300 mg/kg) showed significant hepatoprotection and was comparable to the standard, Silymarin, which was evident from the reduced levels of biochemical serum parameters (AST, ALT, ALP etc.) and increased level of antioxidant enzymes like CAT & SOD. The gene expression studies carried out revealed that the levels of TNF $\alpha$ , TGF  $\beta$ , TIMP 1 were down regulated, whereas the levels MMP13 and IL 10 were upregulated in the TA ETH treated group leading to the inhibition of NF  $\kappa$ B signaling pathway and HSC activation. Detailed phytochemical analysis revealed the presence of Betulinic acid and HR LC-MS showed the presence of bioactive terpenoids and flavonoids.

**Conclusions:** Thus, from the study it can be inferred that the anti-fibrotic potential of *T. akara* may be due to the synergistic effect of bioactive phytoconstituents with antioxidant and anti-inflammatory potential present in TA ETH via inhibiting NF  $\kappa$ B signaling pathway and Hepatic Stellate Cell activation.

**Keywords:** Dilleniaceae, *Tetracera akara*, Fibrosis and Betulinic acid.

09-03

**POLYPHENOLS RICH *MURRAYA KOENIGII* LEAF EXTRACT EXERTS CARDIAC PROTECTION IN STREPTOZOTOCIN INDUCED DIABETIC RATS**

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**Background:** *Murraya koenigii* is a medicinal plant with great therapeutic potential. The leaves are used by Indians in herbal medicines to treat diabetes. The present study is aimed to determine the effect of *Murraya koenigii* in cardiac tissues under diabetic conditions.

**Methods:** Diabetic rats were treated orally with hydro alcoholic extract of *Murraya koenigii* leaves at a dose of 200 mg/Kg body weight for 60 days. The effect of extract on serum glucose, glycated hemoglobin, plasma insulin, and the levels of thiobarbituric acid reactive substances (TBARS), hydroperoxides (HP), conjugated dienes (D), activities of superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx), glutathione-reductase (GRD) and reduced glutathione content (GSH) were estimated. Metformin and atorvastatin were used as standard drugs. Phytochemical characterization of hydro alcoholic extract of *Murraya koenigii* was done using HPLC analysis.

**Results:** A significant increase in plasma insulin, activities of superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx), glutathione-reductase (GRD) and reduced glutathione content (GSH) and a significant decrease in serum glucose, glycated hemoglobin, thiobarbituric acid reactive substances (TBARS), hydroperoxides (HP) and conjugated dienes (CD) were observed in the treated groups. HPLC analysis revealed the presence of biologically active phytochemicals such as gallic acid and morin in the hydro alcoholic extract of *Murraya koenigii* leaves.

**Conclusion:** This study evaluated the antioxidant potential of hydro alcoholic extract of *Murraya koenigii* leaves.

These findings suggest the protective role of *Murraya koenigii* against oxidative stress in the heart of diabetic rats. Hence in addition to the anti diabetic effect, *Murraya koenigii* possess antioxidant potential can be used as a therapeutic agent to diabetic cardiomyopathy. The cardio protective effect of *Murraya koenigii* may be due to the synergistic action of photochemical present in it.

**Keywords:** *Murraya koenigii*, Antioxidants, Heart diseases, Diabetes.

09-04

#### SCREENING AND IDENTIFICATION OF CAMPTOTHECIN PRODUCING ENDOPHYTIC FUNGI FROM *OPHIORRHIZA MUNGOS*

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**Background:** Endophytic microorganisms have been reported to be equipped with the potential for the biosynthesis of plant specific compounds as part of their biochemical adaptation. As camptothecin is reported as the third largest anticancer drug currently available in the world market. Identification of its production by endophytic microorganisms is very important. Hence the present study focused on the identification and characterization of camptothecin producing endophytic fungal isolates for its wide range biological applications.

**Methods:** In the present study, endophytic fungi were isolated from the surface sterilized leaf tissues of *Ophiorrhiza mungos*, selected fungi have been screened and identified for camptothecin biosynthetic potential. This was further confirmed by HPLC and LC-MS/MS analysis.

**Results:** MS/MS analysis confirmed the extract of two fungal isolates *Meyerozyma* sp., and *Talaromyces* sp. isolated from *Ophiorrhiza mungos* to have the presence of compounds with *m/z* 348 same as that of the camptothecin standard. This was further confirmed due to the presence of daughter ion masses of 349, 320, 305, 277, 249 and 220 by MS/MS analysis.

**Conclusion:** The microbial production of camptothecin is very important as it is one among the most selling anticancer drug of high significance due to the increasing global demand. In the present study, 2 endophytes from *Ophiorrhiza mungos* have been characterised for their potential of camptothecin production which suggest the role of endophytic microorganisms for its biosynthetic potential.

**Keywords:** Camptothecin, *Ophiorrhiza mungos*, anticancer drug, endophytes, LC-MS/MS fragmentation

09-05

#### A HIGHTHROUGHPUT APPROACH FOR CANCER DRUG SCREENING USING REDOX GFP AND FRET BASED PROBES OF CELL DEATH

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The most versatile tool known for live cell imaging of cell death is the detection of caspase 3 activation using CFP/YFP based FRET probes with single excitation, dual emission ratiometric imaging. Similarly, redox sensitive GFP probes (roGFP) targeted mitochondria has been employed for live cell imaging of mitochondrial oxidation with dual excitation ratio imaging approach. Even though these probes for caspase activation and mitochondrial oxidation were extensively used for studying the progression of these events in live cells independently, simultaneous single cell imaging of both these events remains as a challenge because of difficulty in imaging owing to their spectral overlap. In order to overcome this limitation, we have introduced the caspase sensor based CFP/YFP FRET probe at the nucleus and mitochondrial oxidation probe at the mitochondria for simultaneous visualization of both the events. We have developed few cancer cells stably expressing these probes that allowed us to visualize both caspase activation and progression of mitochondrial oxidation at single cell level with sufficient temporal and spatial resolution in diverse imaging platforms. We describe a systematic approach for real time visualization of these critical events both by wide-field microscope and confocal imaging. In addition, we also describe how these two events of cell death can be quantitatively measured in high-throughput imaging method for compound screening using a dual ratio imaging. Further, simultaneous with caspase activation and mitochondrial oxidation with potential application in understanding cell death and cell survival

pathways. The real time probe with capability for simultaneous detection of the key events of cell death and cell survival possess diverse application potential in understanding cell death and cell survival signaling and drug discovery process. Preliminary results prove that, mitochondrial oxidation is an event that precedes caspase activation. The cells beyond a threshold level of oxidative stress undergo caspase activation that can be very well identified and tracked using the method described here.

09-06

#### LARVICIDAL EFFICACY AND MODE OF ACTION OF 22-HYDROXYHOPANE FROM ADIANTUM LATIFOLIUM AGAINST ORYCTES RHINOCEROS (COLEOPTERA: SCARABAEIDAE)

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**Background:** *Oryctes rhinoceros* is one of the serious pests of coconuts and other palms. Its larvae depend on microorganisms as symbionts in the digestion of lignocellulosic food. Secretion of digestive enzymes, histomorphology of gut and ecdysteroid level in haemolymph are important for normal development of the larvae. Plants synthesize different phytochemicals to resist the attack of insect pests. The present work aimed in the study of larvicidal efficacy and mode of action of 22-hydroxyhopane isolated from leaves of *Adiantum latifolium* against *O. rhinoceros*.

**Method:** Larvicidal efficacy was studied in third instar larvae of *O. rhinoceros* by feeding the larvae with cow dung mixed with the compound, antibacterial activity by Agar well diffusion method. Histological studies of midgut tissue by Haematoxylin – Eosin staining. Amylase, protease and trehalase activity by following standard protocols, 20-hydroxyecdysone level in haemolymph by ELISA.

**Result:** 22-hydroxyhopane showed significant larvicidal activity against *O. rhinoceros* (LC<sub>50</sub> value 20.81 µg/g) and antibacterial activity on gram positive and gram negative gut bacteria. It also caused histolysis of midgut tissue, inhibition of secretion of digestive enzymes such as protease, amylase and trehalase, 20-hydroxyecdysone surge, prepupation and death of larvae.

**Conclusion:** The leaves of *A. latifolium* can be used as a source of natural pesticidal compounds against *O. rhinoceros*.

**Keywords:** *Oryctes rhinoceros*, *Adiantum latifolium*, 22-hydroxyhopane, 20-hydroxyecdysone Haematoxylin – Eosin, ELISA.

09-07

#### PURIFICATION AND FRACTIONATION OF ANTHOCYANINS FROM SUSPENSION CULTURES OF OSBECKIA ASPERA L. AND OSBECKIA RETICULATA BEDD.

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Anthocyanin show many biological potentialities including their application as food colourant. The present study aims to extract, purify, and fractionate anthocyanin from *in vitro* suspension cultures of *Osbeckia aspera* and *O. reticulata* and to evaluate its biological potentialities. *In vitro* culture including cell suspension, elucidation of anthocyanin, purification, characterization and its fractionation from *Osbeckia aspera* (L.) var. *aspera* and *Osbeckia reticulata* were done. Cell suspension cultures from friable calli was carried out using different hormonal combinations, light intensity, photoperiod, temperature, pH, sucrose concentrations and chemical elicitors like jasmonate, salicylate, CuSO<sub>4</sub>, gibberellic acid and abscisic acid. High accumulation of anthocyanin was attained at 14 days on the medium fortified with 2, 4-D (0.5 mg l<sup>-1</sup>) + BA (0.5 mg l<sup>-1</sup>). 200 - 400 lux light intensity, 24 h light period, 20°C temperature, pH 4.25, 6% sucrose concentration, 200 µm jasmonic or salicylic acid for 72 h induced maximum anthocyanin i.e., 39.85 and 40.2 respectively. Extractability of anthocyanin from cell cultures with Methanol: HCl system yielded the best than isopropanol: HCl system. pH 1.0 and 2.0 with temperature up to 40°C was ideal in terms of extraction efficiency of anthocyanin among the species. UV-Vis absorption spectra of purified anthocyanins were also analyzed. The Amberlite XAD-7HP chromatography shows A<sub>vis-max</sub> at 525 nm, 527 nm, 528 nm and 529 nm respectively for *O. aspera* and that for *O. reticulata* were 524 nm, 525nm, 526 nm and 528 nm respectively. LC-MS analysis yielded the following fractions in *O. aspera* such as malvidin-3,5-diglycoside (655.2); 7,3',5-trideoxy delphinidin-3-glycoside (417.2); cyanidin (287.1);

triconityl-4-hydroxycinnamate (584.3). In the case of *O. reticulata* the fractions were triconityl-4-hydroxycinnamate, bisdeoxy delphinidin-3-glycoside and bisdeoxy cyanidin.

09-08

### DOCUMENTATION AND QR CODE ENABLED DIGITIZATION OF TREE AND GARDEN FLORA OF KANAKAKKUNNU PALACE, THIRUVANANTHAPURAM – INDIA'S FIRST DIGITAL GARDEN IN PUBLIC PLACE

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**Background:** The 21 acres of Kanakakkunnu Palace premise is a unique model of conservation of biodiversity and ecosystem management. In the present investigation both trees and garden plant species at Kanakakkunnu Palace were documented. All the documented data were digitized through website creation, QR code linking and Android App creation.

**Method:** After documentation of trees and garden plants in the Palace premise, each plant species were digitalized through a website with unique URL. After complete digitalization of the floristic data, unique QR code for each plant species was generated by linking the specific URL through online software QRstuff.com. Android App for accessing the tree and garden plant species of Kanakakkunnu Palace was developed by using Java as the programming language and XML as the database.

**Observations:** A total of 126 trees and garden plant species were documented in the Kanakakkunnu Palace premise during the study period (2016-2018). Of the 126 species documented belonging to 105 genus and distributed in 44 families. Database is created as a Blog using Google Blogger with website link - <https://asvnairflora.blogspot.com/>.

**Conclusions:** QR code for each plant was stick along with the plant label. So a person coming to Kanakakkunnu Palace can scan the QR code, using their QR code scanner through their smart phones. The QR code translate to the specific URL of website, where the person can easily access the complete data of that plant which includes the Photograph, economic importance, flowering period, geographical distribution, nativity and botanical characters. It is not possible to provide all the details in the label. In the bottom of each flora page, a download link for the Android App – ‘Golden Flora’ is also provided. Specific QR codes were also stick in the herbarium sheet. By scanning the QR code in the herbarium sheet one can see the natural pictures and all the details of dried specimen without visiting its natural habitat.

**Keywords:** Digital Garden, QR code, Android App, URL, Blog.

09-09

### IRRIGATION REQUIREMENT USING CROPWAT MODEL AND ASSESSING THE INFLUENCE OF NUTRIENT MANAGEMENT AND METHOD OF PLANTING ON CROP AND WATER PRODUCTIVITY OF AEROBIC RICE

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**Background:** Rice (*Oryza sativa* L.) is one of the most important cereal crops, about 55% of the rice area is irrigated and accounts for 75% of the total rice production in the world. Rice crop is a prime target for water conservation, because it is the widely grown crop under irrigation. Rapidly depleting water resources threaten the sustainability of the irrigated rice and hence the food security and livelihood of rice producers and consumers. Conventional rice production systems (puddled transplanting) require large quantities of water. Hence, use of aerobic rice is a new way of production system, which is specially adapted to well-drained, nonpuddled, and nonsaturated soils

**Methods:** The study quantified water requirement of aerobic rice (*Cv. Uma*) using CROPWAT model and in addition, different methods of planting and nutrient management practices were evaluated. Details are as follows: method of planting as transplanted and direct line sowing and different nutrient management regimes (viz., - T<sub>1</sub>, 125 % application of inorganic fertilizers T<sub>2</sub>, 100 % application of inorganic fertilizers and T<sub>3</sub>, 100 % application of organic manures in the field of Water Management (Agriculture) Division at CWRDM, Kunnamangalam, Kozhikode.

**Results:** The current study showed that direct line sowing performed better than the transplanted method under aerobic rice and with respect to nutrient management, 125 % of recommended dose of inorganic N fertilizers (RDIF) inorganic nutrient management produced higher yield compared to the organic manure application. Organic manure applied

treatment produced the lowest crop growth parameters. Net irrigation requirement for the aerobic rice is 380 mm for the cultivated season, whereas the same modeled using CROPWAT for anaerobic rice is 819 mm, which showed a water saving to the tune of 57 %.

**Conclusions:** To conclude, direct method of line sowing along with 125 % of recommended dose of inorganic fertilizers will result in higher crop and water productivity under aerobic rice cultivation.

**Keywords:** Aerobic rice, Productivity, CROPWAT Model.

09-10

#### EFFECT OF BISPHENOL A ON THE PROTEIN TURNOVER REGULATING ENZYMES AND PROTEIN PROFILE IN THE MALE *DROSOPHILA ANANASSAE* (DOLESCHALL)

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**Background:** Bisphenol A (BPA), major industrial chemical and an environmental estrogen, is present in various types of plastic products and has residual effect on the ecosystem. Adult males of *Drosophila ananassae* which were developed in culture with BPA at concentrations of 10, 15 and 20mg/L were tested for effects in protein profile and protein turn over regulating enzymes.

**Methods:** Estimation of total protein, SDS PAGE and assays of Cathepsin D, Leucine amino peptidase, Transaminases and Phenyl oxidase using standard protocols.

**Results:** Significant changes in protein profile and enzyme activities in the studied concentrations indicate stress response to BPA.

**Conclusion:** BPA induces stress in the males of *Drosophila ananassae* which were developed in BPA containing media. Bishenol A present in the environmental matrices is detrimental to invertebrates.

**Key words:** *Drosophila ananassae*, Bisphenol A, protein profile, Transaminases, Phenyl oxidase, Leucine amino peptidase, Cathepsin D

09-11

#### ANALYSIS OF GENETIC DIVERSITY IN *ANANAS COMOSUS* (L.) MERR HYBRIDS USING ISSR MARKER

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**Background:** Pineapple, *Ananas comosus* (L.) Merr., is a commercially demanding important tropical fruit that belongs to the family Bromeliaceae. In pineapple sexual reproduction is rare in nature due to self-sterility. Hybridization is possible due to heterozygosity and hybrids are valuable materials in breeding programmes and a wide variety of genotypes could be generated. Genetic variations are very important in crop improvement and it forms the basis of development of new varieties.

**Method:** Two pineapple hybrid plants (coded as KM 1 and KM 2) from the cross between *Ananas comosus* cv. Mauritius female (coded as M) and *Ananas comosus* cv. Kew male (coded as K) and one hybrid (coded as AK) from the cross between *Ananas comosus* cv. Kew female and *Ananas comosus* var. *bracteatus* male (coded as A) were selected for the present study. DNA isolation was done using NucleoSpin® Plant II Kit (Macherey-Nagel). The quality of the DNA isolated was checked using agarose gel electrophoresis. Nine primers were used for ISSR- PCR analysis. The PCR products were checked in 1.2% agarose gels prepared in 0.5X TBE buffer containing 0.5 µg/ml Ethidium bromide. For analysing the molecular data, strong and reproducible bands were scored. The analysis was carried out in power marker software.

**Results:** In the present study, genetic diversity among the parents and hybrids of a combination of pineapple varieties were analyzed using 9 ISSR primers. But 7 primers only produced banding patterns. Out of the 7 primers, 6 produced polymorphic bands and one primer produced a monomorphic band. In total, primers produced 33 bands, out of which 31 (94.29 %) were polymorphic and 2 (5.71%) were monomorphic. In the UPGMA tree, two principal clusters were formed. The first principal cluster consists of A, AK and KM 1. The second principle cluster contained M, K and hybrid



KM 2.

**Conclusion:** This study proves that ISSR marker is a powerful tool for the detection of genetic variability in different cultivars and hybrids of *Ananas comosus*. So the morphological similarities between hybrids and parents are proved by the molecular analysis.

**Keywords:** *Ananas comosus*, Genetic diversity, ISSR marker, UPGMA

09-12

### POLYPHENOLIC COMPOUND AND ITS FREE RADICAL SCAVENGING POTENTIALITY OF WILD AND CULTIVARS OF *IMPATIENS BALSAMINA*

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Plants are valuable sources for vast array of secondary metabolites. Among them anthocyanins are naturally occurring flavonoids and are the largest group of water soluble pigments derived from the precursor phenylalanine. These are natural colourants with immense biological potentialities. Bright color of anthocyanins ensures a natural healthy alternative to synthetic dyes. Balsam is one of the species show wide variation in terms of colour and shape of flower and are widely distributed throughout the Northern hemisphere and tropics. Tribals use the coloured floral extracts of *Impatiens balsamina* against snakebite, burn, warts, rheumatism, fractures, hair growth, constipation etc. Interestingly, the ethnic usage is not validated scientifically. Anthocyanins are proven for its nutraceutical values. Initially the anthocyanin from Balsam species was screened followed by evaluation of antioxidant potential of the promising species. Significant levels of total phenols and flavonoid content was noticed in the wild and cultivar of *I. balsamina*. Subsequently, the antioxidant potential was analysed. Remarkable scavenging potentialities were showed against metal chelating, ABTS radical, DPPH and FRAP assays and the results were comparable with the synthetic antioxidant like ascorbate and catechin. The varied potentialities of the radical scavenging by the extracts may be due to the factors like stereo selectivity of the radicals or due to the varied fractions of anthocyanin in the crude extract. Further studies are warranted to isolate and fractionate the major anthocyanins from the Balsam species.

**Keywords:** Balsam, Anthocyanin, Ascorbate, Catechin, *I. balsamina*.

09-13

### THE EFFECT OF RHEUMATOID ARTHRITIS SYNOVIAL FLUID ON THE TH17 / TREG RATIO IN A HEALTHY BLOOD SAMPLE

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**Background:** Rheumatoid Arthritis is a chronic autoimmune disorder that affects the joints and leads to their inflammation. The synovial fluid of Rheumatoid Arthritis patients contains many pro-inflammatory cytokines like IL-1 $\beta$ , IL-23, IL-15, IFN- $\gamma$ , TNF- $\alpha$  etc. The peripheral blood sample of Rheumatoid Arthritis patients was found to have disturbed Th17/Treg balance, due to the expansion of Th17 cells and Th17-related proinflammatory cytokines. Decreased frequency of Treg cells have also been observed. Th17/Treg balance is very important for a healthy immunoregulation. A disruption in this pattern can lead to the development of autoimmunity.

**Method:** Healthy blood sample was taken and cultured with 10% cell-free Rheumatoid Arthritis synovial fluid at 37°C in 5% CO<sub>2</sub> for 18 hours. Mitogen stimulation was given for 6 hours. Surface staining and intracellular staining for Th17 and Treg cells were carried out and acquired in Flow Cytometry.

**Results:** From the analysis of the plots obtained, there is a slight increase in the value for Th17 cells and a considerable decrease in the value of Treg cells from the control, signifying a notable increase in the Th17/Treg ratio. The Th17/Treg

ratio was found to be disrupted.

**Conclusions:** The increase in the percentage of Th17 cells may be due to the presence of pro-inflammatory cytokines like IL-1 $\beta$ , IL-23, IL-15, TNF- $\alpha$  etc. present in the Rheumatoid Arthritis synovial fluid. These may have caused the polarization of T cells and gave rise to an increased number of Th17 cells. This has also led to the decrease in the production of Treg cells. This implies the possible role of Th17/Treg imbalance in diseased conditions.

**Keywords:** Rheumatoid Arthritis, Synovial fluid, Th17, Treg

09-14

#### THE HISTOPATHOLOGICAL CHANGES IN THE GILL AND LIVER TISSUES OF FRESHWATER FISH, *LABEOROHITA* EXPOSED TO MALATHION: PROTECTIVE ROLE OF CURCUMIN

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Malathion is used excessively to protect crops which eventually affects the aquatic ecosystem including fishes. Malathion (O, O-dimethyl-S-1, 2-bis ethoxycarbonyl ethyl phosphorodithioate) is a non-systemic, wide-spectrum pesticide in the organophosphate chemical family and is widely used throughout the world. Curcumin, the phytochemical, has proven to be a promising dietary supplement in aquaculture. Therefore, the aim of the present study was to assess the protective role of dietary Curcumin against the histopathological effect on gill and liver of edible fish, *Labeorohita* exposed to long term (10 days) Malathion toxicity. In this study, twenty-four fish were divided into four groups of six each and placed in separate glass aquaria. The fish of group I were freshwater control, group II and III were treated with 0.4 PPM and 0.8 PPM malathion for 10 days respectively and supplemented with commercial fish feed. The group IV fish were treated with 0.8 PPM malathion and dietary curcumin (1g per gm body wt.) were simultaneously administered for 10 days. All the histopathological observation indicated that exposure to sublethal concentrations of Malathion caused destructive effect in the gill and liver tissues of *L. rohita*. However, this toxic effect was neutralised by the administration of dietary curcumin. The administration of curcumin was considered as an effective way to counter the toxicity of malathion in fish. Curcumin supplemented feed can improve the growth of fish in aquaculture

**Keywords:** Curcumin, *Labeorohita*, Malathion

09-15

#### ISOLATION AND CHARACTERIZATION OF AMENTOFLAVONE FROM TWO SPECIES OF *BIOPHYTUM* DC. (OXALIDACEAE)

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**Background:** The biflavonoid, amentoflavone is reportedly a potent bio-active compound and its presence identified earlier in the medicinally important species, *Biophytum sensitivum*. In the present study, extraction protocols were standardized for the isolation of amentoflavone from two other species of *Biophytum* viz. *B. reinwardtii* (Zucc.) Klotzsch and *B. veldkampii* Shanavas *et al.*, followed by its chemical characterization.

**Methods:** The shade-dried plant parts of the two species of *Biophytum* were Soxhlet extracted with ethyl alcohol (70%) as the solvent. Subsequently, this crude extract was used as the raw material for the isolation of amentoflavone. Column chromatography, with a gradient solvent system of chloroform, methanol and water, followed by the thin layer chromatography of the pooled fractions with a solvent combination of chloroform, acetone and methanol was adopted. High Performance Liquid Chromatography was used to confirm the isolated compound as amentoflavone. Yield, physical (solubility and melting point) and chemical properties of amentoflavone were also noted for both species. The spectroscopic techniques adopted for chemical characterization included Ultraviolet-Visible spectroscopy (UV-Vis), High Resolution Mass Spectroscopy (HRMS) and 1D Nuclear Magnetic Resonance Spectroscopy (NMR).

**Results:** The yield of amentoflavone was higher in *B. reinwardtii* (86.66mg /100g dried plant powder) than in *B. veldkampii*, (77.50 mg/100g). The crude ethyl extract was subjected to two rounds of column chromatography. Similar fractions (of *B. reinwardtii* -19 fractions and of *B. veldkampii* -17 fractions) from the first step were pooled together (five fractions each for both the species) according to the TLC profile. The 4<sup>th</sup> fraction in both, showed a clear prominent

band in TLC, which could be seen as a distinct fluorescent yellowband on the chromatogram upon a spray of 8% KOH reagent under short UV (100nm) and blackish brown colour under long UV (320nm). This zone was scrapped off and eluted with pure ethanol which on standing deposited an yellow powdery substance. Co-TLC was used to confirm the isolated compound as amentoflavone ( $R_f$  value- 0.6). In HPLC also the isolated samples showed the peak corresponding to the standard amentoflavone at the retention time (5.3 minutes). The data generated from the different spectral techniques (UV-Vis, HRMS and NMR-  $^1H$  NMR,  $^{13}C$  NMR, DEPT) corresponded well with the chemical configuration of amentoflavone in the database. Therefore it could be confirmed that the isolated pure compound from both species of *Biophytum* was amentoflavone ( $C_{30}H_{18}O_{10}$ ).

**Conclusion:** The present study is the first report on the isolation of amentoflavone from *Biophytum reinwardtii* and *B. veldkampii*. Since the amentoflavone content in the two species of *Biophytum* is high, it can be extracted in sufficient amounts and both species can be considered potential source of the compound.

**Keywords:** *Biophytum*, Amentoflavone, Column chromatography, TLC, HPLC, UV-Vis, HRMS, NMR

09-16

### GUT CONTENT ANALYSIS OF *PILA GLOBOSA* WITH DIGESTIVE ENZYMES - A COMPARATIVE STUDY

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**Background:** *Pila globosa*, the Apple snail forms one of the vital components in maintaining biodiversity of aquatic ecosystems. Many gastropods are capable of aestivation by maintaining low metabolic activities in anaerobic condition. The aim of the present work is to identify the major metabolic changes two periods of activities of *P. globosa*- dormant and active periods with special reference to gut physiology.

**Method:** The physical (Ash, Moisture, pH, Temperature) and biochemical (Protein, Lipid, Carbohydrate and Cellulose) parameters of gut contents (oesophagus, stomach, intestine and rectum) were investigated by using standard protocol and changes in dormancy and active periods were compared. Assays were performed to determine enzymes (amylase, cellulase and protease) produced by the gut regions.

**Results:** All studied enzymes (amylase, cellulase and protease) were detected on the gut regions in varying quantities in both dormant and active periods. These enzyme activities were found to enhance the process of digestion thereby causing a decrease in the gut contents from oesophagus to rectum. Aestivated snails had negligible amount of enzymes in all the gut regions than the active snails. Furthermore, the intestine showed highest quantities of enzymes than other regions of gut.

**Conclusions:** The study clearly evinced that the digestion efficiency in *P. globosa* is not only aided by the presence of rich amount of digestive enzymes but also by the various physico-chemical parameters (moisture, Ash, pH and temperature) with respect to the allied environmental conditions (dormancy and active). Moreover, the above adaptations thriving for its better performance and thereby ensure their survival under extreme environmental conditions.

**Keywords:** *Pilaglobosa*, gut contents, enzymes, physical and biochemical indices, environmental conditions, aestivation, dormancy.

09-17

### METAGENOMIC PROFILING OF MICROBIAL COMMUNITIES IN FLOOD-AFFECTED AREAS OF KUTTANAD

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**Background:** Devastated monsoon flood in Kerala during August 2018 was declared as the calamity of severe nature according to the national disaster management plan. Almost one-sixth of the total population of Kerala had been directly affected by this flood. It can affect the biogeochemical cycles, biological diversity of microorganism and their resistant gene distribution. Kuttanad is one of the worst affected areas in this flood because it lies below the sea level

and the stagnant flood water can cause serious health issues to the public health sector. Here, we initiated a metagenomics approach to analyze the taxonomic profiling and exploring the microbial diversity of sediment samples from flood-affected areas of Kuttanad. We are also interested in identifying the novel antibiotic resistant genes and their effect on public health surveillance.

**Methods:** Three sediment samples were collected per site from five flood-affected areas of Kuttanad, Kerala during August 2018. Metagenomic DNA was extracted using Power soil DNA extraction kit (MoBio Laboratories) and whole-genome metagenome sequencing by HiSeqX Illumina system.

**Results:** High-quality metagenomic DNA was extracted from sediment samples of five flood-affected areas of Kuttanad, Kerala. An equal amount of DNA from triplicate samples was pooled and taken for whole genome metagenome sequencing. We are expecting highly diverse microbial profiles and novel antibiotic-resistant genes from flood-affected areas.

**Conclusion:** Our study provides a better understanding to track the changes in microbial communities during the flood and the distribution of resistance genes in this ecosystem. This can uncover detailed information about pathogenic microbes and their epidemiological information that can benefit the public health sector.

**Keywords:** Metagenomics, Whole genome shotgun sequencing and Taxonomy.

09-18

#### A STUDY ON THE INSECTICIDAL POTENTIAL OF *ASPARAGUS RACEMOSUS* AGAINST RED PALM WEEVIL

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**Background:** In insect immunity, circulating haemocytes have a crucial role in cellular mechanism and caused reduction in total haemocyte count and much variation in their normal profile. Hemocytes play an important role in cellular immunity and identification of different types of haemocytes is important for understanding the cellular immune system in insects.

**Methodology:** The larvae were reared on sugar cane stems for three generations and select the fourth instar larvae were treated with ethanol extract of *Asparagus*, moderate mortality rate was observed and to analyze estimation of protein according to the protocol. (Lowry *et al* 1951). The hemocytes were identified by their distinguishing characters as described by Saheli (2008) and analyze the photographs. Total haemocyte count was obtained by using Neubauer hemocytometer.

**Results:** Treated with *Asparagus* ethanol extracts at concentration 8000ppm and LD<sub>50</sub> 1104.08 ppm on fourth instar larvae they showed drastic reduction in Total Haemocyte Count in the fourth instar larvae. The differential hemocyte count of *Rhynchophorus* larvae showed a sharp increase in the count of granulocytes.

**Conclusions:** The present study on *Rhynchophorus* larvae, ethanol extracts of *A. racemosus* can cause serious disturbance of the total hemocyte population and differential hemocyte counts of the identified hemocyte types as well as exhibited dangerous cytopathological effects and leads to decrease in the capacity of larval immune defense.

**Keywords:** *Asparagus racemosus*, *Rhynchophorus ferrugineus*, Hemocytes, Total Hemocyte Count, Differential Hemocyte Count.

09-19

#### PURIFICATION AND CHARACTERISATION OF AGARASE ENZYME FROM AGAROLYTIC BACTERIA ISOLATED FROM CORAL REEF ECOSYSTEMS

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Agar is a polysaccharide present in the cell walls of certain red algae. Agar-degrading bacteria may utilize agar as sole carbon and energy source and can either (i) soften the agar, forming a depression around the colonies or can (ii) cause extensive liquefaction of the agar. Agarolytic bacteria produce an enzyme *viz.*, Agarase (*agarose 4-glycanohydrolase*).

Agarases are classified as either  $\alpha$ -agarases or  $\beta$ -agarases. When secreted,  $\alpha$ -agarases yield oligosaccharides whereas  $\beta$ -agarases result in D-galactose residues. Agarases have various industrial and medical application potentials like preparation of protoplasts, isolation of monoclonal hybrids, usage in functional foods, cosmetics, extraction of DNA or RNA fragments from agarose gel. It has a greater role in disposal of agar at Plant Tissue Culture Laboratories. The present study attempted purification and characterisation of agarolytic bacteria isolated from selected coral reef ecosystems along the southern coast of India.

**Materials and Methods:** Coral samples were screened for agarolytic activity and the isolated strains were identified by biochemical and molecular characterisation. Agarolytic indices were calculated and qualitative test for agarase was performed. Enzymes were purified by dialysis and SDS-PAGE was carried out. Enzyme assay was performed to analyse the specific activity of the enzymes. Protein quantification was done. The purified enzymes were characterised to get pH - temperature optimum and the time course of reaction. Various substrates were analysed to check substrate specificity. Enzyme kinetics was studied and  $K_m$ ,  $V_{max}$  values were determined.

**Results and Conclusion:** A total of 21 bacterial strains were isolated from different coral reef ecosystems which either liquefies the agar, form pits or soften the agar. Among the 21 strains compared *Aliagarivorans marinus* and *Flammeovirga yaeyamensis* were found to be potent agarase producers. The enzyme was found to be stable at pH at 3.0 - 8.5 and optimum temperature between 20 – 35°C and 30 minutes time course. Calcium ion could increase the activity of the enzyme whereas sodium ion could inhibit its activity. Enzymes showed higher specificity to agarose than agar.

All the 21 strains showed good agarolytic activity which offers a potential source for agarase enzyme production.

**Key words:** *Aliagarivorans marinus*, *Flammeovirga yaeyamensis*, SDS-PAGE

09-20

### IN VITRO SHOOT MULTIPLICATION IN *BRUGUERA CYLINDRICA* W & A

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**Background:** *Bruguera cylindrica* W & A. (Rhizophoraceae) is an important rare mangrove plant. This plant has various medicinal properties and environmental importance. They are very important in protecting the coasts from cyclones. The mangrove plant need to be conserved so that the future generation may benefit by this plant. The main aim of the study is the mass production of the important rare mangrove plant, *Bruguera cylindrica* through micropropagation methods because the survival rate of seedlings is naturally low.

**Method:** The present work suggests protocols for the large scale multiplication through shoot multiplication. The explants were cultured on MS (Murashige and Skoog) medium fortified in different concentrations of benzyl adenine (BA) and supplemented with different combinations of hormones for shoot multiplication. Different concentrations of benzyl adenine (BA) and combination of BA and Naphthalene acetic acid (NAA), Kinetin, activated charcoal and NaCl. Encapsulation in the form of synthetic seeds is also done as part of the study.

**Results:** The seeds produced one shoot and three roots on MS medium. The seeds cultured on MS medium supplemented with 1mg/l BA AND 0.5mg/l NAA produced 1 shoot and 2 roots, 3mg/l BA along with 0.5 mg/l NAA produced 1 shoot and 1 root. The shoot tip cultured on MS medium with 2mg/L BA along with 0.5mg/l NAA produced 1 shoot. The shoot tips on 1mg/l BA and 0.5mg/l KIN produced 1 shoot and seeds on MS medium with 2mg/l BA along with 0.5mg/l KIN produced 2 shoots. The seeds on 2mg/l BA and 500mg/l charcoal produced one shoot and seeds on 3mg/l BA with 500mg/l charcoal produced two shoots. The shoots on 2mg/l BA and 500mg/l activated charcoal produced one shoot. Seeds on MS medium with 4mg/l BA along with 500mg/l NaCl produced 2 shoots and 3 roots and shoot tips on medium with 4mg/l BA with 500mg/l NaCl produced one shoot. Shoot tip produced one shoot on MS medium supplemented with 500mg/l activated charcoal along with 500mg/l NaCl and seeds produced 3 shoots and 6 roots.

**Conclusion:** Tissue culture protocols were standardized for micropropagation of *Bruguiera cylindrica* W & A. Rapid clonal multiplication was achieved via nodal segment culture, shoot tip culture and seed culture.

**Keywords:** Micropropagation, *Bruguiera cylindrica* W & A, Murashige and Skoog (MS) medium, Encapsulation, Activated charcoal, NAA, BA, kinetin.

09-21

### BACTERIAL ISOLATION, HYDROLYTIC ENZYMES PRODUCTION AND ITS RELATION TO ORGANIC MATTER OF MANGROVE SEDIMENTS FROM NORTHERN KERALA

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**Background:** Mangroves are specialised wetland forest found in intertidal zone of estuaries. It is considered as the most productive and economically significant ecosystem in the world. Bacteria is an integral part of mangrove ecosystem, which help to transformation and recycling of different nutrients. Most of the mangrove bacteria are able to produce the hydrolytic enzymes. The extracellular hydrolytic enzymes are widely used in industrial and biodegradation process. Researchers are seeking new bacterial strains to make different enzymes to complete the current enzyme requirements. The organic matter of sediments can influence the bacterial population and hydrolytic enzyme activities.

**Method:** Sediments were collected from Kadalundi, Edaat-Thuruthi, Pazhangadi, Valapattanam, and Kasaragode. For the isolation of bacteria, 10g sediments diluted into 30ml distilled water and serial dilution was done. 100µl dilution spread on to the Nutrient Agar medium. Plates were incubated at 30°C for 24 hrs. Bacteria were screened for the various hydrolytic enzymes such as Protease, Amylase, Lipase, Chitinase, Cellulase, Pectinase and Ligninase. Among the Protease, Amylase, Lipase and Chitinase producing bacteria were performed on Nutrient Agar medium supplemented with casein (2%), starch (1%), tributyrin (1%) and colloidal chitin (5%) respectively. As well as, CMC agar (cmc 1%), Pectin agar (Pectin 0.5%), Crawford's agar with 0.5% tannic acid were used for the detection of Cellulase, Pectinase, and Ligninase enzymes respectively. The pure cultures were inoculated on plates and incubate at 30°C for 24-48 hrs. Until the incubation hydrolytic zone was noted. The determination of organic matter used by Walkely-Black method.

**Result:** Total 57 bacterial isolates were isolated from the mangrove sediment samples. Most of the bacterial isolates produced protease (78.57%), cellulase (71.42%), amylase (50%) and lipase (44.64%). While some of the isolates produced ligninase (7.14%). Chitinase and pectinase enzymes were not observed. Organic matter of sediments founded as 2.057% to 4.063%.

**Conclusion:** This study revealed that mangrove bacteria is one of the potential sources for high yield of extracellular hydrolytic enzyme production.

**Keywords:** Mangroves, Extracellular Hydrolytic Enzymes, Organic matter, Bacteria.

09-22

### EFFECT OF ANTI-ETHYLENE COMPOUNDS ON HYPERHYDRICITY REVERSION AND MULTIPLICATION IN *DIANTHUS CHINENSIS* L.

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**Background:** Hyperhydricity (HH) is a physiological disorder in water imbalance frequently occurs during the tissue culture based propagation especially after 3-4 subcultures. The formation of glassy shoots of HH cultures were noticed in *D. chinensis* cultures and the syndrome adversely affected *in vitro* production of this highly demanded ornamental species. Reversion of HH shoot to normal plantlets through various *in vitro* experiments will improve production of plants thus able to meet the market demand of this ornamental species.

**Method:** This work explores *in vitro* HH reversion experiments in Murashige and Skoog (MS) medium along with various concentrations of plant growth regulators and anti-ethylene compounds (AgNO<sub>3</sub> and CoCl<sub>2</sub>). The effect of ethylene on HH induction were analyzed by using different concentration of ethyphon on MS medium. The HH reversion was conformed through estimation of relative water content, stomatal bioassay, H<sub>2</sub>O<sub>2</sub> and chlorophyll content. Genetic stability of *in vitro* reverted plants were analyzed by using 10 RAPD primers.

**Results:** These findings demonstrated that the induction of HH is triggered by the excessive water accumulation of ethylene action. The hyperhydric nodal segments were cultured on MS medium containing 2.5µM BA, anti-ethylene compounds AgNO<sub>3</sub> (10µM) and CoCl<sub>2</sub> (5µM) showed complete HH reversion and produced normal microshoots (55.0) with reduced RWC (78.3%). The heavy metal ions thus regulate the ethylene biosynthesis and thereby 50% reductions

in H<sub>2</sub>O<sub>2</sub> content characterized by formation of green healthy shoots with proper stomatal morphology. *In vitro* raised shoots were rooted (93.3%) *ex vitro* by 10mM IBA treatment and 92.2% plants were survived. Further, the genetic stability analyzed by using 10 RAPD primers proved plants produced through this method are clonally uniform. Therefore efficient protocol for multiplication of *D. chinensis* using combination of heavy metal salts was established.

**Conclusions:** Outcome of the study provide new insights in to development of hyperhydricity in the *in vitro* cultures, its avoidance and reversal procedures thus contributes improvement of *in vitro* morphogenesis to wide plant groups and in particular to *D. chinensis*.

09-23

#### ROS DEPENDENT ENZYMATIC AND NON-ENZYMATIC ACTIVITIES DURING FLORAL MORPHOGENESIS IN *COCCINIA GRANDIS* (L.) VOIGT (CUCURBITACEAE)

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**Background:** The morphogenesis of flower is controlled by various internal and external factors. Formation of reproductive structures from florally determined meristem will lead to the changes in biochemistry, physiology and morphology. Reactive oxygen species (ROS) have dual role in plants, both as key regulators of growth, development, and defense pathways and as toxic by-products of aerobic metabolism. The enzymatic and non-enzymatic antioxidants have developed to detoxify ROS and prevent the formation of highly reactive and damaging radicals.

**Method:** The present study dealt with the formation of ROS depended antioxidant during the morphogenesis of the flower in *C. grandis*, a dioecious species belongs to the family Cucurbitaceae using biochemical methods.

**Results:** In the *C. grandis*, male and female plants have different developmental rates and have differed in their biochemical performance during floral morphogenesis. The protein and antioxidant enzymes (SOD, CAT, POD, APOX, GR, MDHAR, DHAR) activities were varied during the development in both the sexes.

**Conclusion:** The study noticed that the ROS dependent enzymatic production in *C. grandis* is specific to each developmental stage and that may be due to the changes in physiological activities such as defense mechanism, metabolism and complex signaling pathways that are involved during floral development.

**Keywords:** *C. grandis*, flower development, ROS, antioxidant activity.

09-24

#### DROUGHT STRESS INDUCED CHANGES IN METABOLITE PRODUCTION AND ANTIOXIDANT ENZYME ACTIVITY IN *MOMORDICA CHARANTIA*

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Drought is one of the major environmental factors that reduce the production of yield and growth of many crops. *Momordica charantia*, a vegetable crop belonging to the family Cucurbitaceae, is an annual monoecious with two varieties viz *M. charantia* var *charantia* and *M. charantia* var. *muricata*. The present investigation was carried out to study the effect of drought stress on the production of metabolites (carbohydrate, protein, proline) and antioxidant activity (peroxidase (POX), catalase (CAT), ascorbic acid oxidase (AAO), and guicol peroxidase (GPX)) on the leaves of wild and cultivated varieties of *M. charantia* under controlled conditions. The experiments were conducted in the controlled and treated plants, grew in polythene bags containing garden soil, sand and cow dung (2:1:1). The experimental groups were subjected to water stress by withholding irrigation and control plants were irrigated regularly. The wild plants have more anti oxidant activity than the cultivated one. The study emphasized that wild varieties of *M. charantia* have more potential to drought tolerance than that of cultivated varieties.

**Keywords:** Peroxidase (POX), Catalase (CAT), Ascorbic acid oxidase (AAO), Guaicol peroxidase (POD), Ascorbate peroxidase (APX)

09-25

### TWO NEW RECORDS OF BROWN ROT POLYPORES (AGARICOMYCETES, BASIDIOMYCOTA) FROM INDIA

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**Background:** Polypores are a specialized group of wood inhabiting fungi. They are considered as one of the major wood decomposers, and play important role in nutrient cycling. They are economically and ecologically important. As part of continuing studies on polyporoid fungi of Kerala state, many poroid species were encountered from various localities on various occasions. On detailed macroscopic and microscopic studies and identification using available literature, two brown rot polypores were found as new records to India.

**Methods:** Fruit bodies were collected from dead woods of forest areas in Kerala, India, during the monsoon seasons of years 2015-2017. Macroscopic and microscopic characterization was done. Systematic position is given as per the Index Fungorum (www.speciesfungorum.org).

**Results:** On detailed study and identification using available literature, two of the collected specimens viz *Postia floriformis* (Quél.) Jülich and *Rubellofomes cystidiatus* (B.K. Cui & M.L. Han) B.K. Cui, M.L. Han & Y.C. Dai were found as new records to India. Both these species are brown rot causing fungi, belonging to the family Fomitopsidaceae of the order Polyporales.

**Conclusion:** Both *Postia floriformis* and *Rubellofomes cystidiatus* are economically important since they are capable of causing brown rot disease on the trees/wood they attack. *Rubellofomes cystidiatus* was reported from South China (as *Fomitopsis cystidiata* B.K. Cui & M.L. Han) by Han *et al.* (2014). Since then, there are no reports of this species from other parts of the world. So, this is the first report of the species from a country outside China, and also a new genus record for India. The two new species records are also an addition to the floristic account of polypores of Kerala.

**Keywords:** Brown rot- India- Kerala- polypores - *Postia*- *Rubellofomes*- white rot

09-26

### BIOCHEMICAL ANALYSIS AND *IN SITU* LOCALIZATION OF REACTIVE OXYGEN SPECIES IN MULBERRY GENOTYPES

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**Background:** Mulberry (*Morus spp.*) is a deciduous woody tree and which has great economic significance in sericulture as its leaf is used for feeding the monophagous silkworm (*Bombyx mori* L.). Leaf nutritional quality directly influences the growth and development of silkworm. Abiotic stress such as drought, temperature, salinity/alkalinity of soil etc. reduces the leaf yield in mulberry and it negatively influences the plant growth by altering the developmental, structural and physio-biochemical processes. The primary effects of abiotic stress is ion imbalance and hyper osmotic stresses, which leads to a cascade of the molecular network which in turn activates stress responsive mechanisms to re-establish homeostasis and to protect and repair damaged proteins and membranes. Under normal conditions, the production and destruction of reactive oxygen species is well regulated in plant cells. In abiotic stress conditions, balance between the production of reactive oxygen species (ROS) and the quenching activity of the antioxidant system is upset, and this leads to injury to the plants through oxidative damage. On this background, the present study is mainly focused on the biochemical analysis and in situ localization of reactive oxygen species: superoxide radicals (SOR) and hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) in few selected mulberry genotypes recommended for irrigated conditions (V1), rain fed areas (S13, Mysore local & K2), resource constraint conditions (RC1 & RC2), shade tolerance (Sahana) and soil moisture stress conditions (MSG2 & AGB8) under optimal input conditions. Accumulation of ROS in leaves were correlated with the activity of ROS scavenging enzymes for evaluating the antioxidant responses of these genotypes.

**Method:** Biochemical analysis of ROS scavenging enzymes (superoxide dismutase & peroxidase) and estimation of hydrogen peroxide were carried out in selected mulberry genotypes using standard procedures. Nitroblue tetrazolium (NBT) staining method was used to detect the in situ production of superoxide radicals in leaves and accumulation of



H<sub>2</sub>O<sub>2</sub> was localized with KI/starch reagent. Photographs were captured using a camera installed with Euromex, Image Focus 4.0, version 329271.

**Results:** The hydrogen peroxide content varied among genotypes and it ranged from 358.84 to 916.84 µmol/g. The highest amount of H<sub>2</sub>O<sub>2</sub> was found in Mysore Local (916.84 µmol/g) and RC2 (834.78 µmol/g). Quantity of H<sub>2</sub>O<sub>2</sub> accumulated in leaves can be correlated with peroxidase (POX) enzyme activity and least POX activity was observed in all of these varieties. The histochemical localization of hydrogen peroxide in leaves indicated that the maximum amount of H<sub>2</sub>O<sub>2</sub> was observed in Mysore Local and RC2. Almost similar amounts of H<sub>2</sub>O<sub>2</sub> were localized in V1 and K2. Least accumulation of H<sub>2</sub>O<sub>2</sub> was observed in MSG2, S13, and RC1 and all these varieties recorded high POX activity. Varieties with high POX activity efficiently scavenge H<sub>2</sub>O<sub>2</sub> and therefore their accumulation is comparatively low in leaves. This was confirmed in the present study by the in situ localization of ROS.

The maximum amount of SOR was localized as dark blue deposits in K2; whereas minimum SOR were observed in RC1, RC2, MSG2 and AGB8. High SOD activity was recorded in RC1, RC2 and MSG2 and this can be positively correlated with the least accumulation of SOR in leaves.

**Conclusions:** Present study reported the least accumulation of reactive oxygen species and relatively high activity of antioxidant enzymes in stress tolerant varieties such as RC1, MSG2, S13 & RC2. In situ localization ROS in leaves also confirmed comparatively low accumulation of H<sub>2</sub>O<sub>2</sub> and superoxide radicals in these varieties.

**Keywords:** Mulberry, reactive oxygen species, in situ localization, hydrogen peroxide, superoxide radicals

09-27

**FIRST RECORD OF THE HALOPHILIC FUNGUS, *PENICILLIOPSIS CLAVARIIFORMIS*  
SOLMS (EUROTIOMYCETES, ASCOMYCOTA) ON *DIOSPYROS PANICULATA* DALZ.  
FROM INDIA**

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**Background:** *Diospyros paniculata* Dalz. is a gum secreting plant belonging to family Ebenaceae (Dhongade and Masram 2012), commonly called as panicle-flowered ebony. It is a moderately sized tree reaching 15 meters height and 1.2 meters diameter. According to Dhongade and Masram (2012), gum of the *D. paniculata* shows antifertility effect. Most parts of the tree have potential medicinal value and has been utilized in folk medicine to treat several ailments like blood poisoning, rheumatism and ulcer (Sinha *et al.* 2009). At present, the population size of *Diospyros paniculata* is decreasing due to habitat loss, habitat disintegration and uncontrolled exploitation for medicine (Vedet *et al.* 2015). Vedet *et al.* (2015) has listed the species as vulnerable in the IUCN Red List of Threatened species 2015.

During our studies on fungi in a sacred grove in Kerala, an interesting fungal fruit body was encountered on the fruits and seeds of *Diospyros paniculata*. The taxonomic identity of this fungus producing the fruit body was investigated using morphological and molecular data and is being presented.

**Methods:** Fruit bodies were collected from the fruits and seeds of *Diospyros paniculata* from the sacred grove, Thurayil Kavu Bhagavathy Temple, Kerala, India, during August 2018. Morphological and molecular characterizations were done. Macroscopic and microscopic anatomical features were recorded. Light microscopic observations were made on materials stained using aqueous solutions of 3% phloxine and 1% Congo red and mounted in 5% aqueous KOH. Molecular characterization was done by sequencing the nrITS gene region.

**Results:** The fungus was identified as *Penicillium clavariiformis* Solms (Eurotiomycetes, Ascomycota) based on morphological and molecular data.

**Conclusions:** *Penicillium clavariiformis* was first described from Indonesia by Solms-Laubach (1887) on the seeds of *Diospyros macrophylla*. The species reproduce sexually by forming globose perithecia and asexually by forming conidiomata in their natural habitat (Oxford and Raistrick 1940). Douanla and Langer (2007) reported this fungus from West Africa on the seeds of *Diospyros crassiflora*. In India, this species was first isolated as a salt tolerant fungus from mangroves by Kashyap *et al.* (2016). As per the available reports, this fungus fruits specifically on *Diospyros* species and has not been reported from any other plant so far. The present study reveals the first record of this fungus on *Diospyros paniculata*. The species record is an addition to the mycobiota of Kerala.

**Keywords:** Ascomycota, *Diospyros paniculata*, halophilic, *Penicillium clavariiformis*

09-28

### PURIFICATION, FRACTIONATION OF TERPENOIDS FROM *HYPNEA MUSCIFORMIS* BY GC-MS AND ANALYSIS OF ITS ANTIOXIDANT AND ANTI-INFLAMMATORY POTENTIALITIES

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**Background:** Marine macroalgae produce a diverse array of secondary metabolites such as terpenes, sterols, polyphenols, acetogenins and others which were characterized by a broad spectrum of biological activities. The terpenes composition from the red algae *Hypneamusciformis* was identified. The analysis of the purified fraction revealed the presence of 8 major peaks of terpenoids. The purified terpenoid fraction has exhibited significant *in vitro* antioxidant and anti-inflammatory activity.

**Method:** Fractionation of the crude methanolic algal extract was done by silica gel Column chromatography. The eluted fractions were then subjected to TLC and further analysed by GC-MS. The *in vitro* antioxidant activity was evaluated in terms of 1,1-diphenyl-2-picrylhydrazyl (DPPH), 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulphonic acid) (ABTS), ferric reducing antioxidant power (FRAP) assays. Anti-inflammatory activity of the purified terpenoid fraction was determined by Cyclooxygenase (COX) activity and Lipoxygenase (5-LOX) activity.

**Results:** The methanolic extract of *Hypneamusciformis* was purified by column chromatography. Each fraction was eluted using petroleum ether and ethyl acetate (95:5) as solvent combinations. The analysis of the purified fraction revealed the presence of 8 major peaks of terpenoids compatible with their fragmentation patterns as detected by using GC-MS spectra technique. Parallely, the fractions were subjected to thin layer chromatography for confirming the presence of terpenoids. Purified terpenoids were subjected to evaluate the antioxidant power using various methods. The purified fraction exhibited a dose dependent inhibition of DPPH radicals. The ABTS radical cation-scavenging assay showed that the antioxidant activity increases with an increase in the concentration of terpenoids. The ferric reducing power was found to be higher in terpenoid extract. Further, the anti-inflammatory potential of the purified terpenoid of *H. musciformis* was carried by *in vitro* cyclooxygenase and lipoxygenase inhibitory assays. Purified terpenoid extract tested inhibited LOX in a concentration dependent manner. The IC<sub>50</sub> value was 89.87 µg/mL. Similarly, the extract displayed COX-2 inhibition in a dose dependent pattern inhibiting 58.5% at 100 µg of extract.

**Conclusion:** The red algae *Hypneamusciformis* was known for their nutraceutical potentials. The purified fraction of terpenes isolated from this sea weed act as a potential antioxidant and anti-inflammatory agents. This study demonstrated the candidacy of red seaweeds particularly, *H. musciformis* for use as functional food supplements to scavenge free radicals and to deter inflammation. The pharmaceutical significance of terpenoids should be further analysed.

**Keywords:** Terpenoids, Gas Chromatography- Mass Spectrum, Column Chromatography, Antioxidant, Anti-inflammatory activity.

09-29

### IN VITRO EVALUATION OF ANTI-INFLAMMATORY EFFECTS OF VARANADI KASHAYAM, A POLY HERBAL DECOCTION IN THP-1 DERIVED MACROPHAGES

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**Background:** Varanadi kashayam is an Ayurvedic poly herbal decoction contains 16 plants, for which the mechanisms of action involved in controlling chronic inflammatory conditions has not been evaluated. The use of traditional herbal medicines became a matter of interest in the prevention of inflammation and related disorders due to its natural origin, and fewer side effects. Inhibition of release of pro inflammatory cytokines TNF- $\alpha$  and IL-1 $\beta$  by lipopolysaccharide stimulated monocytes/macrophages are ideal *in vitro* models for identifying anti-inflammatory molecules.

**Aim:** The present study was aimed to determine the effect of Varanadi kashayam on inflammatory responses. Human THP-1 cells were differentiated to macrophages using PMA was used as *in vitro* cell model.

**Method:** The efficacy of Varanadi kashayam on monocyte cell differentiation was determined by quantitative polymerase chain reaction to assess the expression of differentiation markers MMP-9, CD36, CD11b and CD14. Further Varanadi kashayam treated THP-1 macrophages were induced with Lipopolysaccharide and the production of pro

inflammatory cytokines TNF- $\alpha$  and IL-1 $\beta$  were measured and corresponding genes expressions were quantified.

**Statistical analysis:** Significance difference among control and sample treated groups were determined by one-way analysis of variance (ANOVA) and the Dunnett's multiple comparison test. A P value of less than 0.05 was considered to be statistically significant.

**Results:** The result indicates that Varanadi kashayam reduced the differentiation of THP-1 monocytes to macrophages and down regulated the expression of cell surface markers. Further, it could decrease the release of pro inflammatory cytokines from lipopolysaccharide induced THP-1 macrophages and down regulated the expression of TNF- $\alpha$  and IL-1 $\beta$  genes.

**Conclusions:** The results obtained from this study suggests a possible mechanism of action of the herbal decoction in inflammatory processes and opens up the possibilities of identifying bioactive lead molecules with anti-inflammatory potentials.

**Keywords:** Ayurveda, Differentiation, Inflammation, Interleukin-1 $\beta$ , THP-1, Tumour necrosis factor- $\alpha$ , Varanadi kashayam

09-30

### MOLECULAR DETECTION OF PATHOGENIC BACTERIA *PROTEUS MIRABILIS* CONTAMINATION IN CHICKEN MEAT

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**Background:** *Proteus* bacteria species is one of the causes of serious infections in humans, along with *Escherichia*, *Klebsiella*, *Enterobacter* and *Serratia* species. These bacteria are generally known as human opportunistic pathogens, isolated from urine, wounds, and other clinical samples. *Proteus mirabilis* has been suggested as a possible causative agent of outbreaks of gastroenteritis, resulting from the consumption of contaminated food. In such a situation the study on *P. mirabilis* in chicken meat in selected districts of Kerala, India, leads to know the extent of *P. mirabilis* contamination of chicken meat in the study area.

**Methods:** 50 Samples of raw chicken meat were collected from slaughterhouses and meat shops in the study area by simple random sampling method. Bacteriological analysis was carried out on sample by rappaport-vassiliadis broth and hektoen enteric agar. After incubation, black colonies appeared on plates selected, drew out for further confirmation by PCR analysis. After incubation, black colonies appeared on plates selected, drew out for further confirmation by PCR analysis.

**Results:** 50 samples were studied and 2 samples were contaminated by *Proteus mirabilis*. It was successfully amplified using PCR and the product was sequenced using Sanger's method. Then the trimmed forward and reverse sequences were assembled by using Clustal Omega and consensus sequence was taken for analysis. The nucleotide BLAST programme analyzed for the construction of phylogenetic tree using MEGA software.

**Conclusion:** This study shows valuable information about the *P. mirabilis* contamination in chicken meat. The health of individuals is at risk so maintaining a proper hygienic environment is an important step to avoid *P. mirabilis* related health hazards in the consumers or spreading to other birds. Microbial control in each and every stage of chicken production can control an outbreak of food poisoning and reduce the pathogenicity of *P. mirabilis*.

**Keywords:** *Proteus mirabilis*, chicken meat, human pathogen, molecular analysis.

09-31

### BISPHENOL A, A PLASTIC RESIDUE OF THE ECOSYSTEM INTENSIFIES MOSQUITO MENACE BY SHORTENING THE LIFE CYCLE SPAN

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**Background:** Bisphenol A (BPA) is a pseudo-persistent chemical, which despite its short half-life is ubiquitous in the environment because of continuous release. Typical mosquito breeding sites including that of *Culex quinquefasciatus* are polluted waters rich in organic matter and plastic wastes.

**Method:** GCMS analysis of mosquito breeding sites to detect ecologically relevant concentration of BPA was done.

This was followed by elucidating the action of selected doses of BPA such as 1, 2 and 4 ppm on span of life cycle, protein turnover (activity of selected enzymes as well as MALDI TOF analysis of protein bands), levels of 20-Hydroxyecdysone(20-E) and gene expression of Ecdysone receptor, EcRA and regulated gene, E75A in *Culex* larvae.

**Results:** BPA exposure resulted in shortening of life cycle of *C. quinquefasciatus* by 2 and half days in BPA reared larvae. Early peaking of 20-E was found in BPA reared larvae. Activity of enzymes such as cathepsin D and phenol oxidase were elevated with increased expression of a putative uncharacterized protein and phospholipase A2-associated protein in 5ppm treated larvae. Upregulation of EcRA and E75A was also observed.

**Conclusions:** The present investigation proved that exposure of Bisphenol A caused 24% reduction in the length of *Culex* life cycle through shift in protein turnover, novel protein synthesis and early peaking of moulting hormone levels, and upregulation of genes acted upon by Ecdysone.

**Keywords:** *Culex quinquefasciatus*, protein turn over, MALDI TOF, 20-Hydroxyecdysone.

09-32

### COMPARISON OF THE EXPRESSION PROFILE OF mRNA FROM YOUNG AND MATURE LEAVES OF *TECTONA GRANDIS* L F. BY DDRT ANALYSIS

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**Background:** In plant molecular research, transcriptome analysis is one of the major ways for analyzing the differential gene expression because the gene activities are primarily regulated at its transcriptional level. DDRT-PCR is one of the tools that are used by researchers to compare and identify changes in gene expression at mRNA level between two or more cell samples.

**Method:** The present study includes the standardization of RNA isolation from the tender and matured leaves of teak by various methods followed by DDRT-PCR to pinpoint the differential expression profile of the transcript and their sequencing.

**Results:** Remarkable secondary metabolites like polyphenols in the leaves influenced the yield and quality of RNA. Modified GTC method purified the RNA and yielded good quality. DDRT-PCR amplified products were resolved on 1% agarose gel containing ethidium bromide. DNA was extracted from eight differentially expressed bands. The sequencing and BLAST search analysis indicated that 4 of the differentially expressed genes matched the previously characterized genes, while 3 of them matched the uncharacterized sequences as expressed sequence tags (ESTs).

**Conclusion:** The modified GTC method for RNA isolation provided effective against the interference of secondary metabolites of teak. The transcript profile of young and matured leaf showed significant variations and were further sequenced.

**Keywords:** *Tectona grandis*, RNA, GTC, PVP, RT-PCR, DDRT

09-33

### ANATOMICAL STUDIES OF TWO *CALOTROPIS* L. (APOCYNACEAE) SPECIES

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**Background:** The common name 'vellerukku' is applied to two species of *Calotropis* L. viz., white-flowered *Calotropis gigantea* (L.) R. Br. and *C. procera* (Aiton) R. Br. among Siddha and Ayurveda practitioners in Tamil Nadu and Kerala. The reason is that Gamble and Fischer (1921) included these two species in the 'Flora of the Presidency of Madras'. Hence, people in these States thought that the white-flowered *C. gigantea* is *C. procera* and thus several works related to pharmacognosy and pharmacology were carried out with white-flowered *C. gigantea* but published in the name *C. procera*. Abdul Kader and Chellakumar (2015) have studied the distribution of different *Calotropis* L. species in Tamil Nadu and Kerala, and they reported only *C. gigantea* in Tamil Nadu and Kerala. Since anatomical characters have been used as an additional data to solve the identification of several doubtful and closely related species, we have undertaken the present study at Presidency College, Chennai during 2015.

**Methods:** Specimens of *C. gigantea* (L.) R. Br. (both white- and purple-flowered) were collected from Chennai and *C. procera* (Aiton) Aiton f. ssp. *hamiltonii* (Wight) Ali from Ahmadabad, in Gujarat during 2013-2014. Leaf and stem anatomy were studied using Rotary Microtome as per standard procedures (Sass, 1940; Johansen, 1940; O'Brien *et al.*, 1964; Esau, 1964). Toluidine blue stain was used. Photographs of different magnifications were taken with Nikon labphoto 2 microscopic Unit.

**Results:** There were clear anatomical differences between all the three *Calotropis* L. specimens studied. *C. procera* (Aiton) Aiton f. ssp. *hamiltonii* (Wight) Ali. contains more laticifers indicating the presence of more latex in the plant body than white-flowered *C. gigantea* (L.) R. Br. Further, these two species differs in other anatomical characters such as (i) shape of midrib and vascular strand, (ii) structure of lamina epidermises, (iii) palisade thickness, (iv) and vascular anatomy of stem which are very significant in distinguishing white-flowered *C. gigantea* (L.) R. Br. from *C. procera* (Aiton) Aiton f. ssp. *hamiltonii* (Wight) Ali.

**Conclusions:** Since the Siddha system of medicine is originated and widely practiced in Tamil Nadu and less in some parts of Kerala, and the absence of *C. procera* (Aiton) Aiton f. ssp. *hamiltonii* (Wight) Ali in these regions, we conclude that the local name **vellerukku** used by people in Tamil Nadu and Kerala pertains to the white-flowered *C. gigantea* which is sacred to Hindus.

**Keywords:** *Calotropis gigantea* (purple- or lilac-flowered), *C. gigantea* (white-flowered), *C. procera* ssp. *hamiltonii*, vellerukku, anatomy

09-34

#### COMPARATIVE STUDY ON ANTIOXIDANT AND ANTIMICROBIAL ACTIVITY OF ESSENTIAL OIL FROM *POGOSTEMON BENGHALENSIS* (BURM.F.) KUNTZE. AND *P. CABLIN* (BLANCO) BENTH

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**Background:** Western Ghats are one of the rich sources of medicinal and aromatic plants and the natural products from those plants such as essential oils (Eos) possess various biological properties. Essential oils (Eos) are proven to be the potential source of anticancer, antimicrobial and antioxidant activities.

**Method:** The hydrodistillation product of both plant species of *Pogostemon benghalensis* and *P. cablin* were subjected GC-FID and GC-MS analysis to identify the volatiles present. The Eos were subjected to different antioxidant analysis to prove the free radical scavenging activity. Also the microbicidal property of the Eos were analysed by standard protocol.

**Result:** The GC-MS analysis of Eos from *Pogostemon benghalensis* and *P. cablin* identified 41 and 36 volatiles respectively. The Eos showed significant scavenging effect on different free radical assay and were at par with artificial antioxidant BHT and ascorbic acid. Further the antimicrobial activity against selected bacterial and fungal strains were substantiated with significant MIC and MKC values. Percentage leakage of reducing sugars and potassium from the microorganism in turn supports the microbicidal activity of Eos.

**Conclusion:** In this study Eos from the *Pogostemon* species were proven to be natural antioxidants. Also the microbicidal activity of these oils provides scope to develop novel drugs.

**Keywords:** *Pogostemon*, Essential oil, GC-MS, BHT, MIC, Antioxidant

09-35

#### CONNECTOME REGULATES ODOR ADAPTATION AT DIFFERENT THRESHOLDS IN *CAENORHABDITIS ELEGANS*

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**Background:** Olfactory perception occurs through converting the information residing in the form of a molecular structure into a characteristic odor quality and intensity. This perception of an odorant can also differ with a change in its concentration. To understand the logic of olfactory information processing, one has to first appreciate the coding rules generated at each level, from odorant receptor present in sensory neuron up to the level of motor neurons.

**Method:** To analyze the mechanisms of sensory recognition and discrimination by the nervous system, we are using the model *Caenorhabditis elegans*. In *C. elegans*, sensory neurons AWC and AWA mediate attractive behavior whereas AWB, ASH and ADL are involved in repulsive behavior on odorants. The question is how the neurons alter their response for the recognition of gradient in odour concentration. Here we tested the behavior of *C. elegans* towards different volatile odorants isoamyl alcohol, butanone and benzaldehyde with their attractive and repulsive concentrations.

**Results:** GLR-1 is expressed in motorneurons and interneurons, including four of the five pairs of command interneurons that are required for locomotory control, found to have a role in sensing the gradient of odors. Moreover, food associated learning of *C. elegans* with a particular solvent of a low concentration showed an adaptation but the same became repulsive at higher concentration. Our results indicate that the interneuron AIY has a mediatory role in sensing changes in odorant concentrations. Especially sra-11 null mutations, an odor receptor present in AIY interneuron, result in the loss of detection of differences in odor concentration.

**Conclusion:** These results suggest that there is a downstream pathway involving AIY interneuron, apart from AWC, in odor gradient detection.

**Key words:** sra-11, Glr-1, ASH neuron, *Caenorhabditis elegans*

09-36

### MOLECULAR CHARACTERIZATION OF HISTONE H2A - DERIVED ANTIMICROBIAL PEPTIDE, HIPPOSIN FROM INDIAN MAJOR CARP *CATLA CATLA*

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**Background:** Antimicrobial cationic peptides are prevalent throughout nature as part of the intrinsic defenses of organisms, and have been proposed as a blueprint for the design of novel antimicrobial agents. Present study was carried out to identify histone derived antimicrobial peptide from *Catla catla* as part of their innate immunity.

**Method:** Total RNA was isolated from gills using TRI<sup>®</sup> reagent (Sigma) following manufacturer's protocol. First-strand cDNA was generated. PCR amplification of the cDNA was done using Hipposin primer with 60°C as annealing temperature. PCR products were cloned into pGEMT EasyVector, and transformed into DH5 alpha *E. coli* competent cells. Positive recombinant clones were selected for plasmid isolation. Recombinant plasmids were sequenced.

**Results:** Histone H2A-derived peptide, Hipposin from *Catla catla* consisted of a 249bp nucleotide sequence, encoding 81 amino acids, which showed 80% similarity to the histone derived peptide of *Cyprinus carpio*. ExpPAS analysis revealed the presence active peptide sequence of 52 amino acids. The mature peptide of histone derived peptide had a predicted molecular weight of 5.52kDa with +12 charge.

**Conclusions:** The present study describes the isolation and characterization of a new N-terminally acetylated AMP, which is found in *Catla catla*. High similarity of Catla Histone H2A-derived peptide to other histone H2A derived AMPs with proven antimicrobial activity and its physicochemical properties in agreement with those of traditional antimicrobial peptides strongly endorse it to be an antimicrobial peptide.

**Keywords:** Innate immunity; Antimicrobial peptide; Histone H2A; Hipposin, *Catla catla*

09-37

### ANTIBACTERIAL ACTIVITY OF THE ENDOPHYTIC FUNGI FROM THE MANGROVE PLANT, *AEGICERAS CORNICULATUM*

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**Background:** Endophytic fungi are a group of microorganisms which inhabits in the internal tissue of all healthy plants. They do not cause any symptoms of disease in the host cell. These endophytic fungi are the rich source of unique and diverse natural compounds with various biological activities.

**Method:** Endophytic fungi were isolated from the mangrove, *Aegiceras corniculatum* collected from Kollam and Kannur. Healthy leaves and stems of the plants were collected, surface sterilized, cut into small segments and placed on Potato Dextrose Agar (PDA) for 2-3 weeks for the isolation of endophytic fungi. The fungal isolates obtained from the plant tissues were screened for antibacterial activity against selected pathogens by Kirby Bauer disc diffusion method.

**Result:** A total of 40 endophytic fungal isolates were obtained from the tissues of *A. corniculatum* and a preliminary antibacterial screening was performed. Two out of the 40 fungal isolates showed remarkable antibacterial activity against selected pathogens. The endophytic fungal isolates AC 10 and AC 19 inhibited bacterial pathogens viz., *Vibrio cholera*, *Vibrio vulnificus*, and *Bacillus cereus*. The fungus AC 10 showed antibacterial activity against *Vibrio alginolyticus* and *Vibrio parahaemolyticus* also.

**Conclusion:** The study indicated that the mangrove plant *A. corniculatum* is a promising endophytic fungal reservoir with antibacterial potential.

**Key words:** Endophytic fungi, Antibacterial, Mangrove, *Aegiceras corniculatum*

09-38

### DNA BARCODING AND PHYLOGENETIC INFERENCE OF *CAREBARA DIVERSA* (HYMENOPTERA: FORMICIDAE) USING MITOCHONDRIAL CYTOCHROME OXIDASE I GENE SEQUENCE

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**Background:** The ant genus *Carebara* comprises approximately 250 described taxa distributed worldwide. Though it has such a wide distribution range, only limited taxonomic and biological discussions are available on this genus. There are still countless indefinite specimens and morphospecies present in museum collections across the world, which is further expected to grow with the increasing number of species that are being added in accordance with the ongoing researches. The majority of species are very small and seem to have cryptic lifestyles. According to Hebert et al., a single gene sequence, the mitochondrial gene cytochrome oxidase I (COI) can be used as a global identification marker for animals. In the present study a DNA barcode is developed for *Carebara diversa* and a phylogenetic analysis of the same is also performed.

**Method:** Genomic DNA was isolated from *Carebara diversa* using DNA extraction kit. COI genes were specifically amplified by using forward and reverse primer pairs. The PCR products were purified by column purification procedure and sequenced from both ends by dideoxy chain termination method using the primers used for PCR amplification. The forward and reverse sequences were aligned and the consensus sequence was used for BLAST searches.

**Results:** The partial sequencing of mitochondrial COI sequence of the species was done. The phylogenetic tree, sequence divergence table and nucleotide substitution table is also constructed for assessment. The sequence was submitted to NCBI Genbank with accession number MK058407 for worldwide accession. In the present analysis *Carebara diversa* showed least divergence (16.95%) with species of genus *Cardiocondyla*, *Cephalotes*, *Pheidole* and *Wasmannia*. Among these *Cardiocondyla* belongs to the same tribe (Crematogastrini) as that of *Carebara diversa*, whereas the other three genus *Cephalotes*, *Pheidole* and *Wasmannia* belongs to a different tribe (Attini).

**Conclusion:** The method of using molecular methods for identification as well as taxonomic interpretation of *Carebara* species proves to be effective. The present study clearly showed that DNA Barcoding of ant species with mitochondrial Cytochrome Oxidase I will greatly facilitate and complement taxonomic studies, especially those exhibiting cryptic lifestyles. Combining DNA sequencing data with traditional morpho-taxonomy will serve as a model that can be applied in various disciplines so that the rate of species identification increases which will also help to deal with the present biodiversity crisis.

**Keywords:** *Carebara diversa*, Cytochrome Oxidase I gene, Formicidae, Myrmicinae, DNA barcode

09-39

### MARINE ACTINOMYCETES AS ANTIVIBRIO AGENTS FOR APPLICATION IN SHRIMP CULTURE SYSTEM

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**Background:** Among microbial diseases, *Vibriosis*, is one of the most prevalent diseases in shrimp culture. *Vibrioharveyi*, *V. parahaemolyticus*, *V. alginolyticus*, *V. anguillarum*, *V. vulnificus*, and *V. splendidus* are usually associated with shrimp diseases. Actinobacteria, a specific group of Gram positive bacteria are an excellent source of secondary metabo-

lites. In this study the marine actinomycetes were screened for its activity against vibrios and the potential isolates were segregated for application in aquaculture.

Five Actinomycete isolates A17, A42, A43, A60 and A76 showed remarkable antagonistic activity against vibrios, the opportunistic pathogens in aquaculture.

**Material and Methods:** Actinomycetes (75 nos) isolated from aquaculture pond and mangrove sediments were screened for antivibrio activity. Actinomycetes culture broth was prepared and centrifuged at 1000 rpm for 15 min and culture supernatant was used for testing antivibrio activity using Kirby-Bauer disc diffusion method.

**Result and Discussion:** Actinomycetes, A17, A42, A43, A60 and A76 showed significant inhibition against *Vibrio harveyi*. Augustine et al (2016) have reported antivibrio activity by *Streptomyces rubrolavendulae* against vibrios.

**Conclusion:** Marine actinomycetes are promising sources of antivibrio compounds and therefore can be used in shrimp culture system as an alternative to the use of antibiotics.

09-40

### THE EVOLUTION OF *ATROPHA NEURA ARISTOLOCHIAE* AND *TROIDES MINOS* TWO *ARISTOLOCHIA INDICA* FEEDING BUTTERFLIES AND THEIR HOST PLANT FROM THE NUCLEOTIDE SUBSTITUTION RATES OF THEIR CYTOCHROME OXIDASE SUBUNIT I (COI) GENE AND RIBULOSEBISPHOSPHATE CARBOXYLASE (RBCL) GENE.

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**Background:** The identification of evolution in an organism require some methods, able to identify the small changes in the past million years. In this study, we compared the nucleotide substitution rate of mitochondrial Cytochrome oxidase subunit I (COI) gene from two butterflies *Atropa neura aristolochiae* and *Troides minos* with the chloroplast Ribulosebiphosphate carboxylase (RBCL) gene from their associated host plant *Aristolochia indica* for resolving their phylogeny and co - evolution.

**Methods:** The genomic DNA isolated from butterflies and their host plant were amplified using PCR protocol. The amplified genes were sequenced by Sanger sequencing, the sequences obtained were analysed through nucleotide BLAST, ClastalW and MEGA. The divergence rate of both butterflies and their host plant were determined from their phylogenetic trees derived from the isolated sequences.

**Results:** Some correlations were observed in the divergence rates of COI gene sequences from *Atropa neura aristolochiae* and *Troides minos* and RBCL gene from *Aristolochia indica*. The sequences derived were deposited in the GenBank database, it is useful as a molecular barcode helping the species identification and determination of their genetic divergence.

**Conclusion:** The molecular tools used in this study has some powers to determine their evolutionary rate and co – evolution. The divergence of butterflies and their host plant were used in this study and were diverged significantly after the major vicariance events of the sub-continent such as the formation of Himalayas.

**Key words:** Co – evolution, Vicariance, Molecular barcode, Host plant, BLAST, ClastalW.

09-41

### PROBIOTIC CHARACTERIZATION OF LACTIC ACID BACTERIA ISOLATED FROM BREAST MILK AND INFANT FECES

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**Background:** Probiotics are live microorganisms which when administrated in adequate amounts confer health benefits to the host. Breast milk and fecal samples are good sources of probiotics and also the main host specific sources of bacteria to establish in infant gut, mainly lactic acid bacteria which possess many functional properties. The study aims to isolate and characterize lactic acid bacteria from infant feces and breast milk with probiotic potential. **Method:** Breast milk and infant faecal samples were collected from District General hospital, Kottayam. Lactic acid bacterial strains were isolated and their probiotic potential were characterized by tolerance to low pH, simulated gastric juice and bile salt, autoaggregation, hydrophobicity and its antibacterial effect.

**Results:** From a total of 51 bacterial isolates 8 were selected based on their tolerance to low pH. After 6 hrs of incuba-



tion in pH 2 more than 50% of the cells of BM8, BM9, BM10 and P2F2 survived whereas in simulated gastric juice of same pH the isolates showed more survival rate. The tolerance of isolates to 0.5% bile salts was comparable with the control. The ability of isolates to autoaggregation ranges from 22- 97%. The isolate P2F4 showed maximum hydrophobicity. Culture supernatants of P2F2 and P2F4 can inhibit all the pathogens tested. **Conclusion:** probiotic characterization of the isolates showed that P2F2 and P2F4 can be good candidates since they can withstand the gastrointestinal environment and have antibacterial effects.

**Keywords:** Probiotics, lactic acid bacteria, simulated gastric juice, bile salt, autoaggregation, hydrophobicity, antibacterial effect.

09-42

### PHARMACOLOGICAL EFFICACY OF LEAVES OF *SYZYGIUM PALGHATENSE* GAMBLE (MYRTACEAE) ENDEMIC TO PALAKKAD DISTRICT, KERALA

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**Background:** *Syzygium* (Myrtaceae) has received much attention since ancient times due to its multidimensional uses for mankind. The plant shows high species richness and exhibits relative homogeneity in the morphology. The identification of the new species is only based upon the morphological characters. *Syzygium palghatense* is considered as a highly promising traditional medicinal plant of this genus, which is endemic to Palakkad District of Southern Western Ghats of Kerala. So far, scientific studies for *S. palghatense* have not been explored. Due to their multipurpose usages and effective therapeutic properties, it becomes extremely important to supplement the constructive information with regards to the identification and also revealing the pharmacological properties.

**Method:** This study explores different aspects of pharmacology of *S. palghatense* leaf. The effective pharmacological evaluation was done through different solvent extracts of leaf (chloroform, ethyl acetate, methanol and distilled water). The methodology includes-morphological characterization, microscopic studies, nutritional profiling, physicochemical properties, powder characteristics, fluorescence analysis, phytochemical characterization, GC-MS studies and evaluation of antioxidant potential (DPPH radical scavenging assay, Superoxide radical scavenging assay, Hydroxyl radical scavenging activity and Ferric reducing antioxidant power assay).

**Results:** Methanolic extract of *S. palghatense* leaves was found to be most effective as compared to other solvents. Morpho-anatomical and pharmacognostic studies were found to be useful to supplement constructive information with regards to the identification and characterization. GC-MS profile indicates the presence of different phytoconstituents, which may be the reason for the medicinal properties of the study plant. The IC<sub>50</sub> value of the methanolic extract in DPPH, Superoxide radical scavenging assay, Hydroxyl radical scavenging activity and Ferric reducing antioxidant power assay was estimated to be 2.75± 0.07 µg/ml, 52 ± 0.375 µg/ml, 62± 1.821 µg/ml and 2.737±0.06 µg/ml respectively. This shows significant antioxidant activity of *S. palghatense* leaves.

**Conclusions:** The leaf possesses various constituents, especially antioxidantly active phytochemicals which could be a lead in future drug development. This study provides an insight into the pharmacological potential of *S. palghatense*.

**Keywords:** *Syzygium palghatense*, Anatomy, GC-MS, Pharmacology, Antioxidant activity

09-43

### INFRAGENERIC RELATIONSHIP AMONG THE INDIAN *ARISAEMA* (ARACEAE) BASED ON ITS SEQUENCES.

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**Background:** *Arisaema* is one of the Indian plant taxa with disjunct distribution in northeast India and Western Ghats (Puri *et al.*, 2016) rising several systematic and biogeographic questions. The genera shows greater percentage endemism and occur in either northeast India or Western Ghats. In this study molecular phylogenetic investigation was undertaken using sequence of nrITS of nuclear ribosomal DNA with a particular focus on species from India.

**Method:** Genomic DNA was extracted using the protocol of Doyle and Doyle (1990) with some modifications and Dneasy plant mini kit (Qiagen). DNA amplification of nrDNA ribosomal ITS region was performed using primers de-

signed by Muller and Cronk (1997). Phylogenetic analysis was done using Bayesian and Maximum likelihood method using the best-fit substitution model GTR+I+G using the Akaike information criterion (AIC). Tree generated by the two analysis were viewed and exported in FigTree v1.3.1.

**Result:** The ML optimal tree topology was mostly identical to the BI tree and members of each clade detected in ML corresponds to those obtained from BI. Cladogram obtained from the phylogenetic analysis initially bifurcate in to two major clades. The sect. Decipienta and sect Nepenthoidea are close together with high BS and also shows relationship as well and also shows indication of recently described species in a better resolution. Within the sect. Sinarisaema the relationship between the taxa still poses some problems irresolving.

**Conclusion:** From these observations the cladogram supported the infrageneric classification of the genus proposed by previous workers, but with minor deviations evidently demonstrated with molecular support.

**Keywords:** *Arisaema*, Phylogeny, Nuclear ribosomal DNA, Biogeographic questions

09-44

**COMPARATIVE PHENOLOGY OF *TRICHOPUS ZEYLANICUS* GAERTN. SUBSP. TRAVANCORICUS (BEDD.) BURKILL EX K. NARAYANAN: AN ETHNOMEDICINAL PLANT**

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**Background:** *Trichopuszeylanicus* Gaertn. subsp. *travancoricus* (Bedd.) Burkill ex K. Narayanan is an ethnomedicinal herb of southern Western Ghats, commonly known as ‘Arogyapacha’ or ‘Sathankalanga’. As a small perennial rhizomatous herb of the family Dioscoreaceae, this sub species is mainly distributed in the Peppara, Shendurney and Neyyar Wildlife Sanctuaries, Kerala and Kalakkad – Mundanthurai Tiger Reserve, Tamil Nadu of Agasthyamala Biosphere Reserve. The Kani tribe inhabiting in the Agastyarhills of the Western Ghats, Kerala traditionally used the plant as an ant-fatigue and stamina boosting herbal drug.

**Methods:** The present study was conducted on the comparative phenology of the species at Peppara, Shendurney and Neyyar Wildlife Sanctuaries of Agasthyamala Biosphere Reserve, Kerala. Regular field visits were conducted to the study plots of 1x1 m to document phenological events like leaf initiation, maturation, flower bud initiation, fruit initiation, fruit maturation and seed dispersal. Fruit and seed development of the species were identified through flowers tagged on the day of anthesis and subsequent sequential growth was analyzed for the DAA (days after anthesis). Qualitative and quantitative characters of rhizome, stem, petiole, leaf (mature), flower, fruit and seed were documented. Measurements of the plant parts were taken by using Digital Vernier Caliper- Mitutoyo Absolute Digimatic, Japan. To quantify the annual production of leaf, flower, fruit and seed at respective stages were tagged and examined.

**Results:** The phenological events of *T. zeylanicus* ssp. *travancoricus* have solid connection with different climatic changes. The leaf flushing was started after the heavy and continuous southwest monsoon. The flower bud initiation was observed by the mid-September were in the north-east monsoon was over. The maturation period of the fruit was observed to be four to five months, so as to ensure seed dispersal coincides with next southwest monsoon. The vegetative and reproductive annual production analysis of *T. zeylanicus* subsp. *travancoricus* revealed that more elite population is present in the Shendurney Wildlife Sanctuary compared to Peppara and Neyyar Wildlife Sanctuaries.

**Conclusion:** The present phenological study of *Trichopus zeylanicus* Subsp. *Travancoricus* at different population-revealed its periodical events. It is also helps to identify the elite population among other populations. Phenological studies are inevitable for effective maintenance and restoration of endemic species, it give an ideal information for both *in-situ* and *ex-situ* conservation aspects.

**Keywords:** Agasthyamala Biosphere Reserve, Arogyapacha, Kani tribes

09-45

**ANTICANCER EFFICACY OF PETROLEUM ETHER FRACTION OF METHANOLIC EXTRACT OF *LEUCAS ASPERA* ON HeLa CELLS**

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**Background:** The anti-tumour effects of plant constituents have been associated with the indication of carcinogen

detoxifying enzymes, the scavenging of free radicals, cell cycle arrest, triggering of apoptosis etc. Much effort has been made in the search for cancer chemo preventive agents and *in vitro* short-term tests are a valuable tool in the process.

**Methods:** In the present study, anticancer activity of the active fraction of methanolic extract of *L.aspera* was studied *in vitro* on cancer cell lines using MTT assay. The mode of HeLa cell death was investigated by morphological analysis (fluorescent microscopy). LDH release assay was conducted to study whether the active fraction is causing lysis. Changes in the cell cycle of HeLa cells treated with the fraction was analysed by Flow Cytometry.

**Results:** One hundred to 1000µg/ml of *L.aspera* significantly reduced the viability of HeLa cells. But when the doses were increased, the percentage of viable cells was decreased and finally at a dose of 1000µl of *L.aspera*, only 26 % cells were viable in the active fraction. Increased LDH leakage confirms increased membrane damage which is directly proportional to cytotoxicity. Microscopic examination revealed that the extract induced apoptosis in target HeLa cells after 24 hr treatment. The plant extract cause apoptosis at the concentration of 1000µg/ml. Flow cytometric analysis of HeLa cells treated with methanolic extracts showed significant inhibition of cells at G<sub>0</sub>/G<sub>1</sub> phase. There was 45% increase in cells arrested at G<sub>0</sub>/G<sub>1</sub> phase when compared with untreated control whereas the S phase and M Phase cells decreased proportionally. Therefore the G<sub>1</sub> phase arrest was one of possible mechanisms of anti-proliferative activities of the extracts.

**Conclusions:** The MELA active fraction showed cytotoxic potential which correlated with the results of LDH Leakage assay. Morphological analysis of the mode of HeLa cell death, together with the cell cycle analysis showed that the active fraction induced apoptotic cell death. cells. The study gives an insight into a significant source of novel promising anticancer compounds in view of their pronounced cytotoxic activities against HeLa.

**Key words:** *Leucasaspera*, Apoptosis, antitumour effect

09-46

#### INTERACTION STUDIES OF PLANT FLAVANOID ISORHAMNETIN WITH CALF THYMUS DNA: IN *SILCO* AND BIOPHYSICAL EVALUATION

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The molecular interaction of phytochemical Isorhamnetin (IsoH) with calf thymus DNA (ctDNA) has not yet been addressed. We have carried out a combination of *in silico*, calorimetric and spectroscopic investigations to elucidate the mode of binding of IsoH with ctDNA. The induced fit molecular docking analysis was done against ct-DNA showed its specific minor groove binding property. In this perspective the energetics of interaction including the binding energy and binding stoichiometry associated with the binding of IsoH with ctDNA was monitored by isothermal titration calorimetry (ITC). The hyperchromic effect exhibited by UV spectrum along with the significant quenching in the fluorescence intensity of ctDNA upon addition of IsoH revealed a characteristic minor groove binding devoid of significant structural alteration to the ctDNA.

**Keywords:** Isorhamnetin, calf thymus DNA, molecular docking, isothermal titration calorimetry.

09-47

#### ANATOMICAL STUDIES OF *HILDEGARDIA POPULIFOLIA* (ROXB. & WALL.) SCHOTT & ENDL. [= *STERCULIA POPULIFOLIA* ROXB. & WALL.] AND *THESPIA POPULNEA* (L.) SOLAND EX CORREA (MALVACEAE) LEAVES

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**Background:** *Hildegardia populifolia* (Roxb. & Wall.) Schott & Endl. [= *Sterculia populifolia* Roxb. & Wall.], is a vulnerable endemic deciduous tree distributed in forests of Andhra Pradesh, Tamil Nadu and Karnataka (Rao *et al.*, 2011) while *Thespesia populnea* (L.) Soland ex Correa is an evergreen indigenous tree found both on coasts and inland. Both belong to the elaborated Malvaceae family and their leaves are used medicinally for different purposes but their isomorphic nature results difficulty in identification. As plant anatomical characters have been used as an additional aid to

identify closely related species, we have undertaken the present study.

**Methods:** The specimens of *Hildegardia populifolia* (Roxb. & Wall.) Schott & Endl. was collected from Advanced Institute for Wildlife Conservation, Vandalur, near Chennai and *Thespesia populnea* (L.) Soland ex Correa was collected from Presidency College Campus, Chepauk, Chennai during 2018. The anatomical studies were carried out using hand sections.

**Results:** In *Hildegardia populifolia* the leaves have mucilage ducts, stiff veins, and thin lamina made up of with short-columnar palisade cells; in petiole 10 vascular bundles arranged like a ring, vessels homogeneous, and axial parenchyma and one medullary bundle present; midrib abaxial side is cup-shaped, vascular strand is broadly ovate with two leaf traces. Whereas in *Thespesia populnea* leaves mucilage ducts absent, veins herbaceous and comparatively thick lamina made up of long-columnar palisade cells; in petiole 6 (4 + 2) vascular bundles arranged like a broken ring, and axial parenchyma and medullary bundle absent; midrib abaxial side broadly convex, vascular strand 'c'-shaped, and vessels dissimilar.

**Conclusions:** Though the leaves of *Hildegardia populifolia* and *Thespesia populnea* are morphologically similar they have distinct anatomical characters.

**Key words:** *Hildegardia populifolia*, critically endangered, *Thespesia populnea*

09-48

### ROLE OF INSULIN PATHWAY IN MEMORY RETENTION OF *CAENORHABDITIS ELEGANS*

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**Background:** Since insulin has been implicated in conditions like Alzheimer's disease, a neurodegenerative disorder with memory dysfunctions, there is a growing interest among neuroscientists about its role in learning and memory. *Caenorhabditis elegans*, with its well-mapped nervous system, is an excellent model to address this question. The insulin pathway in *C. elegans* function through the daf-2 receptor with many insulin-like peptides acting as its ligand.

**Method:** We utilise the olfactory associative memory tests to analyse the learning and memory alterations in the organism. Our study involves both short-term and long-term training paradigms. We also study the neurodegenerative pattern of the worms following insulin administration using worms expressing GFP in a subset of neurons.

**Results:** Insulin affects memory in a differential manner. Worms with a developmental history of downregulated insulin pathway perform poorly in both short and long-term associated memory tests. However, some mutants in the initial pathways of insulin, like the ligand ins-1 and the receptor daf-2, show better retention of memory. This altered memory is not through the known Akt-1 pathway. We were also able to show that excess insulin antagonises the pathway and improves memory.

**Conclusion:** This work establishes the role of the insulin pathway in learning and memory. Insulin pathway modifies the learning and memory of the worms. We were also able to establish that the daf-2 receptor and ins-1 are involved in enhanced memory retention pathway.

**Key words:** Insulin, daf-2, ins-1, learning and memory

09-49

### ROLE OF SURFACE MICRO FLORA IN ENHANCING THE ANTI CANCEROUS POTENTIAL OF NONI

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**Background:** Noni is an ancient traditional medicinal plant scientifically called *Morinda citrifolia* belongs to the family Rubiaceae is known for its medicinal value and as dietary supplement for over 2000 years. Now it has become a researcher's plant because of its potential therapeutic effects such as antibacterial, antiviral, antifungal, anti-tumor, analgesic, anti-inflammatory and immune enhancing effects.

**Method:** In the present study, the surface microflora of Noni was isolated from unripen fruit, ripen fruit and tender leaves. Morphological characterization was done for the 44 isolated colonies. The selected 3 bacterial colonies from unripen fruit, ripen fruit and tender leaf were screened for its anticancerous activity by rapid plate assay. L-Asparaginase

enzyme activity was confirmed by nesslerization method and was compared with the results of plant extracts. The anti bacterial potential of plant extracts and antibiotic sensitivity of isolated organisms were conducted to support the interaction between Noni and isolated microflora.

**Result:** By pour plate technique, it was clearly inferred that the isolated endophytic organisms were different from those of surface microflora. Rapid plate assay for selected surface microflora isolates showed positive result for unripe fruit and ripen fruit isolates while the isolate from tender leaf showed the negative result. L-Asparaginase enzyme activity was confirmed by nesslerization method and potent asparaginase enzyme activity was shown by the extracellular metabolite of the organism isolated from unripe fruit

**Conclusion:** This work establishes the role of surface microflora in enhancing the anti cancerous potential of Noni. The anticancerous potential of Noni is may be due to the combined effect of plant extract and the extracellular metabolite from the microflora associated.

**Keywords:** *Morinda citrifolia*, Surface microflora, Rapid plate assay, L-Asparaginase, anti cancerous

09-50

### ANTI-OBESITY EFFECTS OF *GARCINIA GUMMI-GUTTA* (L.) ROBS. SEED OIL IN 3T3-L1 ADIPOCYTES

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**Background:** *Garcinia gummi-gutta* (L.) Robs. (Family: Clusiaceae) locally known as “Kudampuli” is an indigenous, tropical tree distributed in the evergreen forests of Western Ghats from Konkan to Kerala and Shola forests of Nilgiri hills. The dried seeds yield edible fat commonly known as ‘seed butter’, due to its solid state in room temperature. In the present study, the *in vitro* anti-diabetic and anti-obesity effects of *G. gummi-gutta* seed oil were studied.

**Methods:** The seed oil extracted from *Garcinia gummi-gutta* was evaluated for *in vitro* anti-obesity effects by determining cell viability, determination of glycerol release, measurement of intracellular cAMP level and triglyceride content in differentiated 3T3-L1 adipocytes *in vitro*

**Results:** The observations in statistical data of MTT assay suggested that in 3T3-L1 cells, *G. gummi-gutta* seed oil did not show any toxicity within the range of 100 µg/mL at the incubation of 48 h. The seed oil showed considerable glycerol release by increasing the concentration of the oil sample ranging from 50-250 µg/mL at the incubation of 72 h. It was found that the seed oil exhibited considerable increase in cAMP level at lower concentration (50 µg/mL). The seed oil showed considerable decrease in the expression of triglyceride level against 3T3-L1 at lower concentrations 50 µg/mL.

**Conclusion:** The present study indicated that *Garcinia gummi-gutta* seed oil exhibited *in vitro* anti-obesity effects. The seed oil increased intracellular cAMP levels and glycerol release and reduced triglyceride content *in vitro*. Thus the results suggest that *Garcinia gummi-gutta* seed oil can be considered as a potential anti-obesity agent.

**Keywords:** Anti-obesity, MTT assay, glycerol release, cAMP, triglyceride level

09-51

### ETHNOBIOLOGICAL SURVEY IN THE COASTAL AREAS OF THRISSUR DISTRICT, KERALA

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**Background:** Traditional Knowledge (TK) is considered as the mother term which is directly linked with the tradition and culture and also is the basis for food, health and economic security of millions of people. TK has evolved, developed and has been transpired down through generations in the form of healing arts, agricultural practices, cultural practices, local languages, customs and customary practices for the wellbeing of the local communities. As a result of change in the lifestyle and livelihood practices of people, TK is rapidly getting eroded from the communities. Therefore, it is important to document such knowledgesystematically to conserve at least the existing TK. The ethnobiological studies of the coastal areas of Kerala have not yet been extensively studied, and hence the relevance of this work is justified.

**Method:** Systematic documentation of TK is carried out scientifically. Initial step is to create contact with the selected coastal Gramapanchayaths of Thrissur district. Contact and awareness programmes were conducted with the President, elected local body members and other local TK holders and the action plan for field survey was carried out. Interaction with the TK holders/providers were done through question and answer sessions (with voice recorder, photographs and short video clippings), after Prior Informed Consent is signed. The recorded information was later decoded, inventorized and documented systematically using specially designed data sheets. Data pooling and analysis of the information were carried out. The information were uploaded in the electronic data base for further reference and research.

**Results:** Ethnobiological survey of 7 Gramapanchayaths (Eriyad, Edavilangu, Perinjanam, Kaipamangalam, Nattika, Thalikkulam and Kadappuram) of Thrissur district was carried out. Awareness on TK and its importance was provided to 151 people including Presidents, Local body members and knowledge holders. A total of 127 knowledge holders were interviewed. 425 information on single drugs, 465 information on combination drugs, 206 information on food plants and 126 information on tools/artefacts were documented.

**Conclusions:** Ethnobiological documentation and awareness campaign is important for making local people aware of the importance of the orally transmitted knowledge. A well designed mechanism is to be brought out to codify the remaining TK at the earliest; otherwise this valuable knowledge will be lost forever. Therefore, systematic documentation of TK among the remaining communities is highly essential to save the existing TK in the oral tradition.

**Keywords:** Traditional knowledge, Systematic documentation, Prior Informed Consent

09-52

#### STUDY OF THE EPIPHYTIC ALGAL BIOMASS FROM PNEUMATOPHORES OF *AVICENNIA OFFICINALIS* L.

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**Background:** Kerala supports wetlands of International or National importance. *Avicennia officinalis* has a wide geographical distribution with wide numbers found in inter tidal estuaries along many of the world's tropical and warm temperate coasts. Members of *Avicennia* have pneumatophores, that project above the mud to facilitate gas exchange for the submerged primary root. The exposed part contains large number of small openings, exposed in air. The water inundated portion and freely exposed portion support rich amount of algae.

**Method:** The present study was carried out in the Kunjimangalam and Valappattanam wetlands of Kannur districts of Kerala during the period of November to March 2018. Quadrant of size 25x25cm<sup>2</sup> where sampled at different locations of the selected two sites mentioned above randomly. Length and breadth of each pneumatophore were measured and by that surface area of pneumatophores is calculated.

**Results:** The pneumatophores of *Avicennia* have been found to support a rich flora of algae and other micro organisms. 15 species of algae belongs to various classes isolated The biomass of algae on pneumatophores were entirely different in the two sites.

**Conclusions:** The comparison of pneumatophore density at the two sites indicate that, Kunchimangalam region have favourable condition for the abundant growth of pneumatophore, supports high density of algae while compared to the most polluted Valapattanam site. 15 species of algae belongs to various classes were isolated

**Keywords:** Pneumatophores, *Avicennia*

09-53

#### ASSESSMENT OF ANTI-INSECT PROPERTIES OF *ANAMRITA COCCULUS*, *STRYCHNOS NUX-VOMICA* AND *CARDIOSPERMUM HALICACABUM* AGAINST *OLEPA RICINI* (LEPIDOPTERA: NOCTUIDAE)

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**Background:** Currently used chemical pesticides have far reaching adverse environmental and ecological impacts. Hence developing alternative eco-friendly pest management methods are in high demand. Biopesticides derived from

plants or animal origin was considered to be eco-friendly viable alternative to chemical pesticides.

**Method:** This work explores anti-insect activities of bark and leaf extracts of *Anamrita cocculus*, *Strychnos nux-vomica* and *Cardiospermum halicacabum*. The antifeedant activity, repellent activity and contact toxicity of these plants were evaluated against *Olepa ricini*. Basic phytochemical compositions of these plants were also analyzed along with TLC profiling.

**Results:** In the present study, the leaf and bark extracts of *S. nux-vomica* (75 mg/ml) showing maximum antifeedant activity with 99.73 % and 99.84 % feeding deterrence respectively. Higher repellent index was shown by the leaf extract of *S. nux-vomica* (100 mg/ml) with  $75 \pm 1.76$ , and leaf and bark extracts of *C. halicacabum* (100 mg/ml) with  $86.6 \pm 0.44$  and  $75 \pm 1.76$  respectively. The bark extracts of *C. halicacabum* and *A. cocculus* (10 mg/ml) have shown to be lethal in contact toxicity assay at the dose of  $43.75 \pm 1.32 \mu\text{g}/\mu\text{l}$  and  $92.5 \pm 0.88 \mu\text{g}/\mu\text{l}$  respectively.

**Conclusions:** *A. cocculus*, *S. nux-vomica* and *C. halicacabum* has shown promising degree of anti-insect properties that could be explored for the formulation of novel biopesticides.

**Keywords:** Biopesticides, Antifeedant, Repellent, Contact toxicity, *Olepa ricini*

09-54

### DIVERSITY OF BUTTERFLY WING SCALES AND THEIR ROLE IN COLOUR PATTERN AND OTHER ACCESSORY FUNCTIONS

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**Background:** Scales of butterflies are submicroscopic particle, they have an overlapping pattern of arrangement. They give alternate shades of colour and study conducted showed more than 20 different types of scales from a single species.

**Method:** Butterflies were collected from the fields as well as from the museum collections of the department and they were identified using standard key. Scales were separated from the wings by using pin head and observed by Labomed microscope (400x) and images are recorded by computer attachment.

**Results:** Nine different types of scales were identified from the wings of *Troides minos* (Family-Papilionoidea). The scales varied on the number of spines, shape and colour. *Pachilopta hector* (Fam; Papilionoidea) showed ten different types of scales, and they have transparent, black and yellow colour. *Jamides sceleno* represents Lycaenidae showed 23 different types of scales. All the scales obtained from the upper surface are transparent. *Eurema andersonii* (Pieridae) the common yellows showed 25 different types of scales.

**Conclusion:** Wing scales exhibited extreme diversity on shape, number of spines and nature of pigmentation. From the four species of butterflies under three families we could observe 67 different types of scales. Reflection and diffraction of light by scales result different shades of colour.

**Keywords:** Lycaenidae, Papilionoidea, Pieridae, *Troides minos*, *Pachilopta hector*, *Jamides celeno*, *Eurema andersonii*.

09-55

### ON GERMPASM CONSERVATION OF SOME ENDEMIC WILD ORNAMENTAL PLANTS IN JNTBGRI FIELD GENE BANK

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**Background:** Western Ghats is the sanctuary of several lesser known and promising wild plant species from the economic point of view. Very little attention has been given certain plant groups like wild ornamentals which have remarkable potential in the field of horticulture. Multiplication and domestication of wild endangered endemic ornamentals is regarded as the best way for its conservation and sustainable utilization. Hence the present study is highly envisaged to conserve this group of plants under *ex-situ* conditions in the Field Gene Bank of JNTBGRI.

**Methods:** Regular field trips and collections of live samples, seeds and herbarium specimens have been made and well documented with photographs along with passport data of all accessions and field notes for herbarium specimens. Live accessions have been introduced at the field gene bank conservatory of the JNTBGRI.

**Results:** The present study revealed that the several endemic wild ornamentals found to occur among the slopes of the Southern Western Ghats region in Kerala are bursting with potential ornamental value and could be domesticated in home gardens, parks, botanic gardens. Many ornamental species are fast disappearing from wild habitats due to over exploitation, catastrophic events and man-made alterations in their micro habitats. This highlights the need of ex-situ germplasm conservation and popularization of these plants prior to their elimination from the natural habitat. *Acrotrema arnottianum*, *Barleria courtallica*, *Begonia floccifera*, *Begonia albo-coccinea*, *Henckelia repens*, *Jerdoneia indica*, *Ophiorrhiza shendurunii*, *Paphiopedilum druryi*, *Sonerila sahyadrica*, *Sonerila tinneveliense*, *Strobilanthes gamblei*, *Strobilanthes gracilis*, *Strobilanthes lupulinus*, *Thunbergia mysorensis* etc. are a few examples of wild ornamentals found to occur in Southern Western Ghats. Wild ornamentals of the Southern Western Ghats are mostly comprises with small gene pools in isolated pockets with reduced out breeding which makes them more vulnerable to the way of extinction. The study highlighted on the *ex-situ* conservation of 14 endemic potential wild ornamental plants in JNTBGRI field gene bank.

**Conclusions:** The present study highlighted with 14 wild endemic ornamentals demarcated in isolated pockets in natural habitats require to have special measures for *ex-situ* conservation other than in-situ protocols.

**Keywords:** Western Ghats, Wild ornamentals, *Ex-situ* conservation, Field Gene Bank

09-56

### MICROPROPAGATION AND SYNTHETIC SEED PRODUCTION OF *EUPATORIUM TRIPLINERVE* VAHL.

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**Background:** *Eupatorium triplinerve* (*Ayapana triplinerve*) commonly called Ayapan, is an evergreen perennial medicinal plant that has its origin from South America. It belongs to Asteraceae family. It also grows in Brazil, Peru, Ecuador, Hawaii and India. Apart from the fancy value that it holds, it has many medicinal benefits also. It is a tropical American herb that is commonly known as water hemp. In view of the medicinal and commercial importance of the species, the present investigation is undertaken to standardize the protocols for rapid clonal propagation through shoot multiplication, indirect organogenesis and synthetic seed.

**Method:** Rapid clonal multiplication of this plant was achieved by shoot multiplication and indirect organogenesis. Nodes and inter nodal segments were cultured on MS medium containing different concentrations and combinations of KIN, IBA, BA, NAA.

**Results:** Nodal segments cultured on MS medium containing 2.5mg/l KIN produced increased rate of shoot production. Nodal segments cultured on MS medium containing 1.5mg/l BA produced 2 shoots. But the concentration of NAA along with BA in MS medium, rate of germination is very low. Callus was induced from internodal explants cultured on MS medium supplemented with IBA (0.5mg/l and KIN (1.5 mg/l).

**Conclusion:** Tissue culture protocols were standardized for the micropropagation of *Eupatorium triplinerve*. Rapid clonal multiplication was achieved via nodal segment culture and shoot tip culture

**Keywords:** Micropropagation, *Eupatorium triplinerve*., Murashige and Skoog (MS) medium, encapsulation, Indirect organogenesis, Indole 3- acetic acid, Benzyl adenine, Kinetin

09-57

### A SYSTEMATIC ACCOUNT OF FRESH WATER DIATOMS - POTENTIAL SOURCE AS LIVE FEEDS IN AQUACULTURE AND BIODIESEL PRODUCTION

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**Background:** Diatoms are unicellular algae that form the base of the aquatic food chain. They have ecological importance too as they are dominant primary producers and have important role in biogeochemical cycles. They are highly abundant and diverse and adaptable to different ecological conditions. Different features of diatoms such as their size, shape, digestibility and nutritional composition make them valuable as live feeds in the field of aquaculture. The high



proportion of saturated and monounsaturated fatty acids in diatoms is considered optimal from a fuel quality standpoint and suggested to be a potential group of microalgae for biodiesel production.

**Method:** Diatom samples were collected from distributor channels of the river Periyar located at Perumbavoor (10.1319° N latitude and 76.4822° E longitude) in Ernakulam district of Kerala. The investigation was done between January 2017 and June 2018. Diatoms were isolated using methods such as serial dilution, agar plating and single cell isolation. The stock cultures of isolated species of diatoms were maintained in f/2 medium. For analyzing the structure and morphology of diatom cells the sample was subjected to acid treatment and identification was done with the help of light microscope. Scanning electron microscope images were used for confirmation at species level.

**Results:** Thirty four species of diatoms belonging to fifteen genera have been identified. The identified diatoms include *Nitzschia* sp., *Navicula* sp., *Diadesmis* sp., *Achnantheidium* sp., *Synedra* sp., *Encyonema* sp., *Sellaphora* sp., *Lemnicola* sp., *Eunotia* sp., *Pinnularia* sp., *Aulacoseira* sp., *Surirella* sp., *Stauroneis* sp., *Gomphonema* sp. and *Cymbella* sp..

**Conclusion:** The study was aimed at screening, isolation and identification of the diatoms collected from fresh water ecosystem and to find out the potential diatoms which can be used as live feeds and as a source of biofuel.

**Key words:** Diatoms; isolation; identification; live feed; aquaculture; biodiesel

09-58

### EFFECT OF DROUGHT STRESS IN GROWTH AND QUALITY OF *CENTELLA ASIATICA* (L.) URB.

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The present study aims to analyze the effect of water stress in the growth and development of *Centella asiatica*. The species is getting cultivated in various parts of the world due to its high therapeutic and cosmeceutic applications. In this study the plants were grown water stress conditions with four different treatments. All the external conditions are maintained uniformly except water availability to the four treatments. Morphological, anatomical and some phytochemical characters were observed for assessing the effect of water stress.

Under stress condition, morphological traits showed significant variation between the treatments. The biomass yield decreased with increasing water stress. The anatomical characteristics in stem and petiole varied significantly. Among the four treatments, plants which got sufficient amount of water showed high content of chlorophyll and plants under treatment of least supply of water had very low amount of chlorophyll. The plants with highest water stress showed high glucose content and lowest starch content. Starch content was highest in well watered plant.

**Keywords:** *Centella asiatica*, drought stress

09-59

### STUDY ON PESTS AND PREDATORS OF *APIS CERANA INDICA* F. IN SELECTED APIARIES OF THRISSUR DISTRICT

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The indian honeybees *Apis cerana indica* are widely used in beekeeping in Kerala. Due to inbreeding and manipulation of beehive they are susceptible to pest and predator attack. Mostly insects groups are causing high degree of disturbance to the colony. They constitute the Hymenopterans, Lepidopterans and Coleopteran insects. The social wasp *Vespa tropica* are fatal to the entire colony. The wax moth *Galleria mellonella* and wax beetle *Platylabus alvearium* are observed continuously in hives. The occurrence were surveyed during the period of May 2018 to November 2018. Total six apiaries in Thrissur district were selected as study area. The colony is more susceptible for pest and predator attack during the period of growth and colony division. *A.cerana indica* are suitable for beekeeping because they are shade lovers.

09-60

**CHEMOPROSPECTING OF *PSILANTHUS TRAVANCORENSIS* (WT. & ARN.) LEROY –  
A MEDICINAL SPECIES OF RUBIACEAE.**

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**Background:** *Psilanthus travancorensis* (Wt. & Arn.) Leroy belonging to the Rubiaceae family is a medicinal plant used for the treatment of a wide range of diseases.. Little seems to be known about the chemical components of this plant. The evaluation of this plant for biological activity is necessary; to scientifically substantiate the use of this plant by traditional healers to develop the new drugs. Preliminary phytochemical studies revealed the presence of various major secondary components.

**Methods:** This study focuses on flavonoids because the quantitative estimation showed that the root of the plant is rich in flavonoids. The root was extracted with 85% ethyl alcohol and concentrated.

**Results:** Only the ethyl acetate extract gave positive Shinoda test for flavonoids and was used for further phytochemical analysis. Characterization of compound was carried out using various spectroscopic techniques. Determination of *in vitro* hepatoprotective effect of isolated compound on CCl<sub>4</sub> induced hepatotoxicity on cultured Hep G2 cells and its effects on various antioxidant marker enzymes were also studied.

**Conclusion:** The compound identified was quercetin-3-O-β-D-glucoside. *In vitro* treatment with quercetin-3-O-β-D-glucoside decreases the CCl<sub>4</sub>-induced liver damage resulted in elevation in biochemical parameters. The results of this study demonstrated that quercetin-3-O-β-D-glucoside has a potent hepatoprotective function against CCl<sub>4</sub>- induced hepatic injuries. This is a first time report on the isolation and hepatoprotective effect of a flavonoid from *P. travancorensis*.

**Keywords:** Column chromatography, quercetin-3-O-β-D-glucoside, hepatoprotectivity

09-61

**LARVICIDAL EFFICACIES OF TWO PLANT EXTRACTS AGAINST *AEDES ALBOPICTUS***

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**Background:** Asian tiger mosquito, *Aedes albopictus* (Diptera: Culicidae) is becoming a competent vector for dengue, chikungunya and other viruses. Current research trends use plant extracts as alternative larvicides because they contain various phytochemicals that are specific in killing mosquito larvae without harming other organisms and the environment.

**Method:** This study is an attempt to investigate the efficacy of aqueous leaf extract of *Clerodendrum infortunatum* and *Ailanthus triphysa* on larval mortality of *Aedes albopictus*. Also the total protein, amino acid, glycogen and lipid profile were estimated in treated larvae against control ones. The qualitative analyses of phytochemicals were also done in the most effective plant extract.

**Results:** Aqueous leaf extracts of *C. infortunatum* showed a higher mortality rate than *Ailanthus triphysa* against the larvae of Asian tiger mosquito. The plant's high larvicidal activity is supported by the presence of phytochemicals also.

**Conclusions:** From the results, it is evident that *C. infortunatum* can be attributed to the susceptibility of plant extracts as killing agent against mosquito larvae.

**Keywords:** Asian tiger mosquito, *Aedes albopictus*, *Clerodendrum infortunatum*, *Ailanthus triphysa*, Larvicidal efficacy.

09-62

### MICROBIAL DIVERSITY AND RESISTOME STRUCTURE OF POLLUTED AND NON-POLLUTED ENVIRONMENTS IN SOUTH INDIA

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**Background:** The environment is increasingly recognized as an important reservoir of resistance genes and plays an important role in their transmission cycles. Recent studies suggest that industrially polluted environments could assist in the rapid spread of antibiotic resistance in a local to global scale (Gothwal *et al.*, 2017). A metagenomic study by Bengtsson-Palme *et al.* on a lake (Kazipally lake, Hyderabad, India) which is severely polluted by pharmaceutical industries showed that resistance genes present in these polluted settings are 7,000 times more abundant than a control taken from Nydalasjön lake, Sweden.

**Method:** Here, we have analysed the metagenomic datasets of Kazipally lake (Bengtsson-Palme *et al.*) and compared their taxonomic structure and resistance genes distribution with mangrove samples collected from Kerala. The taxonomic distribution studies were performed using MEGAN5 and resistome analysis using an updated resistome database (CARD).

**Results:** High bacterial diversity was found in Kazipally and mangrove (Shannon's diversity index > 5) datasets where Proteobacteria as the abundant phylum. We have identified an additional 40 resistance genes in Kazipally lake that were not reported in the previous study. In addition, 6 unique resistance genes in the mangrove ecosystem which is comparable to that of Swedish lake sediment samples used in the study of Bengtsson-Palme *et al.* It is found that most of the pathogenic bacterial species identified in Kazipally lake are multidrug resistant and comes under hazardous categories (CDC report, 2013) whereas pathogenic microbes are comparatively less in the mangrove ecosystem.

**Conclusions:** Our results indicate that resistance elements significantly differs depending on the environment as well as the amount of selection pressure acting upon the bacteria. We found a vast pool of resistance genes in Kazipally lake that are problematic to the public health sector which requires an immediate action plan to prevent its further spread.

**Keywords:** Antibiotic resistance, Metagenomics, Pollution, Microbial diversity

09-63

### EFFECTIVE AND SUSTAINABLE ALTERNATIVE FOR USING CITRUS PEEL WASTE

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**Background:** Citrus fruit is immensely popular worldwide for their flavour and nutrition and it is the most important fruit crops grown throughout the world. Orange juice industry is growing day by day. Orange peel remaining after juice extraction is a major waste. So utilization of these waste cost effectively can reduce the waste and resulted in many valuable products. Several strategies are being used by local farmers and researchers to improve the fertility of degraded soil and increased crop productivity. Mulching are cheap and easily accessible for maintaining soil fertility and productivity. Organic mulches also increase water- holding capacity, nutrient availability and aeration of soil. So mulching with orange peel waste is one of the alternatives for improving soil fertility and there by productivity. Keeping the above facts in mind, we examined the effect of citrus peel mulch (fresh, dry, peel residue) on germination and growth of cow pea seeds.

**Method:** Growth study was done using 3 different type of orange peel (fresh, dry, and peel residue) on the cow pea under the field condition. Morphological characters were observed at regular intervals during vegetative as well as reproductive phase. Estimation of physiological parameters like photosynthetic pigment, proline, lipid peroxidation, phenol, flavanoid was done to analyse physiological changes occurred in cow pea plants under experimental condition. Soil analysis was done to find out decomposing process and soil nutrition.

**Results:** From the present study it was observed that different type of peel treatments in soil not exhibited any negative impact on the growth of cow pea. Both vegetative and reproductive growth was enhanced in M-60 and M-80 treatment when compared to the control. M-100 treatment showed less growth and yield suggest that growth enhancement is dose dependent and high concentration may reduce the growth. While comparing 3 type of peel treatment fresh peel treatment and peel residue showed better growth and yield. Result obtained from the physiological study of treated plants strongly suggests that plants were not subjected to any sort of stress in the field condition. Result of soil analysis to find

the decomposition process of peel and its impact on soil nutrition, revealed that soil pH is maintained between 6.4-7.2. However orange peel of any type greatly increased soil K and P concentrations, but none affected soil N and organic carbon concentrations.

**Conclusion:** The present study thus suggested the potential use of orange peel for increasing growth and yield of cowpea. Moderate quantity of fresh or dry orange peel can be used safely in cowpea field to improve soil conditions thus for crop productivity.

**Keywords:** Citrus peel waste, Mulch, Soil analysis, Cowpea.

09-64

#### DIVERSITY OF PLANKTONIC ROTIFERS IN AYIRAMTHENGU MANGROVE KOLLAM

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Rotifers are a group of aquatic micro-invertebrates comprising around 2000 species of unsegmented, bilaterally symmetrical organisms. Present study was undertaken in the mangrove region habitat of Ayiramthengu, which is a portion of kayamkulam estuary. Present study is aimed to analyse rotifer diversity in this mangrove region. Plankton were collected monthly using plankton net (60 $\mu$ ). During the whole study period 27 species of rotifers are identified. In station I diversity of rotifer is high which is the station where the fresh water influx is also high. The rotifer assume a great ecological significance in mangrove ecosystem because it is the feeding, breeding and nursery ground of many fin and shell fishes larvae and they are also used recently as bio indicator for monitoring aquatic ecosystems and integrity of water.

09-65

#### STUDIES ON THE VARIATIONS IN SECONDARY METABOLITES AND ANTIOXIDANT ACTIVITY OF *ZINGIBER ZERUMBET* (L.) SM. RHIZOME

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**Background:** *Zingiber zerumbet* (L) Smith belongs to the family Zingiberaceae is widely used by the traditional people. Medicinal plants based traditional systems of medicines are playing important role in providing health care to large section of population, especially in developing countries. This species is traditionally known as Asian ginger or Shampoo ginger or bitter ginger. The volatile oil, Limonene occurs exclusively in *Zingiber zerumbet*.

**Method:** Quantitative analysis of phytochemicals, antioxidant activity of *zingiber zerumbet*.

**Result:** Aqueous extract of shampoo ginger showed the presence of alkaloids, flavanoids, saponins, phenols, tannins, phlobatannins, terpenoids, proteins, glycosides, carbohydrates, syringyl group, triterpenes and steroids are present in the analysis. Anthraquinones contents not present in the extract. The ethanol extracts of shampoo ginger showed the presence of alkaloids, flavanoids phenols, tannins, terpenoids saponins, proteins, glycosides, carbohydrates, syringyl group triterpenes and steroids. Ethanol, butanol, acetone, chloroform and aqueous extract of ginger show absence of anthraquinones content. In the different extracts of shampoo ginger showed that high amount of alkaloids. In the chloroform extract of shampoo ginger showed the presence of alkaloids, flavanoids, phenols, tannins, terpenoids, saponins, proteins, glycosides, carbohydrates, syringyl group, triterpenes and . The result shows the variation in the presence of phytochemicals present in the shampoo ginger (*Zingiber zerumbet*) in different extract.

**Conclusion:** The present investigation aimed to evaluate the phytochemical screening and antioxidant activity of rhizome extract of *Zingiber zerumbet* which belongs to the family Zingiberaceae. The rhizome is mainly used to cure digestive problems.

**Keywords:** Antioxidants, *Zingiber zerumbet*

09-66

### NUTRITIONAL AND ANTI NUTRITIONAL ANALYSIS IN *ARTOCARPUS HIRSUTUS* LAM.

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**Background:** *Artocarpushirsutus* Lam. is an endemic tree species of the family Moraceae, belongs to Southern Western Ghats of peninsular India. It is an evergreen tree with approximately 20 to 40 m height, and 3 m girth. Nutritional facts of fruits and seeds of *A. hirsutus* are yet to be validated but several potential phytochemicals have been identified from the fruit pulp. The aim of this work was to evaluate the nutritional and antinutritional compositions of fruit pulp, seed and seed coat with hope the information would be of use to those concerned with plant food for human nutrition.

**Method:** The matured fruits of *A. hirsutus* were collected from Kariavattom Campus, University of Kerala, Thiruvananthapuram. Standard procedures were used for nutritional analysis. Available carbohydrate, protein and total lipid were estimated according to the standard protocol. Calorific value (in kcal/100g) was estimated by multiplying the percentages of crude protein, crude lipid and available carbohydrate by recommended factors. Reducing sugar were determined accordingly. Vitamins like thiamine, riboflavin, niacin, carotenoid and vitamin C were determined according to the respective protocols. The recommended methods were used for the determinations of oxalate and saponin. Standard protocols were used for the determination of total phenols and flavonoids. Statistical analysis was also carried out.

**Results:** On analysing the nutritional content, it was found that, carbohydrate content was high for seed. On the other hand, protein content was high for seed coat. Seeds had comparatively twice the amount of lipid than seed coat and fruit pulp. Values of reducing sugar was found to be ranging from 1.926 g (seed) to 3.046 g (fruit). Vitamin analysis of all the three samples showed that seed coat contained higher amount of riboflavin (4.115 mg), niacin (1.722) and vitamin C (18.823 mg) respectively in fruit pulp and seed. On the other hand, carotene (0.06392 mg) and thiamine (0.10035 mg) were found to be highest in seed. The fruit pulp had low levels of all the vitamins analyzed. On analysis of anti-nutrient factors, it was found out that, the levels of all the anti-nutrient fraction in the fruits of *A. hirsutus* were lower than the value that can cause malabsorption of other nutrients.

**Conclusion:** Fruits are important sources of minerals, fibre and vitamins, which provide essential nutrients to the human body in day to life. But it is known that some fruits have so called anti nutritional factors (e.g. phytic acid and tannins) that diminish nutrient bioavailability, especially if they are present at high levels. The nutritional analysis revealed that the fruit of *Artocarpushirsutus* are edible and all the nutritional analysis will be helpful for the utilization and consumption of underutilized plant.

**Keywords:** *Artocarpushirsutus*, Nutritional Analysis, Vitamins, Anti-nutritional Analysis

09-67

### SCREENING OF BIOACTIVE COMPOUNDS IN *PREMNA WIGHTIANA* SCHAUER (LAMIACEAE)

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The members of the family Lamiaceae are medicinally important and known for the characteristic aroma. *Premna* is one among the medicinally important genus in the family. The species such as *P. serratifolia*, *P. tomentosa* and *P. mollissima*, *P. herbacea* are recognized for their pharmacological properties and are the constituents of different traditional and ayurvedic medicinal formulations. The present study was carried out to characterize the bioactive constituents present in the leaves of *P. wightiana* collected from Pooppara, Idukki District, Kerala State by qualitative methods. Preliminary phytochemical analysis of methanolic leaf extract of *P. wightiana* revealed the presence of alkaloids, flavonoids, terpenoids, steroids, and phenolic compounds. GC-MS analysis was used to detect the composition of the volatile constituents present in the leaves. The mass spectrum of the unknown component was compared and interpreted with the spectrum of the known components stored in the National Institute Standard and Technology (NIST) library. A total of twenty compounds were identified by GC-MS analysis. The major bioactive compounds viz;  $\beta$ -caryophyllene, phytol,  $\gamma$ -sitosterol, squalene,  $\alpha$  and  $\beta$  amyrins were identified by GC-MS analysis. Among the identified compounds a major percentage was of pharmacological importance. The present study provides a foundation for the chemotaxonomic and pharmacological studies.

**Keywords:** Bioactive constituents, GC-MS, *Premna*,

## 10 - MATHEMATICAL & STATISTICAL SCIENCES

10-01

### CHARACTERIZATION OF DISTANCE HEREDITARY GRAPHS USING DISTANCE SPECTRUM

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**Background:** Distance hereditary graphs are connected graphs in which all induced paths are isometric. In this paper, we study the distance spectral properties of distance hereditary graphs. It is well-known that the distance hereditary graphs admit a forbidden subgraph characterization. We obtain the necessary condition of this characterization using distance spectrum. Also, we obtain a new characterization of distance hereditary graphs using distance spectrum.

**Keywords:** Distance hereditary Graphs, Distance Matrix, Distance Spectral Radius, Induced Sub graph.

**2010 Mathematics Subject Classification:** 05C50, 05C75

10-02

### ANALYSIS OF A QUEUE WITH JOINING STRATEGY AND INTERRUPTION REPEAT OR RESUMPTION OF SERVICE

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**Background:** An M/M/1 queuing system with service interruption. If the server is busy at the arrival epoch, the arriving customer decides to join the queue with probability  $q$  and balk with probability  $1-q$ . The service is assumed to get interrupted according to a Poisson process. The interrupted service is either resumed or restarted according to the realization of two competing independent, non-identically distributed random variables, the realization times of which follow exponential distributions. An arriving customer, finding the server under interruption does not join the system. This work has wide application in browsing internet for some purpose like money transactions through Net banking.

**Method:** Analyze the Nash equilibrium of customers' joining strategies using difference differential equations of the system.

**Results:** Compute expected number of interruptions during a single service, expected service time, Also analyze the Nash equilibrium joining strategy under a given reward cost structure because customers have the right to decide whether to enter the system or not.

**Conclusions:** When the joining probability  $q$  adopted by other customers is smaller than (equilibrium probability)  $q_c$ , the expected net benefit of an arriving customer is positive if he chooses to join the system, thus the unique best response is 1. Conversely, the unique best response is 0 if  $q > q_c$  because that the expected net benefit is negative. If  $q = q_c$ , every strategy is the best response since the expected net benefit is always 0. Therefore, we have to avoid the crowd situation.

**Keyword:** Joining strategy, Interruption, Repeat or resumption of service, Nash equilibrium

10-03

### ESTIMATION OF STRESS-STRENGTH RELIABILITY USING A GENERALIZATION OF POWER TRANSFORMED HALF-LOGISTIC DISTRIBUTION

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**Background:** In the present world the problem of increasing reliability of any system has become significant in many fields of industry, transport, communications technology, etc. There are appliances which survive due to their strength; they also receive a certain level of stress. But if a higher level of stress is applied than the strength then the appliances tend to break down. Suppose the random stress applied on a certain appliance be represented by  $Y$  and the random strength to sustain the stress be represented as  $X$ . Then the system fails if and only if at any time the applied stress is greater than its strength. Thus a measure of reliability of a system is given by  $R = \Pr \{X > Y\}$ .

**Method:** A new probability model obtained by generalizing the power transformed half logistic distribution is introduced by transforming the type II beta distribution. The basic properties of the distribution are studied. Then using the new distribution, the measure of reliability of a system is given by  $R = \Pr \{X > Y\}$  is computed.

**Results:** A generalization of the power transformed half logistic distribution is introduced by using the transformation of random variables. The stress strength reliability of a single component system with strength following the proposed model and different cases for stress are obtained. The usefulness of the model is also studied by applying it for a real life data.

**Conclusions:** The following article co-authored with Dr. Joby K Jose deals with developing a new probability model obtained by generalizing the power transformed half logistic distribution is introduced by transforming the type II beta distribution. The usefulness of the model is also studied by applying it to a real life data set. The data set used for the illustration purpose was reported by Smith and Naylor (1987). The data set represents two samples of fiber strength data. The data sets are experimental data of the strength of glass fibers of two lengths, 1.5 cm, and 15 cm, from the National Physical Laboratory in England. It can be observed that the developed density fits both the data sets.

**Keywords:** Half-Logistic Distribution, Transformation Of Random Variables, Drihlet Eta Function, Generalized Hyper geometric Function, Stress-Strength Reliability.

10-04

### AN APPLICATION OF INTERIOR EXTERIOR AND BOUNDARY OF FUZZY SOFT MULTI TOPOLOGY IN FLOOD

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**Background:** Vagueness is a matter of discussion in almost fields of knowledge. To represent uncertain values fuzzy set was introduced [1]. Soft sets [2] cleared the inadequacy of parameterization. Multi-set allows multiple occurrence of an element. In the paper [3] Naisal and Raji Kumar explains an application of fuzzy soft topology in Ayurveda.

This paper takes steps to take the measures to take on flood related issues.

**Methods:** Each area affected by flood in the aerial photo is viewed as a fuzzy set/point in the soft fuzzy space. The fuzzy value of each area affected by flood is defined as

$$\left( \frac{\log(\text{Area } \delta \text{ certain affected area})}{\log(\text{Total area } \delta \text{ affected area})} \right)$$
, which is a well-defined mapping from the interval  $[1, \infty]$  to the interval  $[0, 1]$ . From many studies it was found that some area have chance to be affected by flood quickly, some has less chance. So we wish to put these as parameters.

**Results:** Here we discussed on soft multi exterior, soft multi interior, soft multi closure. At last we produced a model of decision making which is an application of fuzzy soft multi sets. We found the maximum affected area by the flood using interior, boundary, and row maximum, row minimum using the numerical value of resultant fuzzy soft set. In such areas that are affected by the flood area will be helpful to find the chance of most areas and to give remedial measures.

**Conclusion:** From GIS perspective it is really mandatory to know the regions which may be affected. This may help them to identify the correct places to be live.

10-05

### MINIMAL IMMERSIONS OF STATISTICAL MANIFOLDS

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**Background:** In this paper we study certain properties of statistical immersions. A necessary condition is obtained for a statistical immersion to be an immersion for statistical manifolds with  $\alpha$ - connection in the case of co-dimensions one as well as in general co-dimensions. Then necessary condition for an immersion to be minimal for co-dimension one is given. Also obtained condition for an immersion to be minimal for statistical manifolds with  $\alpha$ - connections.

**Classification:** MSC 53A15, MSC 53C42

**Keywords:** Statistical manifolds, Statistical immersions, Minimal immersions

10-06

### SPIKING NEURAL P SYSTEMS WITH STRUCTURAL PLASTICITY AND MEMORY

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**Background:** Spiking neural P systems (in short SNP systems) [1] are the computing devices inspired by the spiking neurons. Spiking neural P systems with Structural Plasticity (SNPSP systems) is a variant of SNP systems in which the biological feature of structural plasticity is incorporated. From nineteenth century onwards it is noted that the repeated activation of a neuron causes the metabolic changes. Gheorghe Pun [2] arouse a problem whether the usage of synapse determine the dynamic nature of synapses. Paolo Cazzaniga et. al. proposed P systems with memory, having facility to store the input and solutions of previous computation [3]. Motivated from these concepts, we propose a transducer model benefited with memory, using biological features synaptogenesis, synaptic pruning, polarization, dynamic synaptic connectivity and diversity in spike transmission. This paper imbibes the link between the structural changes in brain and memory for the construction of transducer model with memory. This proposed model which computes, gives solution, provides the facility to store input and solutions of computations and retrieves a copy of solution from memory if necessary.

**Keywords:** Spiking Neural P systems, Structural plasticity, Memory

10-07

### ON A QUEUEING-INVENTORY SUPPLY CHAIN SYSTEM WITH IMPATIENCE OF CUSTOMERS

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**Background:** Supply chain consists of all activities associated with flow of goods and services, movement and storage of raw materials, work-in-process inventory and finished goods from point of origin to point of consumption. Effective supply chain helps firms to optimize inventory levels to reduce costs and also helps enterprises to avoid production stoppages.

**Method:** A queueing inventory supply chain with two units is considered. A distribution centre where the stocks are kept for meeting the demand of customers and a production centre in which the items produced are kept for meeting the demand from the distribution centre. When the inventory in the distribution centre depletes to a pre fixed level(s), it orders a fixed quantity(Q) from the production centre. If the production centre has this required amount it will be send to the distribution centre. It takes an exponentially distributed amount of time for the item to reach the distribution centre. On the other hand if the production centre has only fewer items than the required amount, the customers in the distribution centre have to wait till the required items accumulate in the production centre and get transferred to the



distribution centre. Though no customers from outside is allowed to enter into the system when the inventory in the distribution centre is zero, those customers who are already in the system at this stage may leave the system due to impatience after an exponentially distributed amount of waiting time. A stochastic model is developed by identifying the Continuous Time Markov Chain. The model is constructed and analysed using matrix analytic method. Cost function is developed to numerically investigate the optimal values. The effects of various parameters on the system performance measures are also investigated.

**Results:** Numerical analysis shows that as the level of inventory in the distribution centre, at which the order is placed increases, the value of the expected total cost decreases. A series of numerical works are performed for the evaluation of the performance measures of the system.

**Conclusion:** In this paper we studied a queuing inventory supply chain model with one production centre following  $(rQ, kQ)$ -policy and a distribution centre which follows  $(s, S)$ -policy. The model developed could be applied to similar queuing inventory problems.

**Keywords:** Queuing inventory, production inventory systems, supply chain, customer impatience,

10-08

### A NEW FAMILY OF ALPHA POWER TRANSFORMED FRÉCHET DISTRIBUTION AND ITS APPLICATIONS IN RAINFALL DATA ANALYSIS

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**Introduction:** The extreme value distribution of type II was named after Fréchet (1927), who devised one possible limiting distribution for a sequence of maxima, provided convenient scale normalization. Extreme Value distributions are widely used in risk management, finance, insurance, economics, hydrology, material sciences, telecommunications and many other industries dealing with extreme events. In the present paper we introduce a new distribution from the Fréchet distribution by using the Alpha-power transformation suggested by Mahdavi and Kundu (2016), called Alpha Power Transformed Fréchet (APF) distribution. This family of distribution includes the Fréchet distributions as special cases. Some of the tractable properties are investigated. We discuss maximum likelihood estimation of model parameters and maximum rain fall data is used to evaluate the performance of the proposed distribution.

#### **Materials & Methods:**

##### **Alpha Power Transformed Fréchet Distribution**

Definition 1: The random variable  $X$  is said to have a three-parameter Alpha Power transformed Fréchet distribution denoted by  $APF(\lambda, \beta; \cdot)$ , with the parameters  $\lambda$ ,  $\beta$  and  $\alpha$ , then its pdf can be defined as follows

**Results and conclusions:** In this section, we present real life applications of the APF distribution in analyzing rainfall data. We collected monthly precipitation data of Kozhikode for the period 2013 to 2017 from the meteorology department. The data we considered for the analysis is the maximum monthly maximum rainfall in Kozhikode during 2013 to 2017. We fitted the APF, Fréchet and Gumbel to the rainfall data (Figure 3). We used Akaike's Information Criterion (AIC) (Akaike, 1973; Burnham and Anderson, 1998) to assess the appropriateness of APF over the Fréchet and Gumbel distributions. Smaller value of AIC indicates that the estimated density of the APF distribution fits the data quite well compare to Fréchet and gumbel density. Hence APF model can be used for the estimation and prediction of rainfall.

**Keywords:** Fréchet distribution, alpha power transformed Fréchet, extreme value distribution

## 11 - PHYSICAL SCIENCES

11-01

### GRAPHENE INCORPORATED TITANIUM DIOXIDE CO-EXPOSED WITH HIGH ENERGY {001} AND {010/100} FACETS FOR SELF-CLEANING NANOCOATINGS

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**Background:** Interest in developing self-cleaning surfaces and coatings is increasing rapidly nowadays because of the growing demand for self-disinfecting, uncontaminated, unpolluted and hygienic surfaces. This Lotus leaf-inspired nanotechnology finds wide applications on glass windows, textiles, paints, and as coatings on high performance optoelectronic devices like solar panels, green houses, flat panel displays, etc. The major requirements of a super hydrophilic self-cleaning coating material are high photo catalytic activity, photo induced super hydrophilicity, good optical transparency, photo stability etc. for which anatase Titanium dioxide (TiO<sub>2</sub>) forms a promising candidate. But, the photo activity of TiO<sub>2</sub> is limited due to high recombination rate and photo response in UV region, which can be rectified by graphene hybridization. Graphene can act as a good scavenger for electrons retarding the bulk and surface recombination of photo generated excitons during photo excitation of TiO<sub>2</sub>.

**Method:** A hydrothermally modified sol-gel method is adopted under varying acidic pH conditions for the synthesis of TiO<sub>2</sub> nanocrystals with good wettability. 0.1% reduced Graphene Oxide (rGO) is incorporated to TiO<sub>2</sub> synthesis at pH 3 (T3/rGO) to obtain the binary hybrid adopting the same hydrothermal method. Synthesized samples are characterized by XRD, DRS UV-Vis, Raman, TEM and HRTEM, PL and TRPL measurements. Nanocoatings are fabricated on glass substrate by spin-coating techniques for analyzing its self-cleaning behavior by studying its photo degradation, contact angle measurements, and photo stability.

**Results:** TiO<sub>2</sub> nanocrystals synthesized at pH 3 (T-3) is found to have ellipsoidal morphologies with larger percentage of exposed high energy {001} and {010}/100} facets with better photo catalytic activity. The photo catalytic activity is enhanced from 83% ( $k = 9.23 \times 10^{-3} \text{ min}^{-1}$ ) for T-3 sample to  $2.4 \times 10^{-2} \text{ min}^{-1}$  in T3/rGO binary hybrid. The binary hybrid shows a photoinduced super hydrophilic behavior with a water contact angle of  $\sim 0^\circ$  within 15 min of UV irradiation at 365 nm. This is because the recombination rate is reduced by the incorporation of graphene for the hybrid as evident from photoluminescence spectra.

**Conclusions:** We developed a novel hydrothermal assisted synthetic pathway for the synthesis of pristine TiO<sub>2</sub> and TiO<sub>2</sub>/graphene hybrid. Synergism created by graphene incorporation resulted with stronger dye adsorption ability and high electron mobility along with photogenerated charge separation which resulted in the superior self-cleaning property for TiO<sub>2</sub>/graphene binary hybrid.

**Keywords:** Superhydrophilicity, Self-cleaning, TiO<sub>2</sub>/graphene hybrid, nanocoatings, crystal facets.

11-02

### DEVELOPMENT OF AN IONOGEL MEMBRANE FOR CO<sub>2</sub> SENSING APPLICATION

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**Background:** The increasing level of CO<sub>2</sub> in the atmosphere is presently noteworthy ecological anguish in current society. In this scenario, research upon CO<sub>2</sub> monitoring in atmosphere and problems associated with it is demanding one, to preserve the clean environment in an airtight chamber. To achieve this different class of materials has been explored viz adsorbents, adsorbents, permeable membranes, etc. Among them, polymer-based membranes including hybrid polymer-organic membranes, polymer-inorganic membranes are considered as most efficient for CO<sub>2</sub> separation.

**Method:** This work is intended to address the development of an ionogel membrane by entrapping most conductive ionic liquid, 1-Ethyl, 3-methyl imidazolium thiocyanate ([EMIM][SCN]), in a non conducting polymer, polyvinyl alcohol (PVA). After having a deep insight into its morphological, thermal and electrical changes on varying concentration

of the ionic liquid, a low-cost chemiresistive type CO<sub>2</sub> sensor was fabricated on interdigitated Ag electrodes, and the CO<sub>2</sub> response rate was monitored.

**Results:** Developed an ionogel membrane with varying weight ratios of [EMIM][SCN] in the PVA matrix. It is found that the ionogel membrane with 20% IL has superior performance, further increase in IL adversely affects due to agglomeration of ions. Fabricated interdigitated sensor plays a crucial role in the CO<sub>2</sub> gas adsorption and separation with high CO<sub>2</sub> response rate. Computational investigations were also employed to study the interaction between the trapped CO<sub>2</sub> with the ionogel membrane. The obtained results revealed that the thiocyanate anion plays an acute role in gas capture by forming carbamate, whereas the cation and PVA matrix were mediocre by forming hydrogen bonds with captured CO<sub>2</sub> to form the structure more complicated one and this complexity increases the resistance of the material, that is evidently observed from the experimental results too.

**Conclusion:** The free-standing wet crack free ionogel membrane with 20 % [EMIM][SCN] can be used for CO<sub>2</sub> sensor applications while ionogel membrane with a higher concentration of [EMIM][SCN] can be used for CO<sub>2</sub> capturing and storage.

**Keywords:** Ionogel membrane; Thermal properties; Electrical Properties; CO<sub>2</sub> Sensors; CO<sub>2</sub> capturing and storage application; PVA, [EMIM][SCN].

11-03

### ENHANCEMENT OF MICROWAVE DIELECTRIC PROPERTIES OF CA<sub>3</sub>TE<sub>2</sub>ZN<sub>3</sub>O<sub>12</sub> GARNET CERAMICS BY COLD SINTERING PROCESS

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**Background:** Microwave dielectric ceramics with suitable dielectric constants, low dielectric losses and nearly zero temperature coefficients and their low temperature fabrication have been a hot topic for the last few decades. Conventional sintering techniques require huge amount of energy, here comes the importance of low temperature/ room temperature sintering (Cold sintering). This work compares the microwave dielectric properties of Ca<sub>3</sub>Te<sub>2</sub>Zn<sub>3</sub>O<sub>12</sub> garnet ceramics sintered by conventional and cold sintering process.

**Method:** This work envisages the improvement in dielectric properties of Ca<sub>3</sub>Te<sub>2</sub>Zn<sub>3</sub>O<sub>12</sub> garnet ceramics densified by cold sintering method using Li<sub>2</sub>MoO<sub>4</sub> at 120-200°C from conventionally sintered at 1100°C aided by B<sub>2</sub>O<sub>3</sub>. Structural probing was carried out using X-ray Diffraction and vibrational spectroscopy. Further, the microwave dielectric properties were measured with a vector network analyser using cavity method excited by TE<sub>018</sub> mode.

**Results:** The XRD pattern depicts the single crystalline phase of Ca<sub>3</sub>Te<sub>2</sub>Zn<sub>3</sub>O<sub>12</sub> ceramics and further confirmed by vibrational spectroscopic outcomes. Rietveld refinement of the XRD pattern gives the lattice parameters (Cubic structure with space group Ia-3d, a = 12.632 Å). Conventional sintering gives a densification of 90% and having Q<sub>u</sub> x f of 20340 GHz and of -31.61 ppm/°C where as Cold sintering aided by 50% of LiMoO<sub>4</sub> gives 88% densification with of 5.6, Q<sub>u</sub> x f of 27427 GHz and of -47 ppm/°C.

**Conclusions:** The microwave dielectric properties and their correlation with symmetry of Ca<sub>3</sub>Te<sub>2</sub>Zn<sub>3</sub>O<sub>12</sub> garnet ceramics was studied for the first time and the cold sintering process aided by Li<sub>2</sub>MoO<sub>4</sub> enable Ca<sub>3</sub>Te<sub>2</sub>Zn<sub>3</sub>O<sub>12</sub> garnet ceramics as an efficient low loss (~10<sup>-4</sup>) material for microwave substrate applications.

**Keywords:** Garnet tellurates, XRD, Vibrational spectroscopy and Cold sintering process.

11-04

### SPR INDUCED Au@Ag CORE SHELL DOPED SiO<sub>2</sub>-TiO<sub>2</sub>-ZrO<sub>2</sub> FIBER OPTIC SENSOR FOR VITAMIN A DETECTION

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Au@Ag core-shell nanoparticles were embedded in SiO<sub>2</sub>-TiO<sub>2</sub>-ZrO<sub>2</sub> ternary matrix for potential Vitamin A sensing applications and are reported for the first time. Ternary SiO<sub>2</sub>-TiO<sub>2</sub>-ZrO<sub>2</sub> glasses were prepared through a non-hydrolytic sol-gel process and were incorporated with Au@Ag core-shell nanoparticles having an average size of 30 nm. The sensing capability and selectivity of the as prepared Au@Ag core-shell nanoparticles were studied using absorption spectroscopy and was established to have good selectivity over other biomolecules. The title specimen was coated

on an optical fiber to reveal the practical application of such a sensor and analyzed its specificity towards vitamin A sensing using transmittance spectra. A linear response towards vitamin A concentration ranging from 10-1000  $\mu\text{M}$  was observed for the as prepared novel vitamin A sensor. An economical, low toxic and sensitive bio-sensor for vitamin A detection based on SPR mechanism is proposed in the current work.

11-05

### RICE STRAW BASED COPPER OXIDE NANOCOMPOSITE AS ANTIBACTERIAL AGENT

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In the present Structural study, nanoparticles of Copper oxide (CS) and nanocomposite of Rice straw based Copper (RSCS) were synthesised through controlled co-precipitation method with citric acid as capping agent. Characterizations of all the four synthesized samples were carried out using XRD. Comparison of XRD's of metal oxides with JCPDS confirmed that the formed metal oxide was CS, Phase purity and crystallinity of these samples were confirmed from XRD. Crystallite sizes were calculated using Scherrer equation. Copper oxide – Rice straw nanocomposite showed visible range absorption in addition to UV range. From band gap calculation it was seen that all of them showed subgaps. The present study investigates the antimicrobial activity of the synthesized samples as antibacterial agents. The gram positive bacteria: **Staphylococcus aureus** and the gram negative bacteria: Escherichia coli are the microbes used in the present study. The study confirms that the copperoxide samples prepared in the present study can be used as antibacterial agent against Escherichia coli. The results suggest that proper tuning can make them good antimicrobial agent.

**Keywords:** Biopolymer, nanocomposite, Co- Precipitation, Anti-Bacterial Agents

11-06

### BEAUTY MEASUREMENT: AN ATTEMPT TO DERIVE AN EQUATION OF BEAUTY

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**Background:** Visual attractiveness, which we call beauty, has been one of the most important things which has shaped human civilizations. Attempts were and are always made by humans through all ages to preserve their beauty, and from ancient times itself they have identified the importance of golden ratio in visual beauty. There have been leaps and bounds in this field and we have reached the era of cosmetic surgeries. Most important among them is Dr. Stephen Marquardt who studied human beauty for years in his practice of oral and maxillofacial surgery. After his analysis of the human face from ancient times to the modern day, he established the relationship between beauty and golden ratio for both genders of all races, cultures and eras through the Beauty mask which he developed. Pentagonal and decagonal structures form the foundation of this beauty mask, which include golden ratios in all their dimensions. In this work an attempt is made to form an equational analogue of the face mask.

**Results:** By using the curve fitting method, which is an approximation method, an equation of beauty for the face is derived. In the derivation of this equation not all the golden ratios of the face are taken in to account. Due to these reasons, the accuracy and applicability of this equation can be determined only through trials.

**Conclusions:** Beauty has many facets. Yet, through this study it is established that at least the physical aspect of beauty is measurable.

**Keywords:** Equation of beauty, Beauty mask, Curve fitting.

11-07

### ENHANCED ELECTROMAGNETIC ABSORPTION OF CB AND RGO INCORPORATED SILICON RUBBER IN X AND KU BAND

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**Background:** While smart phones and tablets of modern times use high speed microwaves and millimeter waves for

communications, electromagnetic interference from different sources significantly debilitate their performance. In this regard, conducting polymer nano-composites represent a novel class of materials that possess unique combination of electrical, dielectric, magnetic and mechanical properties which are useful for the suppression of electromagnetic noises. Here, polymer chosen was Silicon rubber since they possess low density, good chemical resistance, weather resistance and convenient fabrication technique. In the present work, our focus is to explore the shielding behavior of an easily available and cost effective alternative, Carbon Black (CB), in accompanying with a well-known graphene without compromising the flexibility of SR.

**Method:** Solution mixing followed by hot pressing was adapted for the preparation of polymer nano-composites. Modified Hummer's method was used for the synthesis of reduced graphene oxide (rGO). The as-prepared rGO and CB were subjected to ultra-sonication for 30 min in n-hexane medium separately. Then the above solutions were mixed together and again sonicated about 1h to get a homogeneous solution. Then silicon rubber and dicumyl peroxide were dissolved into n-hexane and mixed well with the above solution. After mixing, dried overnight at 60°C and then hot pressed at 200 °C/20 min under a pressure of 2 MPa using appropriate dies.

**Results:** In the present work the as-prepared rGO was characterized using various techniques such as X-ray diffraction, UV-Visible absorption, FTIR and FESEM. Then the incorporation and uniform distribution of fillers within the polymer were also confirmed by XRD, FESEM image and FTIR spectra of the composite. Microstructure of the composite mimic the layer like structure of rGO and the CB particles are more or less homogeneously distributed throughout the entire composite without agglomeration. A lot of interfaces and boundaries were produced by the multiple carbonaceous fillers and also form a 3D conductive network within the rubber matrix. From the electrical conductivity studies it was found that the overall conductivity of the composites increases with increase in rGO wt%. Permittivity measurements revealed that both  $\epsilon'$  and  $\epsilon''$  increases with increase in wt% rGO and CB. The dielectric loss tangent  $\tan\delta_{\epsilon} = \epsilon''/\epsilon'$ , was also effectively improved. The composite shows absorption dominated EMI shielding and a maximum  $SE_T \sim 28$  dB can be achieved at 8-18 GHz.

**Conclusions:** A simple and economical strategy for the fabrication of flexible shielding material for practical applications, have been demonstrated. The strategy follows the utilization of a hybrid carbonaceous filler, easily available CB and the 2D rGO, as an efficient EM radiation attenuator for the silicon rubber. The composite displays superior absorption dominated shielding property,  $SE \sim 28$  dB due to the synergistic effect of hybrid fillers. The electric conductivity, microstructure and EMI SE results suggest that the hybrid rGO@CB filler forms a 3D conductive framework within the polymer matrix wherein the EM radiation undergo multiple reflections and subsequently dissipated as heat. Therefore, the results indicate that the proposed simple strategy can be widely applied for effective and practical EMI shielding systems.

**Keywords:** Polymer composites; Electromagnetic interference shielding; Microstructure Electrical properties

11-08

## OPTIMIZATION OF ELECTROCHEMICAL PERFORMANCE, AND OPERATION VOLTAGE OF SUPER CAPACITOR

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**Background:** It is highly desirable to develop an electrochemical double layer supercapacitor (EDLC) with high energy and power densities, improved stability and other performance parameters. This goal can only be achieved by improving the structural and electrochemical properties of the electrodes, choosing an electrolyte with improved ionic conductivity and reducing contact resistance of the current collector and their correlated effects.

**Methods:** In this work, we have fabricated EDLC supercapacitors with carbon based electrode materials, conventional and ionic liquid electrolytes and aluminium and copper current collectors were used to investigate the effect of process variability, stability and operating voltage of the fabricated supercapacitor investigated their performance by physico-chemical properties: X-ray diffract meter (XRD), Atomic Force Microscopy (AFM), Scanning Electron Microscopy (SEM), Raman Spectroscopy and FTIR; and electrochemical performance: Cyclic Voltammetry, galvanostatic discharge measurements and impedance spectroscopy of the fabricated supercapacitors.

**Results:** By tuning the individual and collective effects, we could fabricate a super capacitor with high specific capacitance of 726F/g and operation voltage of 4V with activated carbon as electrode, inorganic salt crossed IL gel as electrolyte and PCB designing copper clad as current collector to propose this combination to be the best cost-effective

choice for energy storage application.

**Conclusions:** Individual effects governing the performance of a supercapacitor was investigated by choosing different electrodes, electrolytes and current collectors by physicochemical and electrochemical means for optimizing their operating voltage and achieved capacitance. The electrode material used was activated carbon, while electrolytes were inorganic salt (Na<sub>2</sub>SO<sub>4</sub>), ionic liquid (Trihexyl (tetradecyl) phosphonium bis (trifluoromethanesulfonyl) imide) in aqueous and gel forms further by crossing the inorganic salt and IL. The current collectors used were copper foil, aluminium foil and PCB designing copper clad. The results revealed that the individual components viz. electrode, electrolyte and current collector had unique contribution to the overall electrochemical performance. The electrode material with high surface area can enhance the storage capacity, while the operating voltage is decided by the ionic conductivity and mobility of ions in the electrolyte. The overall resistance of the supercapacitor cell is governed by the current collector.

**Keywords:** super capacitors, Physical studies, electrochemical studies

11-09

### INSIGHT INTO INTERPLAY BETWEEN CRYSTAL STRUCTURE AND LUMINESCENT PROPERTIES OF GARNET PHOSPHORS

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**Background:** The endeavors for energy efficient lighting has now reached the era of solid state lighting in which light emitting diodes (LED) is the new alternative for lighting applications. The significant gap that exists between the present limiting performance of LEDs and the target performance should be reduced. For that, a thorough understanding regarding the role played by the host crystal in determining the emission properties is essential for tuning the optical properties.

**Methods:** The electronic copies of articles on garnet phosphors were collected from various publishers such as American Chemical Society, Royal Society of Chemistry, ScienceDirect, IOP etc. The correlation exist between selected quantities were plotted using Origin 9.0 software. The structural models were drawn using Crystal Maker software. The garnets under study were reported to be synthesized via solid state reaction route, sol gel method etc.

**Results:** Reviewing reported articles on garnets, it became obvious that with respect to the ionic radii of the cation and the site with which cation occupies in the host lattice, emission wavelength varies accordingly. More significantly, we found the strong coupling of bond distance with internal quantum efficiency as well as emission wavelength.

**Conclusions:** This review deciphers the interplay between the host crystal structure and luminescence properties which are essential in designing phosphors to overcome the present limitations for lighting applications.

**Keywords:** Garnets, Light Emitting Diodes, Optical properties, Internal quantum efficiency, Emission wavelength

11-10

### ANTIOXIDANT PROPERTIES OF LANTHANUM OXIDE NANOPARTICLES SYNTHESIZED USING ORGANIC AND BIOLOGICAL CAPPING AGENTS

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**Background:** Lanthanum Oxide (La<sub>2</sub>O<sub>3</sub>) is an odorless white inorganic rare earth oxide compound which is soluble in acids but insoluble in water. Due to its hygroscopic property, it absorbs moisture from atmosphere and change to Lanthanum hydroxide. It is suitable for ceramic and optical applications due to the thermal stability. Lanthanum Oxide nanoparticle have a lot of unique properties that make them suitable for biological, industrial and technological application such as biosensors, optical fibers, automobile exhaust catalysts etc.

**Method:** In the present work, we have synthesized Lanthanum Oxide nanoparticles by chemical co-precipitation method using biological capping agents such as DNA and STARCH and chemical capping agent Ethylene diamene tetra acetic acid (EDTA). The carbonate thus obtained is calcinated accordingly with the thermo gravimetric analysis (TGA) to obtain the oxide nanoparticles. Then the samples are characterized by X-ray diffraction pattern (XRD), Scanning Electronic Microscopy (SEM) and Energy Dispersive X-ray Analysis (EDAX). The antioxidant activity of different

samples is determined by using 1, 1-diphenyl-2-picryl hydrazyl (DPPH) assay according to Chang et al [2001]. The decrease in the absorption of the DPPH solution after the addition of the sample is measured at 517 nm. Ascorbic acid (10mg/ml DMSO) is used as reference. Antioxidant (H-A) reacts with DPPH and reduce it to DPPH-H and as consequence the absorbance decreases.

**Results:** The particle size obtained from XRD analysis using biological capping agents is compared with that of chemical capping agent for different temperatures. The average particle size is obtained from XRD analysis. Using SEM analysis morphology of the nanoparticles is studied for different temperatures. The elementary configuration is obtained from EDAX.

**Conclusions:** The XRD result shows that biologically synthesized Lanthanum Oxide nanoparticle has small grain size than chemically synthesized Lanthanum Oxide nanoparticle. The SEM images of the Lanthanum Oxide nanoparticles for different capping agents at different temperatures shows that the morphology of the nanoparticles has a good correlation with the particle size. The antioxidant study reveals that Lanthanum Oxide nanoparticles synthesized using biological capping agents have good antioxidant activity than the nanoparticle synthesized using organic capping agent at different concentrations.

**Keywords:** Chemical co-precipitation method, Lanthanum Oxide nanoparticle, EDTA, DNA, STARCH, TGA, XRD, SEM, EDAX, Antioxidant.

11-11

### INVESTIGATING THE ELECTROMAGNETIC AND CHEMICAL ENHANCEMENTS IN G-SERS WITH THERMALLY EVAPORATED SILVER

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Surface enhanced Raman spectroscopy (SERS) is an analytical tool with single molecular detection capability. Graphene, the two-dimensional allotrope of carbon, can take multiple roles in SERS. It can act as probe, a uniform surface for plasmonic nanostructures, nanometer size gap and as fluorescent quencher. Silver thin films were deposited over the graphene coated copper foil by thermal evaporation to make a Ag/G/Cu graphene mediated SERS substrate. Using Raman spectra, the maximum chemical enhancement along with electromagnetic enhancement has been identified for 15 nm Ag deposited G-SERS substrate. The limit of detection for the SERS substrate was  $10^{-10}$  M.

11-12

### STRUCTURAL STUDIES OF ZINC OXIDE THIN FILM BY SOL - GEL DIP COATING METHOD

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**Background:** Highly transparent semiconductor based metaloxides thin films have gained wide range of applications in modern industry, due to their extraordinary properties. Zinc oxide thin film is considered as the best candidate among the various semiconducting metal oxide thin films, since it is cost-effective, non-toxic and reproducible with consistent stoichiometry using chemical synthesis method.

**Method:** In this work, sol-gel dip coating technique is used to synthesize Zinc oxide thin films on glass substrate, with Zinc acetate precursor and ethanol as solvent. XRD, FTIR and UV-Visible spectroscopic techniques are used to determine its structural and optical properties. Effect of deposition parameter such as number of dipping, on the structural properties of the deposited films have been studied.

**Results:** XRD pattern confirms the preferential orientation which is sensitive to deposition parameters. Film deposited having 80 layers shows (101) plane and better transmission of 70% at 800 nm. Films of 40 layers depicts the transition from amorphous to polycrystalline characteristics having (002) plane and better than 92% at 800 nm. These films can be strictly used in optoelectronic devices.

**Conclusions:** Sol-gel dip coating technique is the best technique for the preparation of Zinc oxide thin films owing to

its simplicity, low cost and non-vacuum system of deposition. The structural and optical properties of those films can be tailored by changing various deposition parameters.

**Keywords:** Sol-gel, transparent conducting oxide, deposition parameter

11-13

### RESPONSE OF BHINDI (*ABELMOSCHUS ESCULENTUS* L. MOENCH) TO FERTIGATION AND FOLIAR NUTRITION OF MICRONUTRIENTS ON THE GROWTH, YIELD AND QUALITY OF BHINDI

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**Background:** Fertigation coupled with foliar application of micronutrients is gaining popularity as tools for improving production. As there is widespread micronutrient deficiencies in most of the soils Fertigation and foliar nutrition proved to improve growth by providing optimum nutrient availability conditions for nutrient absorption. For attaining maximum crop productivity, the right quantity of fertilizers at the right time is essential; hence the present investigation is taken up to study the influence of these practices on growth, yield and the quality of in bhindi.

**Method:** A field experiment was conducted during 2016-2018 to standardize the time and site specific dose of nutrient application and to evaluate the effect of fertigation of major nutrients and foliar nutrition of micronutrients in bhindi variety 'Arka Anamika', to assess the impact of nutrient on yield and quality of the crop. The field experiment was laid out in Randomized Block Design (Factorial RBD) with eight treatments and two controls and each were replicated three times.

**Results:** Foliar application of micronutrients was significant regarding number of fruits per plant, highest number of fruits per plant (21.92) and highest carotenoid content (2.56 mg g<sup>-1</sup>) was observed with S<sub>2</sub> (Foliar application of micronutrients at 4 per cent concentration) and it was superior to S<sub>1</sub> (21.45). Application of micronutrients increases fruit number, length and diameter.

**Conclusions:** The findings revealed that time of fertigation at once in two days, levels of fertigation at the rate of 100 per cent NPK and foliar application of micronutrients at 4 per cent concentration had remarkable influence on growth, yield and quality of bhindi, the same treatments recorded maximum soil nutrient status and leaf nutrient content of bhindi.

**Keywords:** Bhindi, fertigation, foliar application of micronutrients, yield

11-14

### WETTING MECHANISM OF BIMODAL POROUS TiO<sub>2</sub>-ZrO<sub>2</sub> TRANSPARENT COATINGS

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**Background:** TiO<sub>2</sub> as a self cleaning coating has the advantage to make use of both solar energy as well as rainfall to clean the surface and hence it is possible to lower the cost of maintenance. For balancing both transmission and photocatalytic properties in titania, general approach is to synthesize binary composites made up of TiO<sub>2</sub> and a low refractive index material such as ZrO<sub>2</sub>, SiO<sub>2</sub> etc. The excess surface hydroxyl groups arising by incorporating ZrO<sub>2</sub> into TiO<sub>2</sub> trap photo induced holes which increases catalytic activity by recombination of electron-hole pairs.

**Method:** Hierarchically porous double templated TiO<sub>2</sub>-ZrO<sub>2</sub> composites as self cleaning coatings were developed on glass substrates using dip coating technique. For comparative studies, single templated TiO<sub>2</sub>-ZrO<sub>2</sub> thin films were also synthesized using the same method with PMMA only.

**Results:** The formation of the composite and successful incorporation of the polymer into the composite was verified by means of Fourier transform infrared spectroscopy and thermogravimetric analysis. The porous nature of the film was studied using field emission scanning electron microscopy. Raman studies and elemental mapping revealed the presence of Titanium (Ti), Zirconium (Zr) and Oxygen (O) elements.

**Conclusions:** The double templated nanoporous TiO<sub>2</sub>-ZrO<sub>2</sub>-PMMA-PF127 coating is found to have better hydrophilic



property even a day after UV-irradiation. Efficient photocatalytic property was observed for porous hydrophilic film, which is more accessible to water and hence cleans out dirt quickly showing higher self cleaning nature.

**Keywords:** Nanoporous, Composites, Hydrophilicity, Retainability

11-15

### A FLEXIBLE, POROUS, ENVIRONMENT FRIENDLY, INTEGRATED SUPERCAPACITOR USING rGO-MODIFIED FILTER PAPER

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**Background:** Super capacitors are gaining attention as high-performance energy storage devices and flexible super capacitors have wide range of applications especially in flexible portable electronic devices. This work reports the construction of a flexible, porous, environment friendly integrated super capacitor from modified filter paper using reduced graphene oxide (rGO) as the active material which is produced by a green reduction technique.

**Method:** L-ascorbic acid- reduced graphene oxide was used as the active material. The structural characterization, morphological and optical characterization of the samples were done. A filter paper was cut, folded and rGO electrodes were patterned in a particular way such that both the electrodes and the separator were integrated into a single system and the electrochemical performance was evaluated.

**Result:** Reduction using L-ascorbic acid is successful in synthesizing rGO. The modified filter paper-based super capacitor has higher values of specific capacitance when compared to conventional coin type super capacitor using the same active material. This is due to the porous nature of the filter paper that enabled the used of more surface area.

**Conclusion:** A filter paper was cut, painted with the rGO electrode material and folded in a proper pattern to act as both the electrodes and the separator thus forming an integrated flexible, porous super capacitor where the specific capacitance was much higher than that of a coin type supercapacitor.

**Keywords:** Super capacitor, L-ascorbic acid, reduced graphite oxide, flexible supercapacitor

11-16

### INFLUENCE OF EU<sup>3+</sup> SUBSTITUTION ON CRYSTAL STRUCTURE AND OPTICAL PROPERTIES OF SrBiLiTeO<sub>6</sub> DOUBLE PEROVSKITE

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**Background:** Light Emitting Diodes (LEDs) are propitious solutions to the share of lighting in the global energy crisis. The commercially available Yttrium Aluminium Garnet (YAG) coated white LEDs lack good Correlated Color Temperature and Color Rendering Index values. This pronounces the importance of synthesizing new chemically and thermally stable red phosphors. Host materials with Double Perovskite structure doped with red emitting Eu<sup>3+</sup> activator ions provide appreciable results in the literature.

**Method:** This work envisages the variations developed in the structure of the previously reported compound, SrBiLiTeO<sub>6</sub> (SBLTO) when doped with various concentrations of xEu<sup>3+</sup> ions (x = 0.025-0.175mol in steps of 0.025 mol) with the aid of X-ray Diffraction and FT-Raman Spectroscopy. Further, the site symmetry of Bismuth ions and the luminescent properties such as band gap, emission wavelength, concentration quenching and emissive life time is studied using Diffuse Reflectance Spectroscopy and Photoluminescence Spectroscopy.

**Results:** The XRD patterns confirm the effective incorporation of Eu<sup>3+</sup> ions into the host lattice. The expected shift in the Raman peaks affirm the absence of structural variations on doping and also probes the local site symmetry. The band gap of 3.67eV favors UV-Visible excitations and using an excitation wavelength of 464nm, an orange red emission of 610 nm is observed with a concentration quenching at 0.15 mol of Eu<sup>3+</sup> ions. The emissive life time values suggest that the developed phosphor is suitable for white LED applications.

**Conclusions:** The optical properties and local site symmetry of the tellurate, SBLTO was studied for the first time and luminescent characterizations carried out conclude that the compound could be efficiently excited under UV-Visible radiations to emit orange red color, suitable for white LEDs

**Keywords:** Double Perovskites, Tellurates, Eu<sup>3+</sup> ions, orange red phosphor.

11-17

### ENHANCED LIGHT EXTRACTION FROM ORGANIC LIGHT EMITTING DIODES USING A NANOPARTICLE SCATTERING LAYER

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**Background:** Organic light emitting diode (OLED) based lighting technology has gained significant momentum because of fast response, high efficiency, low power consumption, self-emission, superior color quality, ultrathin profile and applicability to flexible substrates. Although the internal quantum efficiency of OLEDs can be made nearly 100% by using phosphorescent emitters, the refractive index mismatch between the layers causes total internal reflection at the layer interfaces. Thus, only about 20% of the generated photons can leave the device as useful light. Modification of the glass air interface at the emitting surface by appending a light extraction layer can enhance the amount of light out coupled several folds.

**Method:** We prepared an external light extraction layer for enhancing the out coupling efficiency of an OLED. Sylgard 184 from Dow Corning was used for the film preparation. The clear elastomer and the curing agent were thoroughly mixed with a weight ratio of 10:1 and vacuum de-gassing was done for removing the air bubbles in the mixture. ZnO nanoparticles (NPs) were added with different weight percentage to the mixture and were mixed thoroughly. The substrates for the PDMS-ZnO film preparation were made by coating a sacrificial layer of ARP 3510 photoresist from ALLRESIST GmbH on a plane glass. The PDMS-ZnO composites were then spin coated at different speeds over the prepared. The layers were cured by keeping at 150<sup>o</sup> C for 15 minutes. The cured film was then separated by keeping the substrate in acetone.

**Result:** A maximum enhancement factor (EF) of 102% was observed for the green device on applying the extraction film of 108  $\mu\text{m}$  thickness and having a concentration of 100 mg/g at 4 V. As the voltage goes higher, more light will be emitted from the device and there is a possibility of destructive interference of the scattered light within the film. Thus, the EF decreases as the voltage goes higher. A maximum EF of 56% was observed for the red device with an extraction film of 50 mg/g concentration and a thickness of 119  $\mu\text{m}$  at 4 V.

**Conclusion:** A polymer-NP scattering layer was fabricated by simple and low-cost solution processing technique. The layer can be attached to the emitting side of the OLEDs without interrupting the device fabrication. The electroluminescence spectra of the devices with the film did not show any variations in the chromaticity. This procedure can be easily attributed to the roll to roll process for high volume manufacturing.

**Keyword:** External Light extraction layer, Zinc oxide, Optical outcoupling, OLED.

11-18

### ULTRAVIOLET PHOTODETECTORS BASED ON ZINC OXIDE: DEPENDENCE ON MORPHOLOGY

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**Background:** Ultraviolet (UV) radiation has very important role on the survival and development of human kind. Moderate skin exposure to UV radiation is useful for health but over exposure to UV radiation can cause skin cancer, premature ageing, burns etc. Thus UV photodetectors find wide range of applications in civilian and military areas. Many wide band gap semiconductors are used for developing UV photodetectors. Among them Zinc Oxide(ZnO) is a most promising material for the fabrication of fast response, high sensitivity and high selectivity UV photodetectors. Various morphologies of ZnO can be easily obtained. The electrical, optical and structural properties of ZnO vary with

the morphology, which influences the device performance.

**Method:** This work deals with the fabrication of UV photodetectors based on ZnO nanoparticles and ZnO nanorods in photoconductor configuration. ZnO nanoparticles were synthesized by precipitation method and ZnO nanorods were synthesized by hydrothermal method. The current-voltage characteristics and transient photoresponse of the device were studied with Keithley source meter and 6 W UV lamp with 365 nm and 254 nm wavelengths.

**Results:** The device based on nanoparticles exhibited an on/off ratio of 1.5 under 365 nm light illumination and 2.8 under 254 nm light illumination at 20 V. On the other hand, ZnO nanorod based device exhibited an on/off ratio of  $1.73 \times 10^2$  under 365 nm light illumination and 79 under 254 nm light illumination at 1 V. The ZnO nanorods based device exhibited good performance due to high surface to volume ratio and long conduction path. The ZnO nanoparticles based device exhibited rise and fall times of 1.51s and 0.54s respectively under 365 nm light illumination at 20V. The ZnO nanorods based device exhibited rise and fall times of 8.19s and 18.97s respectively under 365 nm light illumination at 20V.

**Conclusions:** We fabricated UV photodetectors based on ZnO nanoparticles and ZnO nanorods and studied the effect of morphology on device performance. It is found that nanorod morphology is more effective in UV detection. Since the ZnO nanoparticles and nanorods were synthesized at low temperatures, these techniques are suitable for the fabrication of flexible UV photodetectors.

**Keywords:** ZnO, nanoparticles, nanorods, UV photodetector

11-19

#### INFLUENCE OF GATE DIELECTRIC PROCESSING ON THE PERFORMANCE OF OFETs: EFFECT OF SOLVENT POLARITY

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**Background:** Among various organic materials based devices Organic Field-Effect Transistors (OFETs) have gained enormous interest due to their potential applications in memory devices, complementary circuits, radio frequency identification tags (RFID), flexible active matrix displays and various chemical and biological sensors. Performance of the OFET largely depends on their processing.

**Method:** This work focusses on the electrical performance parameters of the pentacene based OFETs, fabricated with poly(methyl methacrylate) (PMMA) gate dielectric layer cast from solvents of varying dipole moments. Fabrication and characterisation of the OFETs involves spin coating, physical vapour deposition, structural and morphological analysis and electrical characterisation.

**Results:** Dielectric constant of PMMA films cast from solvents of varying dipole moments showed an increase with increasing the polarity of the solvent used. Leakage current was minimum in the case of PMMA film cast from low dipole moment solvent. Surface morphology studies of pentacene showed large grain sizes which when deposited on PMMA cast from low dipole moment solvent. OFETs electrical performance parameters were found to be decreased with increasing the polarity of the solvents used for casting PMMA gate dielectric layer.

**Conclusions:** This report reveals that the selection of appropriate solvent for the gate dielectric is an important factor to obtain very good electrical performance and stability of the organic field-effect transistors. This study reports that organic field-effect transistors fabricated with PMMA gate dielectric cast from low dipole moment solvent showed enhanced electrical performance in comparison with those from high dipole moment solvents.

**Keywords:** Organic field-effect transistor, solvent polarity, gate dielectric

11-20

**GREEN FLUORESCENT CARBON NANOPARTICLES FROM THE PITH OF  
MANIHOT ESCULENTA (TAPIOCA) STEM FOR Fe(III) DETECTION**

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**Background:** The production of better functional materials for future application from naturally existing materials with the help of green chemistry is a great challenge for the scientific community to satisfy the needs of modern lifestyle and developing technology. In this situation, Carbon nanostructures capable of providing better desired property has a major role if they can be synthesized from naturally existing biomaterials by cost effective synthesis methods. Pith from tapioca stem is a better source for the production of carbon nanoparticles since they are rich in carbon containing molecules as well as it is a non-edible part of a common agricultural product in Kerala.

**Method:** In this work, Carbon nanoparticles were synthesized from pith of tapioca stem by simple and cost effective hydrothermal method at 210 without using any chemicals. The obtained functionalized Carbon nanoparticles were characterized by XRD, HRTEM, XPS and FTIR methods and their optical properties and applicability in Fe(III) sensing are studied by UV-Visible absorption and Photoluminescence emission spectroscopy.

**Results:** The XRD and HRTEM analysis indicates that the derived structures are amorphous in nature and has a spherical morphology with an average dimension of 24 nm. The FTIR and XPS results confirm that the extracted nanostructures from pith are functionalized Carbon nanoparticles. The functional groups present on the surfaces of them act as charge trapping centres and result in strong UV absorption as well as an excitation dependent high intensity PL emission with a high quantum yield value of 19.2%. By taking the fluorescence quenching of emission in presence of different ions, it is identified that these functionalized carbon nanoparticles are efficient candidate for Fe(III) ion detection.

**Conclusions:** This study concludes that Hydrothermal Synthesis is a cost effective and facile synthesis method to extract Carbon nanoparticles from biomaterials. The functionalized carbon nanoparticle thus derived from pith of tapioca stem can be used as an efficient green luminescent material as well as a highly sensitive sensor for the detection of Fe(III) ions in water.

**Keywords:** Functionalized carbon nanoparticles, Fluorescence quenching, Fe(III) ion detection.

11-21

**THERMODYNAMICS OF QUARK GLUON PLASMA USING CLUSTER EXPANSION**

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**Background:** The experimental demonstration of quark gluon plasma (QGP) in large hadron collider (LHC) provides new insights, where the experiments were carried out at extremely very high energy densities and temperature. Under this condition quantum chromodynamic (QCD) many body interactions are possible, and the quarks are interacting through the coupling of their color charges. In this paper we found the non ideal equation of state, energy density and entropy density and their variation with temperature of non ideal Quark Gluon Plasma (QGP) in the deconfined phase using the Mayer's cluster expansion.

**Method:** To make theoretical study and predictions of the QGP phase, different models are developed like bag model, Cornell potential model, relativistic harmonic oscillator model etc. In this paper, to find the equation of state and other properties of deconfined phase, we use the potential suggested by S. Mattiello and W. Cassing. The interaction potential in the deconfined state is given by

$$U(r) = \left( \frac{\pi}{12r} + \frac{C_2}{2N_c T} \right) e^{-m_D r} \quad (1)$$

where  $r$  is the radial distance,  $C_2$  is the non perturbative dimension two condensate,  $M_D = 1.26 T$  is the Debye mass,  $T$  is the temperature and  $N_c$  is the number of color. The Mayer's cluster expansion method is used with the Fourier transformed potential.

**Conclusions:** This work establishes the use of cluster expansion to obtain the equation of state, energy density and

entropy density of QGP phase and their variation with temperature. It is proved that in the high temperature limit the equation of state and other thermodynamic properties matches with the Stefan-Boltzmann limit.

**Keywords:** Equation of state, Cluster expansion, Quark gluon plasma.

11-22

### ENHANCEMENT OF PROPERTIES IN BiFeO<sub>3</sub> DUE TO PHASE TRANSITION BY EUROPIUM DOPING

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**Background:** BiFeO<sub>3</sub> is a room temperature multiferroic system with rhombohedral structure. Rare earth doping in place of Bi<sup>3+</sup> induce phase transition in BiFeO<sub>3</sub>. It enhances the structural, magnetic, and dielectric properties of the system. It also improves the memory storage and gas sensing properties of this multiferroic system.

**Methods:** Eu<sup>3+</sup> doped BiFeO<sub>3</sub> multiferroic nanopowder samples are prepared by sol-gel method and are calcined at 600°C for 2 hours. Positron annihilation spectroscopy and X-ray Diffraction spectroscopy used for the study of structure transformation. Better studies can be carried out if the samples are prepared in thin film form by, say, Pulsed Laser Deposition (PLD).

**Results:** The phase transition of the samples from rhombohedral to an orthorhombic structure occurs at the composition  $x > 0.2$ . and are observed by both positron annihilation spectroscopy and X-ray Diffraction. This structural transformation enhances the properties such as magneto electric coupling, magnetic properties and dielectric characteristics of the samples.

**Conclusion:** Nanosized Bi<sub>1-x</sub>Eu<sub>x</sub>FeO<sub>3</sub> (x=0, 0.1, 0.2) system has been prepared by sol-gel method using PVA as a chelating agent. The XRD result and Positron lifetime spectroscopy confirms the structural transformation from rhombohedral distorted perovskite structure to orthorhombic structure Eu doping. It enhanced the dielectric and magnetic property of the sample at x = 0.2 in Bi<sub>(1-x)</sub>Eu<sub>x</sub>FeO<sub>3</sub>.

**Keywords:** Bismuth ferrite, defects, positron annihilation, vacancies, pulsed laser deposition

11-23

### SPECTROSCOPIC STUDIES OF CERIUM BASED NANOPHOSPHORS

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**Background:** The luminescence properties can be tuned by doping with suitable rare earth metals. Among these, Cerium is an efficient dopant, because it has only one electron in the first shell of the 4f orbital and its optically active transition (4f-5d) can occupy only in low symmetry sites. Cerium ion doping in ZnS produce efficient phosphor materials with a complete subset of colors.

**Method:** Nanometer sized Ce<sup>3+</sup> doped ZnS were synthesized via solid state reaction method at low temperature. The structural, compositional and morphological of the samples were analyzed by XRD, FTIR, EDS and FE-SEM. The optical characteristics were analyzed using UV-Vis spectroscopy, PL spectroscopy and CIE chromaticity coordinates.

**Results:** The XRD results reveal that the prepared samples belong to hexagonal wurtzite structure. The crystallite size of the particles calculated by Scherrer formula shows that the size of the particles decreases with Ce<sup>3+</sup> doping. The presence of Ce<sup>3+</sup> ions in the synthesized samples were confirmed by energy-dispersive spectrum. FTIR spectra characterize various vibrational bonds present in the samples. The value of band gap energy has been found in the range 3.2-3.4eV using UV-Vis spectrophotometer. The photoluminescence spectrum of Ce<sup>3+</sup> incorporated ZnS phosphor showed an UV emission and a defect emission and the Ce ions induced a red shift in the UV emission and a small enhancement in the

defect emission. The CIE chromaticity co-ordinates for all the concentrations were calculated.

**Conclusions:** The prepared sample confirms the hexagonal phase structure. The XRD results indicated that particle size decreases with Cerium doping. The FTIR observations show the chemical bonding in the lattice structure. The Energy Dispersive X-ray analysis reveals the presence of Zn, S and Ce element in doped samples. The optical band gap energy increases with Ce<sup>3+</sup> doping. The PL spectra show a green light emitting from ZnS and by doping with cerium shows blue fluorescence. The obtained ZnS:Ce nanophosphor emits blue light with CIE coordinates x=0.128 and y=0.192. In conclusion, Ce<sup>3+</sup> doped ZnS nanophosphor form an efficient phosphor material with strong visible emission intensity applicable in light emitting devices.

**Keywords:** Luminescence, nanophosphor, solid state, doping, UV emission, CIE coordinates.

11-24

### DIELECTRIC RELAXATION AND THERMAL STUDIES IN SUPER COOLED AND GLASSY STATES OF ANTI CANCEROUS ALKALOID BRUCINE

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Differential scanning calorimetry (DSC) is used to study the glass transition phenomenon and Broad Band dielectric spectroscopy (BDS) is used to study the molecular mobility through dielectric relaxation processes. Glass transition temperature (T<sub>g</sub>) obtained from DSC experiment is very much above the room temperature and it is closer to the T<sub>g</sub> obtained by BDS. Temperature and frequency dependence of real and imaginary part of complex dielectric constant are studied for broad frequency range of 10<sup>-2</sup> Hz to 10<sup>7</sup> Hz. Primary ( $\alpha$ ) and secondary relaxations ( $\beta$  and  $\gamma$ ) are observed above and below the glass transition temperature respectively. The temperature at which  $\alpha$  relaxation freezes is close to the T<sub>g</sub> value obtained from DSC experiment. Dielectric loss spectra are fitted using Havriliak - Negami equation and temperature dependence of relaxation time and dielectric strength are studied. Temperature dependence of relaxation time is fitted by Vogel-Fulcher-Tamann equation and found the values of activation energy of the  $\alpha$  relaxation fragility and glass transition temperature of Brucine. From the value of fragility (90.3) obtained from VFT fit, Brucine is a fragile glass former.

**PACS codes:** 64.70.pm, 81.05.Kf, 61.43.Fs, 65.60.+a, 77.22.Gm, 73.61.Jc, 65.80.-g

**Keywords:** Broad band dielectricspectroscopy, Dielectric relaxation, Glass transition, Brucine

11-25

### GREEN SYNTHESIS OF SILVER NANOPARTICLES AND THEIR APPLICATION AS SERS SUBSTRATES

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**Background:** The recent advances in the field of nanoparticle synthesis have a strong impact in many scientific areas. Out of different nanostructures synthesized so far, metallic nanostructures have been widely used as surface enhanced Raman scattering (SERS) substrates. Highly localized electromagnetic fields are produced by exciting the localized surface plasmon resonance (LSPR) of these nanostructures, which leads to remarkable enhancement of Raman scattering signals from the molecules at the surfaces of these nanostructures. Biogenic nanoparticles, compared to chemically synthesized, is still new but is developing rapidly in the last five years. Growing demand to develop environmental friendly processes for nanoparticle synthesis, avoiding toxic chemicals.

**Method:** Fresh latex from the plant *calotropis gigantea* is collected. The latex is centrifuged and the supernatant is collected. It is made up to 3% and reacted with silver precursor solution using chemical method. The product is purified to obtain spherical shaped silver nanoparticles.

**Results:** The spherical morphology of the nanoparticles obtained was analyzed using Field emission scanning electron microscope (FESEM) and High-resolution transmission electron microscopy (HRTEM). UV-visible absorption spectroscopy showed surface plasmon resonance (SPR) in the range of 430-440 nm. The X-ray diffraction pattern (XRD)

revealed the face centred cubic structure of silver nanoparticles. SERS activity of these nanoparticles as substrates were tested using two probe molecules crystal violet (CV) and nile blue chloride (NBC) which showed excellent signal to noise ratio in the spectra obtained. Linear calibration curves plotted for varying concentrations of probe molecules against signal intensity which showed excellent results.

**Conclusions:** Green synthesis of silver nanoparticles using *calotropis gigantea* plant is reported. Different characterization techniques were used for the analysis of these nanoparticles. SERS activity studies of the nanoparticles using crystal violet and nile blue chloride. The measure of linearity responses obtained here indicates that these silver nanostructures can find potential applications in SERS based sensors.

**Keywords:** Green synthesis, silver nanoparticles, surface enhanced Raman scattering, crystal violet, nile blue chloride.

11-26

### UTILIZATION OF PERLITE AND VERMICULITE IN CEMENT COMPOSITES FOR GAMMA RAY SHIELDING APPLICATIONS

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**Background:** The shield design is the most important aspect of the reduction of radiation to an acceptable level. Concrete is one of the important matrices, which play a very important role in the radiological shielding because of its good properties like structural strength, ability to attenuate gamma rays and low cost. Attempts to improve the shielding capacity by adding new multi-efficient materials to the conventional concrete mixture are going on at various levels. Its importance is increasing as more and more radiation sources are made use of nuclear physics research, electronic industry, material modification, material science, agricultural service etc.

**Method:** The present work is aimed to investigate the effects of adding perlite and vermiculite aggregates to cement as a shielding material. The Mass and linear attenuation coefficient of the samples were determined by using NaI (TI) detector and also calculated using Xcom program for the photon energies of 662 keV, 1172 keV, 1275 keV, and 1330 keV. The chemical composition as weight fraction for all samples were analyzed by EDXRF. Mechanical and physical properties such as compressive strength, water absorption, and porosity have been investigated. The thermo gravimetric analysis (TGA) and X-ray diffraction were used to examine the thermal stability and the other characteristics of the studied samples.

**Results:** Gamma-ray shielding capability of perlite and vermiculite composites were experimentally and theoretically examined. It can be seen that mass attenuation coefficients of both samples decrease as energy increase. The results of the experimentally determined attenuation coefficient agree with the theoretically evaluated values. Also, the mass attenuation coefficients of the selected samples were compared with values of known shielding materials (ordinary concrete and iron) for the same gamma-ray energies. The physical properties such as density, water absorption, porosity, and compressive strength were measured.

**Conclusions:** The obtained values of the mass attenuation coefficient,  $\mu$ , HVL and MFP were compared with values of different types of studied shielding materials. Considering factors such as availability, cost, thermo-chemical stability, and energy, we can conclude that perlite-vermiculite materials can be a choice for gamma radiation shielding for both medical and nuclear applications.

**Keywords:** Perlite, Vermiculite, Mass attenuation coefficient, half value layer, Compressive strength.

11-27

### THE STRUCTURAL AND MORPHOLOGICAL STUDY OF VERTICALLY ALIGNED ZNO NANORODS PREPARED BY CHEMICAL ROUTE

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**Background:** Nanorod morphology of ZnO prepared by chemical route is a versatile and low cost method for Quantum

dot sensitized solar cell as photo anode. The special nanotaper structure of ZnO rod will enhance the efficiency of the solar cell due to the increase in surface area.

**Method:** ZnO nanorod array were synthesized by hydrothermal method on ZnO seed layer prepared by chemical bath deposition on glass substrate. The structural, morphological and optical properties were investigated by adjusting the hydrothermal growth parameters.

**Results:** The study proved that single crystalline ZnO nanorods aligned along (002) direction could be grown on seed layers grown up to a growth time of 3 min. at a comparatively low growth temperature of 140°C without any post deposition treatment. The films were found to become polycrystalline with the increase in seed layer thickness higher than 3 min. The obtained ZnO thin films were transparent with a band gap of ~ 3.1 eV. Morphological investigation shows that by adjusting the hydrothermal growth parameters, ZnO nanorods with tapered ends could be obtained, which has promising application in quantum dot sensitized solar cells.

**Conclusions:** The study proved that the thicknesses of the seed layer influence the structural, optical and morphological properties of the prepared thin films. The seed layer prepared by chemical bath deposition was polycrystalline in nature. By varying the thickness of the seed layer, nanorods with tapered ends could be grown. ZnO thin films, which can be used as a photoanode for quantum dot sensitized solar cells, can be grown by a cost effective route at a low growth temperature.

**Keywords:** ZnO nanorods, ZnO nanotaper, Hydrothermal, Chemical bath deposition, Quantum dot sensitized solar cell.

11-28

### SPECTROSCOPIC FT-IR, FT-RAMAN, MOLECULAR DOCKING STUDIES, THERMAL STABILITY ANALYSIS, COMPUTATIONAL INVESTIGATION AND CONFORMATIONAL ANALYSIS OF DIURON

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**Background:** Density Functional Theory is a computational modelling method used to investigate the electronic structure of many-body systems. Thermo Gravimetric Analysis is a method of thermal analysis in which the mass of a sample is measured over time as the temperature changes. It can be used to evaluate the thermal stability of the compound.

**Method:** Theoretical and experimental investigations on the molecular structure and vibrational characteristics of 3-(3,4-dichlorophenyl)-1,1-dimethylurea (Diuron) have been carried out by density functional calculations. Potential energy scan was carried out to examine the effect of the  $-N(CH_3)_2$  group rotation on the overall stability of the molecule. The TGA analysis (Fig.S1-supporting information) was carried out using an SDT Q600 V20.9 Build 20, Module DSC-TGA Standard instrument.

**Results:** From HOMO-LUMO plot, it is clear that HOMO is delocalized over the entire molecule while LUMO is delocalized over the phenyl ring and chlorine atoms and this gives the charge transfer effect. The TG curve of diuron indicates that stability is up to 200 °C and shows two decomposition stages. The carbonyl oxygen atom and phenyl ring were found to be the electrophilic regions and the NH moiety the nucleophilic region of the title compound. The stretching mode of NH in the IR shows a downshift of from the computed value which is due to the strong interaction as evident from NBO analysis.

**Conclusions:** The spectroscopic properties of the title compound are examined experimentally and theoretically and the vibrational assignments are done by means of potential energy distribution. From molecular docking studies, the binding affinity value of diuron is calculated to be -6.5 kcal/mol. The Anti conformer was predicted to be more stable than the Syn conformer.

**Keywords:** Thermo Gravimetric Analysis, HOMO-LUMO, Density Functional Theory



11-29

### EFFECT OF ELECTROLYTE TEMPERATURE ON ALUMINIUM DOPING OF TiO<sub>2</sub> NANOTUBES BY ELECTROCHEMICAL ANODISATION

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**Background:** TiO<sub>2</sub> nanotubes has been extensively studied as a novel material in various applications including dye-sensitized solar cells (DSSCs), photocatalysis and sensors because of its photochemical properties, biocompatibility and low-cost. Eventhough the wider bandgap of TiO<sub>2</sub> is desirable for certain applications, it shows poor response to visible light absorption and hence limits its photocatalytic applications. Also the low electrical conductivity of TiO<sub>2</sub> adversely affects its use in optoelectronic devices. To enhance the electrical and optical properties, metal ions are selected to dope into the TiO<sub>2</sub> structure.

**Method:** Here a simple two electrode system is used to fabricate Al doped TiO<sub>2</sub> nanotubes using 'two step anodisation' process.

**Results:** FESEM shows that even with Al doping, the tubular structure of the TONTs remain intact. The temperature reported here (40°C) is the lowest temperature reported so far for the preparation of crystalline TONTs. EDAX spectra show that Al concentration increases as the electrolyte temperature increases and that it contributes to increase in electrical conductivity of the doped TONTs, an observation very useful in DSSC applications. DRS analyses shows that Al doping decreases the band gap from 3.10 eV (pure TiO<sub>2</sub>) and it reduces from as the bath temperature of electrolyte increases from 20°C to 28°C thereafter an enhancement in bandgap is observed

**Conclusions:** Low fabrication cost, improved crystallinity, and tuned optical and electrical properties are the major advantages of this study and hence it is very much relevant in energy and environmental applications such as photocatalysis and DSSCs.

**Keywords:** Titanium dioxide, Nanostructures, Electrochemical anodization, Al doping, Crystallization.

11-30

### BIOCOMPATIBLE LUMINESCENT EUROPIUM DOPED FLUORAPATITE FOR IMAGING APPLICATIONS

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**Background:** The difficulties such as poor solubility and poor biocompatibility make fluorescent quantum dots like CdS, CdSe etc less applicable in the field of bioimaging. Apatites are a group of biocompatible phosphate minerals and fluorapatite (FAp) have higher luminescence than hydroxyapatites. The luminescent FAp crystal can be effectively used for bioimaging applications.

**Method:** In this work biocompatible luminescent Eu<sup>3+</sup> doped fluorapatite (FAp:Eu<sup>3+</sup>) was successfully synthesized by both coprecipitation and hydrothermal methods as an efficient bioimaging probe which can also be used for targeted drug delivery. X ray diffraction (XRD), photoluminescence (PL), fluorescence microscopy and energy dispersive spectroscopy (EDS) were respectively used for the structural analysis, luminescence studies and compositional analysis of the sample.

**Results:** The doping concentration of Eu<sup>3+</sup> for bioimaging applications is optimized to be 15 at%. The XRD and PL patterns showed that material is crystalline and shows luminescence corresponding to the D → F transitions in europium on UV excitation. Fluorescent microscope images of the as prepared and annealed samples show the luminescent nature of the material, making it suitable for bioimaging applications. The effects of doping on composition was inferred from the EDS data.

**Conclusions:** The fluorescent microscope images of the Eu<sup>3+</sup> doped FAp implies that it can be effectively used as a biological probe, both for targeted cell imaging and targeted drug delivery, to deliver chemotherapy molecule like doxorubicin to the cancer cells.

**Keywords:** Bioimaging, Fluorapatites, Biocompatible, Luminescence

11-31

### EFFECT OF NICKEL DOPING ON THE STRUCTURAL, MORPHOLOGICAL AND OPTICAL PROPERTIES OF PULSED LASER ABLATED $\text{BaSnO}_3$ FILMS

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**Background:** Barium stannate is an n-type semiconductor with cubic perovskite structure having a wide band gap of 3.1eV and has high stability upto 1000 °C. It has an important applications in the field of thermally stable capacitors, solar cells and can be used as a sensor materials for gases like CO, NO and for humidity sensors etc.

**Method:** The nickel oxide doped  $\text{BaSnO}_3$  films were prepared by pulsed laser deposition method. The deposition of the films are carried out using a Q-switched Nd:YAG laser (Quanta-Ray INDI-series, Spectra Physics) having frequency doubled 532 nm laser radiation of pulse width 7 ns. The NiO doped  $\text{BaSnO}_3$  films thus prepared were used for the structural, morphological and optical studies in detail. The crystalline nature and orientations of the NiO doped  $\text{BaSnO}_3$  films were characterized by different techniques such as XRD, FESEM, AFM and UV-Visible analysis.

**Results:** The XRD patterns shows that all the films are polycrystalline in nature corresponding to cubic phase of barium stannate and are indexed on the basis of JCPDS Ref. Code 15 -0780.

There is no peak corresponding to the nickel oxide which indicates that the incorporated nickel oxide is dissolved in the  $\text{BaSnO}_3$  films and it does not alter the cubic nature of the film. The undoped film has the highest average value of transmittance of 85% and the transmittance decreases with increasing doping concentration.

**Conclusions:** The NiO doped  $\text{BaSnO}_3$  films with 3wt% shows the highest crystallinity reveals that moderate doping enhances the crystalline quality and higher doping deteriorates the crystalline nature. The average size of the crystallites and the lattice parameter are calculated. The morphological and EDX reveals the incorporation of NiO in the  $\text{BaSnO}_3$  lattice. The transmittance decreases systematically with increase in NiO doping concentration and the band gap value decreases with with increase in NiO doping concentration .

**Keywords:** Pulsed laser deposition, Barium stannate, XRD, UV-Visible analysis.

11-32

### CADMIUM OXIDE AND STRONTIUM OXIDE - NOVEL NANOPARTICLES WITH EFFECTIVE BANDGAPS FOR TECHNOLOGICAL APPLICATIONS

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Cadmium Oxide (CdO) and Strontium Oxide (SrO) nanoparticles were synthesized by chemical co-precipitation method. The nanosamples annealed at 800°C were used for structural and optical studies. Debye-Scherrer equation was used to calculate the particle sizes of the synthesized materials. Optical characterizations of the nanosamples were carried out by using UV/Visible analysis. From the analysis of the absorption spectra, the direct optical bandgap of the nano samples were calculated in detail.

Oxide nanomaterials synthesized through chemical methods have proved to be very effective, providing better control as well as enable different sizes, shapes and functionalization than those generated through other physical methods. Metal oxide nanoparticles can be produced by soft chemical methods such as co-precipitation, sol-gel, hydrothermal synthesis etc. Among various chemical methods, co-precipitation has chosen in this work for the synthesis of the nanoparticles of Cadmium Oxide and Strontium Oxide.

Cadmium oxide nanoparticles are highly reactive and they can be used in energy storage systems, electro chromic thin films, magneto resistive devices etc. Metal oxide nanoparticles with high specific surface area and a high fraction of surface atoms have been studied extensively due to their unique physicochemical characteristics like catalytic activity, optical properties, electronic properties, antimicrobial activity etc. Cadmium oxide nanoparticles has not only the unique optical and optoelectrical characteristics but also has the selective catalytic properties that can be used to photo degrade some of the organic compounds, dyes, pigments and many environmental pollutants.

About 8% by weight of cathode ray tubes is strontium oxide, which has been one of the major uses of strontium oxide nanoparticles.

## Materials and Methods

### Synthesis of CdO and SrO nanoparticles

CdO nanoparticles were synthesized by chemical co-precipitation method using AR grade 0.1M cadmium nitrate, 0.02M citric acid and 0.5M sodium hydroxide as the reagents. Among the reagents, citric acid was used as the stabilizer to prevent agglomeration. The precipitates thus formed by stirring were separated from the reaction combination and were washed several times with distilled water. The dried precipitates at room temperature were thoroughly grounded using an agate mortar to obtain the fine nano powder. On heating at 800°C, nanoparticles of CdO were formed. The same procedure was used for the synthesis of SrO nanoparticles also.

## Results and Discussion

### Analysis of XRD Patterns of CdO and SrO nanoparticles

X-Ray Diffraction (XRD) is one of the commonly used methods for crystalline structure determination of nanomaterials<sup>2</sup>. XRD pattern divulge that the particles are nanosized and crystalline. The sharp peaks obtained from the XRD pattern indicate the crystalline nature of the nanosamples. The XRD patterns are drawn by taking angle (2 $\theta$ ) along the X-axis and intensity (counts) along the Y-axis. There is a definite line broadening of the XRD peaks which indicates the synthesized materials consist of particles in nanometer scale.

XRD patterns of the nanoparticles of CdO and SrO annealed at 800°C are shown in figures 1 and 2 respectively. Particle sizes are calculated using Debye-Scherrer equation<sup>3</sup>,  $t = k\lambda / (\beta \cos\theta)$ ; where  $k$  is the Scherrer constant and its value is taken as 0.9,  $\beta$  is the full width at half maximum of XRD peaks,  $\theta$  is the Bragg diffraction angle and  $\lambda$  is wavelength of X-rays used in XRD analysis. The broadening of the peaks in the XRD pattern may be due to the micro straining of the crystal structures arising from the defects like dislocations and twinning. The particle sizes are found to be 27 and 65nm for CdO and SrO nanoparticles respectively.

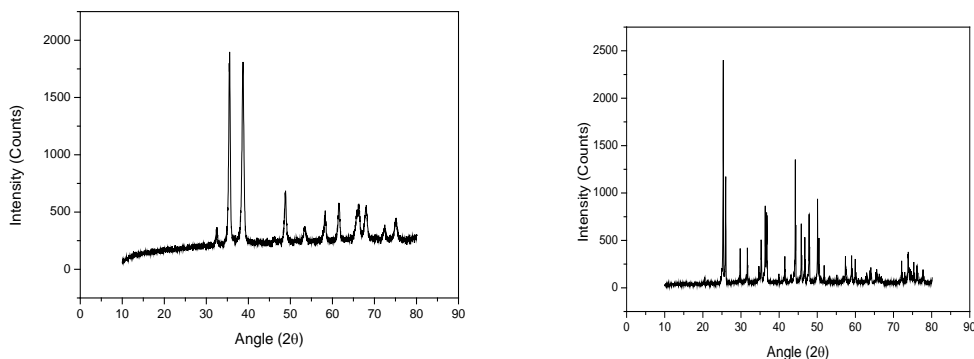


FIGURE 1 and 2 XRD Pattern of CdO and SrO nanoparticles

### UV Spectral Studies

Ultraviolet-Visible spectroscopy studies are widely used to quantitatively characterize organic as well as inorganic nanomaterials<sup>4</sup>. UV spectra of the nanoparticles of CdO and SrO annealed at 800°C are shown in figures 3 and 4 respectively. UV spectra provide important information about the details related with optical bandgap of the nanomaterials. The regular decrease in absorption indicates the presence of optical bandgap in the material. This corresponds to the excitation of surface plasmons in the composite nanoparticles. The energy band of the material is related to the absorption coefficient  $\alpha$  by the Tauc's relation<sup>5</sup>,  $\alpha h\nu = A(h\nu - E_g)^n$ , where  $A$  is a constant,  $h\nu$  is the photon energy,  $E_g$  is the bandgap and  $n=1/2$  for an allowed direct transition. Plot  $(\alpha h\nu)^2 - h\nu$  graph of the samples heated at 800°C and extrapolation of the straight line to  $(\alpha h\nu)^2 = 0$ , gives the value of the optical bandgap. The direct optical bandgap of the nanoparticles of CdO and SrO are shown in figures 5 and 6 respectively. The direct optical bandgap values are found to be 3.78eV and 2.33eV for CdO and SrO nanoparticles respectively.

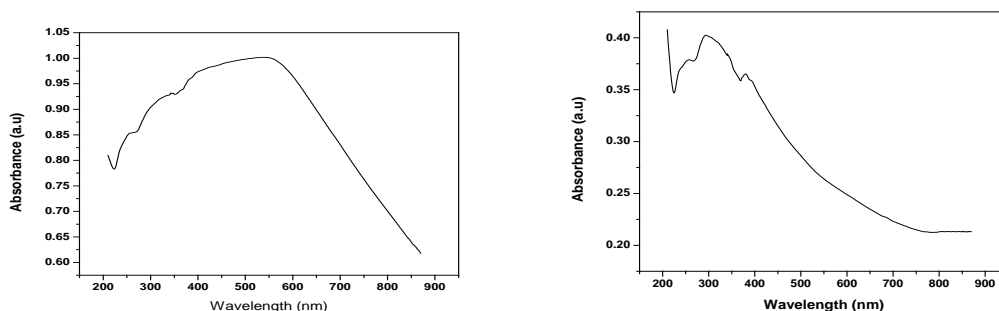


FIGURE 3 and 4 UV spectra of the nanoparticles of CdO and SrO

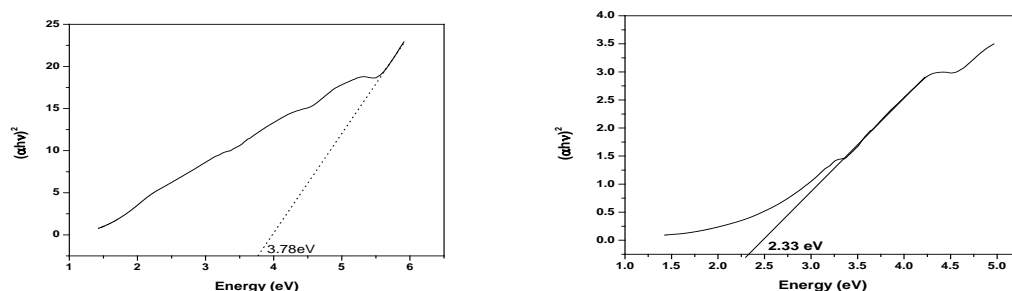


FIGURE 5 and 6 Optical bandgap energy calculation of CdO and SrO nanoparticles using Tauc's plot.

### Conclusion

Cadmium Oxide and Strontium oxide nanoparticles have been synthesized by chemical co-precipitation method. XRD patterns reveal that the nanoparticles synthesized are crystalline in nature. The broad peaks are the characteristics of the nanocrystalline nature of the samples. The particle size is found to be 27nm for CdO nanoparticles and 65nm for SrO nanoparticles. Direct optical bandgap values of the nanoparticles of CdO and SrO using Tauc's relation are found to be 3.78 and 2.33eV respectively.

11-33

## HYDROTHERMAL SYNTHESIS OF MOLYBDENUM DISULPHIDE ( $\text{MoS}_2$ ) NANOPARTICLES FOR ENERGY STORAGE APPLICATIONS

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**Background:** Molybdenum disulphide ( $\text{MoS}_2$ ) is a very promising 2D material. It's elemental constituents are abundant, nontoxic and can be easily synthesized at gram scale with cost effective techniques. Among the various 2D materials molybdenum disulphide becomes a material of significant interest due to its unique atomic and electronic structure. Moreover, Nano  $\text{MoS}_2$  can be considered as an analogue of graphene, which is well known for its distinct electrical, electrochemical properties and so on.

**Methods:** In this work we prepare  $\text{MoS}_2$  nanostructures using Ammonium Molybdate and Thiourea by hydrothermal method. Hydrothermal growth is an attractive and relatively simple method in which crystal growth occurs at mild conditions in water, producing high purity samples. XRD, SEM and PL studies were employed for the characterization of synthesized sample

**Results:** X-ray diffraction studies revealed the formation of randomly stacked layers of phase pure hexagonal phase  $\text{MoS}_2$  (2H-  $\text{MoS}_2$ ) were obtained at long growth durations. The FESEM images indicated the formation of porous

spherical nanostructures of MoS<sub>2</sub> which can be used for efficient charge storage. The layered structure was further confirmed by the PL spectra. The layered spherical structure enhances the surface area and act as efficient charge storage centres.

**Conclusions:** This work establishes a simple cost effective low temperature synthesis technique has been developed to synthesize MoS<sub>2</sub> for energy storage application

**Keyword:** Ammonium Molybdate, Thiourea, Hydrothermal growth

11-34

### CRYSTAL STRUCTURE, MICROSTRUCTURE AND MICROWAVE DIELECTRIC PROPERTIES OF NOVEL GLASS FREE NaPb<sub>2</sub>B<sub>2</sub>V<sub>3</sub>O<sub>12</sub> (B=Mg, Zn) CERAMICS

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**Background:** The modern communication systems demands dielectric materials with temperature stability and stringent dielectric properties, such as (i) high dielectric constant (ii) low dielectric loss (iii) high quality factor (iv) Low sintering temperature. They are widely used as dielectric resonators, duplexer, dielectric waveguide and microwave substrates etc. The sintering temperature of the materials can be reduced by adding low-melting glasses, chemical processing, and using nano particles as starting materials. However, the complication in fabrication method and increase in production cost become the main disadvantages of chemical synthesis. Hence, for microwave applications glass-free materials with good dielectric properties are strongly advised. It is reported that compounds having garnet structure possess low sintering temperature as well as good microwave dielectric properties.

**Method:** The present work investigates structural and dielectric properties of NaPb<sub>2</sub>Mg<sub>2</sub>V<sub>3</sub>O<sub>12</sub> (NPMVO) and NaPb<sub>2</sub>Zn<sub>2</sub>V<sub>3</sub>O<sub>12</sub> (NPZVO) ceramics. The compounds were prepared through conventional solid state reaction route under the calcinations temperature of 650 and 600°C respectively for NPMVO and NPZVO ceramics. The crystal structures of these compounds were studied using XRD and Raman spectroscopy. The dielectric properties and thermal properties were studied by the TE<sub>018</sub> mode cavity method using a vector network analyzer. The microstructures were analyzed using scanning electron microscope.

**Result:** XRD confirms that NPMVO and NPZVO have cubic garnet structure with a space group of Ia-3d. The deconvoluted Raman spectrum shows 14 and 15 Raman active modes out of 25 predicted by factor group analysis. The NPMVO ceramics exhibits relatively high dielectric constant in the order of 20.6 and high unloaded quality factor (Q\*f) around 22,800 GHz and a positive temperature coefficient of resonant frequency of 25.1 ppm/°C. While NPZVO ceramic has relatively higher relative permittivity of 22.4, unloaded quality factor of 7,900 GHz and near zero temperature coefficient of resonant frequency of -6 ppm/°C. The SEM analysis shows a relatively dense microstructure grain size varies about 2–10 μm for NPMVO and an average of about 7 μm for NPZVO ceramics.

**Conclusions:** In this work we developed a series of novel low temperature sintered ceramic compounds with good microwave dielectric properties, which can be used for future microwave dielectric applications.

**Keywords:** Crystal structure, Raman spectra, Garnet, Microwave dielectric properties

11-35

### BIOSYNTHESIZED, MAGNETICALLY RETAINABLE BINARY TRANSITION METAL OXIDE FEO/ MNO NANOCOMPOSITES FOR ENVIRONMENTAL REMEDIATION

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**Background:** Recently, biosynthesis of nanoparticles became a better choice for producing environmentally decontaminating and non-toxic product. Magnetically retainable binary transition metal oxide nanocomposites have a vital role in environmental protection due to their photo catalytic and pathogen destruction properties.

**Method:** In the present work the sample was prepared by chemical co-precipitation method using iron (III) chloride and manganese (II) chloride as cationic precursors at their respective molarity and sodium hydroxide solution being an anionic precursor to adjust the pH of the solution. The precipitate obtained was washed with alcohol and distilled water

several times. Then dried and heated at 600 °C to obtain FeO/MnO nanocomposite. The photo catalytic activity of FeO/MnO nanocomposites were studied by monitoring the degradation of Congo Red under UV-Visible light irradiation. The antioxidant and antimicrobial activities of the composites were also studied.

**Results:** The nanocomposite is very effective in the degradation of azo dye like congoRed. Defense against microbial studies reveal, the synthesized nanocomposites exhibited the strongest antibacterial activity against E.Coli than S. aureus in lower and higher concentration. Nanosized FeO/MnO Nanocomposite showed maximum of 72.43% scavenging activity against DPPH.

**Conclusion:** In conclusion, biologically synthesized nanoparticles possess an enormous potential in environmental remediation and can be pursued as an important material for future studies.

**Keywords:** FeO/MnO nanocomposites, azo dye, antibacterial, DPPH.

11-36

### STUDY ON YTTRIA/ALUMINA NANO COMPOSITE SYSTEM FOR THEIR APPLICATIONS AS INFRARED TRANSPARENT CERAMIC WINDOW MATERIAL

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**Background:** Infrared transparent ceramics found to have applications in infrared windows and domes in homing missiles and spacecraft employed for strategic defense and space missions. Yttria is a hopeful refractory material but its strength, sinterability etc are marginal. Alumina is an excellent additive to yttria matrix as it exhibits high strength, hardness and excellent corrosion resistance.

**Method:** In the present study we have developed a system of 80:20 mass percentage of yttria/alumina nanocomposite and studied their structural, optical, thermal and vibrational properties. The ultrafine starting powder of the nanocomposite ( $Y_2O_3 - Al_2O_3$ ) is synthesised by a single step modified combustion method.

**Results:** The as-prepared samples are characterized using X-ray diffraction (XRD) for determining the crystalline structure and phase of the nanomaterials. The phase formation of the system is confirmed from the JCPDS data viz. Card No 89-5591 for cubic yttria and 46-1212 for  $\alpha-Al_2O_3$ . The crystallite size calculated by Debye Scherrer equation for the high intense peak (222) plane of yttria is 17 nm and that for (122), (141), (212) plane of aluminium oxide is 12 nm, 11nm, 17nm respectively. Particulate properties of the combustion product are analyzed with the high resolution transmission electron microscopy (HRTEM) and are in good agreement with XRD results. The phase purity of the as prepared powder is further confirmed by FTIR spectroscopy. The thermal stability of the sample at elevated temperature is analyzed by TGA method. The UV-visible absorption spectrum was recorded in the range 200–800 nm. The band gap obtained for the material is 5.69 and absorbance wavelength is 227 nm. The theoretical refractive index is 1.85 and is in the range of infrared transparent materials (1.38-4). The material shows absorbance in UV region and theoretical transmittance determined from powder is about 83.6%.

**Conclusions:** The production of a high quality infrared transparent ceramic material is mainly focused on a high quality starting powder. The properties exhibited by starting powder of yttria/alumina sample at 80:20 mass% ratio reveals its suitability as an excellent infrared transparent ceramic material.

**Keywords:** Nanocomposite, Modified Combustion, Infrared Transparent, Sinterability

11-37

### INVESTIGATION OF NON-MONOTONIC VARIATION OF SECOND MAGNETIZATION PEAK IN A LOW $T_c$ SUPERCONDUCTOR, $Ca_3Rh_4Sn_{13}$

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**Background:** The occurrence of second magnetization peak (SMP) anomaly in the mixed phase of type-II superconductors indicates the order-disorder transition of the vortex lattice. Non monotonic variation of second magnetization peak anomaly with temperature is reported in high temperature superconductors. We elucidated the non-monotonic

behavior of the SMP in a low  $T_c$  superconductor,  $\text{Ca}_3\text{Rh}_4\text{Sn}_{13}$  ( $T_c=8.37$  K) by analyzing the critical current densities of the specimen.

**Method:** The dc magnetization measurements of  $\text{Ca}_3\text{Rh}_4\text{Sn}_{13}$  superconducting crystals were carried out using SQUID-vibrating sample magnetometer.

**Results:** Isothermal dc magnetization measurements in low temperature cubic superconductors,  $\text{Ca}_3\text{Rh}_4\text{Sn}_{13}$ , revealed the non-monotonic variation of second magnetization peak anomaly while increasing the temperature. It is further observed that the high critical current density ( $J_c$ ) of the samples may elicit the non-monotonic variation of SMP anomaly. From X-ray diffraction and electron probe micro-analyses, it is evident that the crystal which shows the non-monotonic SMP has slightly higher concentration of point disorders and this causes the increase of critical current density.

**Conclusion:** The slightly higher concentration of point disorders causes the increase of critical current density in type-II superconductors,  $\text{Ca}_3\text{Rh}_4\text{Sn}_{13}$  and the increased critical current density causes the non-monotonic variation of the SMP anomaly.

**Keywords:** Second magnetization peak, vortex lattice

11-38

### ANTIOXIDANT ACTIVITY OF BIO-SYNTHESISED NANOSTRUCTURED CERIA USING ONION JUICE EXTRACT

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**Background:** To enhance the properties of cerium oxide nano materials and thereby meet the need for different applications, it is very essential to decrease the size and thus to increase the active surface area of nanoparticles. Chemical co-precipitation method using biological capping agent is more attractive compared to others for its cost effectiveness, eco-friendliness and its simplicity.

**Methods:** Nanstructured cerium oxide or nanoceria with an average crystallite size of 6nm was synthesized through chemical co precipitation method using Cerium nitrate hexa hydrate and Ammonium carbonate as starting material. Onion juice extract is used as the biological capping agent. The structural characterization of the prepared nanoparticles were studied with x-ray diffraction (XRD), Transmission electron microscopy (TEM) and Raman spectroscopy. The antioxidant efficacy of nanoceria is evaluated by the free radical scavenging activity of 1, 1-diphenyl 2-picryl hydroxyl (DPPH).

**Results:** The average crystallite size of the cerium oxide nano particle is found to be 6 nm. The results obtained from XRD, TEM and Raman are in close agreement with each other and confirm the cubic fluorite structure and polycrystalline nature of cerium oxide nanoparticles. The mass of sample for scavenging 50% of the free radical DPPH (SC50) was calculated as 88.43  $\mu\text{g}$  from the graph and the inhibition increases as the concentration increases.

**Conclusion:** The evaluation reveals that nanoceria can act as an excellent antioxidant in scavenging the DPPH radical even in very small concentration.

**Keywords:** Nanoceria, chemical co-precipitation, capping agent, DPPH

11-39

### DECIPHERING THE CRYSTAL STRUCTURE AND PHOTOLUMINESCENCE PROPERTIES OF B SITE ORDERED DOUBLE PEROVSKITES $\text{Ba}_2\text{Ln}_{2/3}\text{TeO}_6$ (Ln = Y, Gd-Lu)

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**Background:** Double Perovskites are a class of ceramic compounds known for its exceptional structural and compositional flexibility which in turn leads to versatility in its applications. Identifying the exact crystal symmetry is essential in order to predict the physical as well as chemical properties of these materials. Vibrational spectroscopic techniques such as Raman and IR are the cheapest yet powerful tools to determine the crystal symmetry. Further photoluminescence of activator substituted double perovskites are an interesting area of research as potential candidates for efficient red emitting components in WLED applications.

**Method:** In the present work, we investigate the crystal structure and photoluminescence properties of double perovskites  $\text{Ba}_2\text{Ln}_{2/3}\text{TeO}_6$  ( $\text{Ln} = \text{Y, Gd-Lu}$ ). The compounds are prepared by Solid state ceramic route. The crystal symmetry is identified using Raman and IR spectroscopy. The optical properties were characterized by diffuse reflectance spectroscopy and photoluminescence spectroscopy.

**Results:** X-ray diffraction patterns indicate a pseudo-cubic structure with rocksalt ordering of B- site cations; however tolerance factor values indicate lowered symmetry possibly due to octahedral tilting. Unlike in cubic perovskite systems with only four Raman and four IR active modes,  $\text{Ba}_2\text{Ln}_{2/3}\text{TeO}_6$  possess more than four Raman and IR modes which point out the lowered symmetry from cubic. In accordance with observed number of modes and group theoretical predictions the most likely symmetry of  $\text{Ba}_2\text{Ln}_{2/3}\text{TeO}_6$  is monoclinic with the space group  $P2_1/n$ . The crystal symmetry is further confirmed by the Rietveld refinement of the XRD patterns. The band gap energy of all the compounds are determined. The band gap of  $\text{Ba}_2\text{Y}_{2/3}\text{TeO}_6$  is estimated to be 4.8 eV which corresponds to wavelength of absorption in UV region. Thus, in order to investigate the photoluminescence properties,  $\text{Eu}^{3+}$  is substituted in the  $\text{Y}^{3+}$  site at five different concentrations (2.5, 5, 10, 15 and 20 mol %). The luminescence spectra monitored at an excitation of 270 nm show an emission maximum centered at 592 nm that corresponds to the  ${}^5\text{D}_0$ - ${}^7\text{F}_1$  electric dipole transition of the  $\text{Eu}^{3+}$  ions. This confirms that  $\text{Eu}^{3+}$  ions occupies a symmetric B-site with an inversion center. Chromaticity coordinates are calculated and show emission colour in the orange-red region of visible spectrum.

**Conclusions:** The photoluminescence characteristics show that the phosphor can act as a red emitting component in WLED applications.

**Keywords:** Double perovskites, Raman modes, Crystal symmetry, Red phosphors.

11-40

## IN VITRO CYTOTOXICITY ANALYSIS OF CALCIUM SULFIDE NANOPARTICLES

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**Background:** Semiconductor nanoparticles have gained considerable interest among researchers owing to their wide range of applications in biomedicine. Widespread use of the nanomaterials for medical and commercial applications leads to exposure of these materials into the environment, ecosystem, water, food supplies, and the human body. For the safe use of nanoparticles in biomedicine a detailed understanding of the toxicity of the nanoparticles in the human body is necessary. Our objective was to determine the biocompatibility of undoped Calcium sulfide (CaS) nanoparticles on L929 human fibroblast cell lines using MTT [3 (-4,5-Dimethylthiazol-2-yl)2,5- diphenyltetrazolium bromide] and Lactate dehydrogenase (LDH) release assay.

**Methods:** Undoped highly luminescent CaS nanoparticles capped with Triethanolamine were synthesized by an eco-friendly wet chemical coprecipitation method. Cytotoxicity analysis of undoped CaS nanoparticles was carried out in human fibroblast cell lines using MTT assay and LDH release assay.

**Results:** MTT assay analysis method revealed that viability of the cells was more than 90% in all the samples tested which is well above the 70% cut off for cytotoxicity as recommended by ISO 10993-5:2009. LDH release assay method showed that the nanoparticles were less toxic at lower concentrations (up to 25  $\mu\text{g/mL}$ ) and the toxicity increases at higher concentrations. The IC50 value for the CaS nanoparticles was found to be 710  $\mu\text{g/mL}$ .

**Conclusions:** The surface modified CaS nanoparticles are biocompatible across a wide range of concentrations which makes them a suitable candidate for various biomedical applications. Cytotoxicity studies are preferred pilot project test as it is simple, fast and has high sensitivity. Multiple techniques must be adopted, carefully assessed and applied to the nanomaterial system before its widespread use in various fields.

**Keywords:** nanoparticles; cytotoxicity; optical density; viability; assay.



11-41

### OPTICAL BAND GAP ANALYSIS OF COPPER OXIDE AND MANGANESE OXIDE NANOPARTICLES - A COMPARATIVE STUDY

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Compared with bulk copper oxide, nano copper oxide exhibits unusual physical and chemical properties such as high surface effect, superiority of the quantum size effect, volume effect and macroscopic quantum tunneling effect. It has monoclinic structure with many attractive characteristics including super thermal conductivity, photo voltaic properties etc. Copper oxide nanostructures exhibit magnetic and super hydrophobic properties. Manganese Oxide nanoparticles appear in a solid green powder form with high surface area and interesting unique properties. Nano oxides of Copper and Manganese were synthesized by chemical co-precipitation method. The samples annealed at 800°C were used for structural, surface morphological and optical studies. Debye Scherrer equation was used to calculate the particle size of the nano oxide samples. Optical characterizations of the nano samples were carried out using UV/Visible analysis. From the analysis of the absorption spectra, the optical bandgap of the nanocomposites were calculated. Detailed surface morphological studies were carried out using SEM analysis and the chemical composition of the nano samples were verified using EDAX.

11-42

### PHOTOLUMINESCENT PROPERTIES OF TERBIUM DOPED FLUOROBORATE GLASSES FOR GREEN EMISSION APPLICATIONS

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A new and economical Tb<sup>3+</sup> activated alkali fluoroborate glasses were synthesized by conventional melt quenching technique. Using photoluminescence (PL) emission, excitation and decay curve analysis luminescence properties have been studied. The radiative parameters including radiative transition probabilities, total transition probability, fluorescence branching ratio and stimulated emission cross section were determined via a reverse calculation approach. The optimum dopant ion concentration to get maximum emission intensity seems to be 1 mol%. CIE coordinates of the samples were determined to reflect the true colour of luminescence and are found to be much closer to the commercial green phosphors. The study proves the prepared glasses to be beneficial for various optoelectronic applications including green lasers and w-LEDs.

**Key words:** Melt quenching technique, luminescent properties, radiative parameters

11-43

### VIBRATIONAL SPECTRAL INVESTIGATION OF ORGANIC NLO CRYSTAL MORPHOLINIUM HYDROGEN TARTRATE: A DFT APPROACH

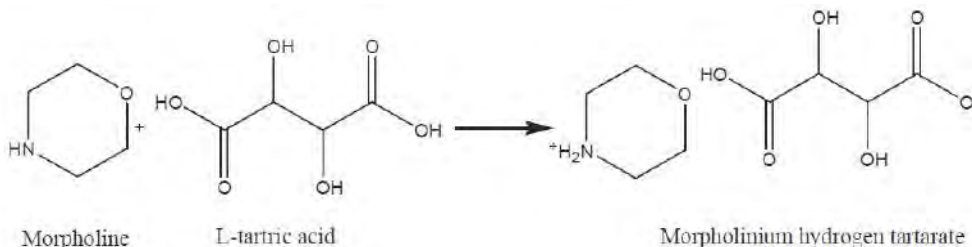
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**Background:** The charge transfer interaction, conjugation, hyper polarizability and electron delocalization of the molecule are studied to determine the structural dependence on the NLO property of the morpholinium hydrogen tartrate and spectroscopic investigation of MHT

**Method:** Morpholinium hydrogen tartrate has been synthesised in slow evaporation solution technique from morpholine and L-tartaric acid with following reaction



Experimental FT-infrared, FT-Raman, absorption and photoluminescence spectra are recorded and analysed. Complete vibrational analysis and optimised molecular structure is obtained using density functional theory calculation. Computationally all the electronic structure calculations were carried out using the Gaussian '09 program package. The geometry is fully optimized at the Becke-3-Lee-Yang-Parr (B3LYP) level with a standard 6-31G\* basis set. In this work, the popular B3LYP hybrid functional has been used for calculations. The vibrational contribution of each normal mode is figured out with the aid of VEDA 4 (vibrational energy distribution analysis) program.

**Results:** The optimized molecular structure of morpholinium hydrogen tartrate calculated using DFT theory at Becke-3-Lee-Yang-Parr (B3LYP) level with standard 6-31 G\* set is obtained. The optimized geometrical parameters are compared with experimental values. The FT-IR spectrum of the MHT crystal was recorded in the frequency region of 400-4000  $\text{cm}^{-1}$  and compared with the simulated IR spectrum computed at B3LYP/6-31G\* basis set. The presence of functional groups were confirmed using FT-IR, FT-Raman spectra. The UV-VIS absorption spectrum of the morpholinium hydrogen tartrate was recorded in ethanol solution using VARIAN CARY 100 B10 UV-VIS spectrophotometer. The morpholinium hydrogen tartrate crystal is active in the UV-Vis region and it could be a viable alternative for optical material in the entire visible region. The observed nature of absorption in the visible region is a desirable property of NLO material. The result of HOMO (-0.08706 hartree) and LUMO (0.09557 hartree) energies indicate the charge delocalization taking place within the crystal. The HOMO-LUMO energy difference is 0.18263 hartree.

**Conclusions:** The single crystals of morpholinium hydrogen tartrate were grown by slow evaporation technique. Density functional theoretical calculations and vibrational spectral studies have been performed on morpholinium hydrogen tartrate in order to identify its structural and the characteristic features. The vibrational spectral analysis has been carried out based on B3LYP/6-31G\* theory calculation. The HOMO-LUMO orbitals clearly explicate the charge transfer interaction involving donor and acceptor groups.

**Keywords:** DFT, FT-IR, FT-Raman

11-44

#### ANALYSIS ON CRYSTALLOGRAPHIC STRUCTURE, SIZE AND BAND GAP VARIATIONS IN ANNEALED $\text{CuFe}_2\text{O}_4$ SPINELS

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**Introduction:** Copper ferrite is an inverse spinel oxide with formula  $\text{CuFe}_2\text{O}_4$ , widely used for various purposes in electrical and communication fields. Also it is used as a catalyst in various industrial processes such as the Fischer-Tropsch process, the Haber-Bosch process.

**Method:** Co precipitation method is used for the synthesis of  $\text{CuFe}_2\text{O}_4$  powder from  $\text{Cu}(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$  and  $\text{Fe}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$  with Lactose monohydrate ( $\text{C}_{12}\text{H}_{22}\text{O}_{11} \cdot \text{H}_2\text{O}$ ) as the capping agent with the presence of 0.1M NaOH solution. The pH of the reaction was kept greater than 10. The obtained powder sample was annealed for a stipulated period of time at different temperatures ranging from 600 °C to 1000 °C. The formation, structure and homogeneity of the powder of confirmed with XRD (X-Ray diffraction)

**Results and discussion:** The obtained peak positions and d values were found to be in agreement with cubic spinel phase. The broadened peaks in the XRD patterns indicate the diminished nano crystals and with Debye-Scherrer equation the average crystallite size was obtained. The contributions of crystalline sizes and lattice strain on the peak broadening of  $\text{CuFe}_2\text{O}_4$  particles were studied by Hall-Williamson analysis and size-strain plot method. As the annealing temperature increases, the crystallite sizes were found to be increasing, but the crystallographic structure (cubic spinel

phase) remains conserved. The band gap of the nanocrystals is determined from the UV–Visible absorption spectrum.

**Keywords:** Spinel, Ferrite, Nanocrystalline, Crystallite size, Capping agent

## 12 - SCIENCE EDUCATION, COMMUNICATION & SOCIETY

12-01

### NUTRITIONAL PROFILE AND THE EFFECT OF DIETARY INTERVENTIONS IN TYPE II DIABETES PATIENTS

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Diabetes patients suffer from poor nutritional status due to unhealthy dietary practices and over the time they develop secondary diabetes complications due to poor awareness. Patient education is the most effective way to lessen the complications of diabetes and its management. Thus the present study is an attempt to assess the nutritional profile of type II diabetes patients and to assess the effect of dietary interventions in the management of diabetes. A total of 500 type II diabetes patients who attended the outpatient department of a leading hospital in Thiruvananthapuram was selected for the study. In order to assess their nutritional profile, Food Habits Score, Dietary Nutrition Index and Nutritional Status Index were worked out from the patient details collected through direct interview and was statistically analysed. In order to assess the effect of the dietary intervention, a dietary ready reckoner was developed and the study proceeded through a pre-test post-test study design for three months. The statistical methods employed were Mean, Independent two sample t-test, One-way Anova and Chi-square test (SPSS version 21.0). Conclusively, the findings suggest that the dietary habits, nutrient intake and the overall nutritional status of diabetes patients were inferior. Also the dietary intervention with the help of developed dietary ready reckoner has appreciable effects on type II diabetes patients in general and in specific it was effective in improving their Knowledge Attitude and Practice and Post Prandial Blood Glucose. Given sufficient time and constant reinforcement of dietary guidelines to the patients until gained knowledge and the changed attitude become a part of their life, it would definitely help them attain the goals in diabetes management.

**Keywords-** Type II diabetes mellitus, Nutritional profile, Dietary Intervention, KAP

12-02

### BIBLIOMETRIC ANALYSIS OF CYCLOTIDE RESEARCH

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**Background:** Cyclotides are a group of macrocyclic plant peptides with a circular backbone. They have a knotted arrangement of three disulphide bonds. In the recent years, they have been extensively studied in plants and the topic has evolved as a separate group among proteins and peptides. These peptides have been considered significant because of their extreme stability under rigorous treatments like high temperature etc. They are believed to be having a protective role within the plant system. Owing to this fact, enormous possibilities as drug candidates and scaffolds have been associated with cyclotides. The present study involves bibliometric analysis of the available cyclotide literature till date.

**Method:** The data was collected from Web of Science and three free software packages were used to do the analysis like contribution from authors, different countries, trends in research and future possibilities.

**Results:** The biggest contributing country to cyclotide research was Australia and the most significant contributor was Craik D J. Therese research trends were towards exploring cyclotides in new plants.

**Conclusions:** It was observed that no significant or impact-making studies have been initiated in India. With the rich biodiversity that India harbours, it is logical to take up cyclotide based research here so as to better tap the plant resources of this country.

**Keywords:** Pharma, cyclotide, citation, scaffold, host defence.

12-03

### ENHANCING SEED LONGEVITY IN VEGETABLE SEEDS USING FILM COAT TECHNIQUE

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**Background:** Success of any crop production program depends on the quality of seeds own. Seeds undergo deterioration over storage and hence, maintenance of seed vigour and viability from harvest until planting is vital. Seed treatment is a common practice in agriculture for effective storage and preservation of seed. Polymerfilm coating is one such seed invigoration technique which is associated with chemical seed treatment.

**Method:** Freshly harvested and processed seeds of okra, variety Arka Anamika and orientalis pickling melon, variety Mudicodelocal were separately treated with polymers. The treated seeds along with the control were packed in 700 gauge polyethylene bags and stored under ambient conditions and observations were recorded at bimonthly intervals for a period of sixteen months.

**Results:** Throughout the storage period there was a decline in the seed quality parameters like germination and vigour. Inokra and OP melon Polykote (10ml) + carbendazim-mancozeb (2g) + bifenthrin (0.1%) were found to be superior among the treatments with respect to germination(%), seeding vigour indices and other seed quality parameters.

**Conclusions:** The results indicated that seed treatment with polymers was highly effective for enhancing the storage life of okra and OP melon. The polymers along with plant protection chemicals help to retain viability and storability of seeds. Among the treatments, polykote (10ml) + carbendazim-mancozeb (2g) + bifenthrin (0.1%) showed best results which may be recommended for pre storage seed treatment. Seed treatment with polymers therefore provides a cheaper and safe method to enhance seed viability and seedling performance under ambient storage condition

**Keywords:** Polymers, Seed coating

12-04

### E-LESSON TEMPLATE GENERATION IN SCIENCE BASED ON TAXONOMY OF INGENUITY AND CONNECTEDNESS

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**Background:** The 21<sup>st</sup> century emphasises outcome-based education, which generates sharp expectations of the learners' achievements. The classroom design needs to be restyled by adopting flexibility as the powerful idea behind. Also, the learners need to be well versed in utilizing technology and require thoughtful access to accessible technologies in order to thrive in the 21<sup>st</sup> century. It is high time for the students to be acquainted with the significance and necessity of saving our resources and safeguarding our environment. The learners have to be so moulded as to readily take initiative to resolve problems, think about and consider various alternatives in difficult situations.

**Method:** The investigator developed the Taxonomy of Ingenuity and Connectedness (TIC) for the 21<sup>st</sup> century learners as a part of the doctoral study. For the practical implementation of TIC, an online software platform for creating, editing and sharing lesson templates in Science was developed named 'TicEasy.com'. TicEasy.com was developed by availing the service of a reputed software development centre. Also, an interactive workshop was conducted in order to generate e-lessons in selected science topics based on TIC using the developed software platform.

**Results:** TicEasy.com enabled the teachers for the effortless and effective implementation of the designed taxonomy in classroom interaction. It helps to create, edit and share lesson templates in Science based on TIC through a self-explanatory, step-by-step approach, and enables downloading lesson templates as pdfs. It also provides users with a number of recommended lesson templates according to their profile and search history. TicEasy.com thus eases the lesson template creation based on TIC.

**Conclusions:** TicEasy.com has been envisioned to be the platform for creating, editing and sharing lesson templates, with a motto of enriching teacher/learner experiences. The investigator wishes to come up with an earnest attempt for facilitating such a global platform for the entire teaching and learning fraternity as a continued service as part of the global projection / propaganda of the Taxonomy of Ingenuity and Connectedness (TIC), which strongly point towards a future digital paperless classroom.

**Keywords:** Taxonomy of Ingenuity and Connectedness, 21<sup>st</sup> century learners, online software Platform, TicEasy.com, Science, e-lessons.

12-05

### INFORMATION BEHAVIOUR OF VETERINARIANS IN KERALA

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Information behaviour of veterinary surgeons was studied was measured using the schedule developed by Nisha (2008) in terms of four components viz., information seeking behaviour, information storing behaviour, information processing behaviour and information dissemination behaviour. It was found that the information seeking behaviour of most of the veterinarians was high while information storing and processing behaviours were medium. Nonetheless, information dissemination behaviour was low.

12-06

### DETERMINANTS OF CONSUMPTION OF LIVESTOCK PRODUCTS AMONG SCHOOL GOING ADOLESCENTS IN KERALA

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**Abstract:** The research was conducted among the school going adolescents in Kerala to study their livestock products' consumption pattern and to understand the determinants of consumption. The study revealed that majority of the school going adolescents were not consuming enough livestock protein and their Body Mass Index (BMI) was in the underweight category. Only less than one-third of them had normal BMI.

**Keywords:** adolescents, livestock products, consumption pattern, Body Mass Index

12-07

### ROLE OF HAEMOGLOBIN LEVELS IN THE COGNITIVE PERFORMANCES OF PRESCHOOL CHILDREN

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**Background:** Iron deficiency is the most prevalent nutritional disorder in the world. One of the most worrying consequences of iron deficiency in children is the alteration of behaviour and cognitive performance.

**Aim/Objective:** The present research paper aimed to study iron deficiency anaemia in preschool children and to study the association of cognitive performance and haemoglobin level.

**Materials and methods:** The sample for the study comprised of 50 preschool children of 48-54 months, selected randomly from the rural areas of Malappuram district, Kerala. 25 children evidenced of anaemia formed the experimental group and 25 children with normal haemoglobin levels were included as the control group. Modified version of Wechsler's intelligence scale for preschool children was administered to assess the cognitive performance. The statistical methods adopted were Chi-square test and Anova using SPSS version 21.0.

**Results:** The results of the study indicated that there was significantly different correlation between the cognitive performance score and Hb level of the children in the two groups. Lower the Hb level, the time taken to perform the activity was found to increase and Hb was observed to be correlated negatively with performance time.

**Conclusion:** The present study indicated that haemoglobin level in children have significant role in cognitive performance. The present research paper also concluded that there is significant association between Hb level and cognitive performance in preschool children.

**Keywords:** Cognitive performance, anaemia, Wechsler's intelligence scale, Preschool children, hemoglobin,

12-08

### INTERNET ADDICTION ON CAMPUS

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**Background:** The internet is an exciting new medium that is evolving into an essential part of everyday life all over the world. However, students often get lured by the endless possibilities on the internet. Students appear to be most vulnerable to developing a dependence on the internet. Realizing the extreme negative impact of internet addiction on youth, the investigator decided to focus on internet addiction among college students in the current piece of research.

**Method:** The sample chosen for the present study consisted of 1138 college students in Phase I, out of whom, 104 were subjected to in-depth analysis (Phase II). The 'Internet Addiction Test' (I A T) developed by Young (1996) was the tool used.

**Results:** Out of the 1138 subjects who were using internet, 104 subjects i.e. 9% of the total sample were spending more than 3 hours/day on the internet, and hence were labeled as those who were addicted to internet. Among those who were labeled as addicted (N-104), 69% were seen to be moderately addicted to the internet. One fifth were (20%) were severely addicted to the internet. Boys are more addicted than girls. More than half of the students (55%) were always staying longer than intended on the internet. Majority of the respondents (64%) sometimes neglected their studies to spend more time on-line. Majority of the internet users affect their emotions and interpersonal relationship.

**Conclusion:** The following conclusions can be made based on the present study: -

1. Internet addiction on campus is a reality, with 9% of the students being addicted to the internet.
2. Most of the addicted students were in the moderately addicted category.
3. Boys are more addicted than girls.
4. Majority of the addicted students are spending excessive time in using internet.
5. Internet addicted adolescents neglected their studies in order to spend more time on-line.
6. Internet usage of the addicted individuals does have an effect on their interpersonal relationships.
7. Excessive internet usage has a negative impact on emotional aspects.

**Keywords:** Excessive internet use, Study habits, emotional aspects, interpersonal relationships

12-09

### MARKETING DYNAMICS OF VALUE ADDED COCONUT PRODUCTS IN KERALA - A CASE STUDY ON VIRGIN COCONUT OIL

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**Background:** A study on the awareness and the consumption pattern of Virgin coconut oil (VCO) in Kerala was conducted confining to the three districts of Kerala viz., Trivandrum, Ernakulam and Kozhikode which are placed almost equidistantly along the length of Kerala and representing southern, central and northern zones.

**Methods:** The districts and the respondents selected were from elite class in the urban centres using purposive sam-

pling. Percentage analysis is used for the study.

**Results:** Out of 376 consumers interacted 82 and 78 per cent of them were found to be aware, and purchasing and using VCO, respectively. Out of those who were aware 90 per cent were purchasing/using it. The monthly expenditure for VCO was found to be Rs. 325 corresponding to 5.1 and 2.1 percentage to food and food plus non-food expenditure respectively. The consumption pattern of consumers revealed high market potential for VCO and the marketers may try to take advantage of this situation. Regional differences observed in the awareness and preference of brands may be due to the inappropriate and inadequate distribution of the products to which the marketers should give more attention. Even among the elite classes of respondents only 82 per cent was aware and 78 per cent was using VCO.

**Conclusion:** Since VCO is an upcoming product in the market irrespective of rural and urban areas appropriate awareness and promotional activities should be conducted by the marketers.

**Key words:** Consumer awareness, Consumption pattern, Virgin coconut oil

12-10

## AN ETHNOBOTANICAL INVESTIGATION ON ZINGIBERALES OF KERALA

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**Background:** Zingiberales is a monophyletic order consisting of eight families with immense medicinal values is distributed widely throughout the tropics, particularly in Southeast Asia. It constitutes a vital group of rhizomatous medicinal and aromatic plants characterized by the presence of volatile oils and oleoresins of export value. Previous studies indicate that the documentation of traditional knowledge about this ethnic plant order will promote prospective drug development (Raghupathy et al., 2008). The identification of traditional healers who were uses plant species of Zingiberales and the quantitative documentation of indigenous knowledge on the utilization of these plants may promote the drug development technologies and other industries.

**Methodology:** An ethnobotanical study was carried out in Kerala, India, inhabited by 34 different tribal communities, who still depend on plants of Zingiberales for medicinal use and most of them have a basic knowledge on the use of plants for disease remedies. We collected information from tribal practitioners of our study area and compared this with results obtained during earlier visits. The present study covered 18 tribal communities distributed over 10 districts of Kerala and 394 informants were interviewed during house to-house surveys. The following data was recorded for plants used by tribal people: family, scientific name, local name, parts used, mode of preparation, medicinal uses, etc. Based on this information we categorized the reports into 10 ailments and three other categories viz. Genito Urinary Ailments (GUA), Respiratory System Disorder (RSD), Dermatological Infections/Disorders (DID), Gastro Intestinal Ailments (GIA), Ear Infection (EAI), Eye Infection (EYI), Tooth Pain (TP), Endocrinal Disorders (ED), Kidney Stone (KS), Poisonous Bites (PB), Food (FP), Spice (SP), Others (OT). The estimated plant species were passed through taxonomical evaluations and the collected voucher specimens were deposited for further investigations at CATH and live conservation strategy adopted for them in the Catholicate College Botanical Garden (CCBG). Then the data were analyzed for the informant consensus factor (Fic) (Heinrich et al., 1998) and use values (Phillips et al., 1994).

**Results:** A total of 27 ethnobotanically important plant species distributed in five familie: Zingiberaceae (20 species), Marantaceae (2), Costaceae (2), Cannaceae (1) and Musaceae (2).

In the present study, ear infection, eye infection and tooth pain had the highest ICF. The most commonly used species was *Curcuma longa* with 179 use reports from 89 informants, giving the highest UV of 2.01.

**Conclusion:** Traditional beliefs, concepts, knowledge are to be documented and valuable plants should be conserved for future generations. The proper documentation of this indigenous knowledge have great role in promotion and production of modern drugs for diseases.

**Key words:** Ethnobotany, Zingiberales, Kerala, Use value, Informant consensus factor.

12-11

### COMPARATIVE EVALUATION OF SALAD CUCUMBER CULTIVATION UNDER DIFFERENT DESIGNS OF POLYHOUSE STRUCTURES

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**Back ground:** In the present scenario of perpetual demand of vegetables and shrinking land holdings drastically and uncertainty in climatic conditions, protected cultivation is the best alternative and drudgery-less approach for using land and other resources more efficiently. The cucumber yield in protected structures can be increased manifold as compared to than in open field cultivation. In this study, the performance of two popular varieties of salad cucumber was tested under different designs of poly house structures so as to select the best structure suitable for Kerala for commercial cultivation of salad cucumber.

**Methods:** Three naturally ventilated poly houses (Gable type, Quonset type and Mansard type) have been constructed at Farming Systems Research Station, Sadanandapuram, Kottarakkara. Establishment of drip system with fertigation facility, fogger units is installed in each of the structures. Performance of salad cucumber varieties was evaluated in soil, soil less media, soil + coir pith media and soil with plastic mulch treatment. The selected hybrid varieties are Multistar and Rica. A digital temperature and humidity meter was used to record the temperature and relative humidity inside each structure and outside the poly house.

**Results:** Gable type structure recorded highest yield followed by Quonset and Mansard type for both Multistar and Rica varieties. Rica variety of salad cucumber recorded highest yield than Multistar. Maximum per plant yield of Rica variety was observed in soil + coir pith media ( 5.36 Kg) followed by soil+ mulch (4.84 Kg) , soil ( 4.79 Kg) and lesser yield was observed in soil less media ( 4.02 Kg). Earlier flowering was noticed in Gable type structure followed by Quonset type structure and Mansard structure. The tallest plants, maximum number of branches/plant and higher leaf area expansion rate were found in the plants grown under Gable type poly house as compared to other poly house structures. Lowest temperature was recorded in Gable type followed by Quonset and Mansard type. Relative humidity was also high in Gable type followed by Quonset and mansard type.

**Conclusions:** The best structure suitable for commercial cultivation of salad cucumber in Kerala is Gable type poly house. Rica variety of salad cucumber recorded highest yield than Multistar. Highest yield was observed from soil with coir pith treatment followed by soil with plastic mulch treatment in all types of structures. Lowest temperature was recorded in Gable type followed by Quonset and Mansard type. Year round cultivation of vegetables even under the extreme climatic conditions is possible using these structures. Better quality of produce, high yield and minimizing pesticides can be ensured. Efficient use of water and fertilizer can be achieved. Continuous monitoring of crops is needed inside the poly house.

**Key words:** Poly house structure, salad cucumber, yield, temperature, humidity

12-12

### SOCIAL INTERVENTIONS ON IMPROVING THE QUALITY OF LIFE OF WOMEN LIVING IN SC SETTLEMENTS IN KAVUMKAL DESOM, KOLLAM

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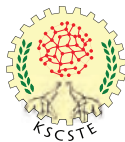
The scheduled caste comprise only of a minor proportion of the population in Kerala, especially in the Southern areas like Kollam. In spite of several welfare programmes and policies, put forward by the Government from time to time, significant changes cannot be still made in the overall quality of life and empowerment of the tribal people. Henceforth, the present study on “Social Interventions on improving the Quality of life of women living in SC settlements in KavumkalDesom, Kollam” was carried out to find out the quality of life of people living in those settlements, with special focus on the role and extend of participation of self help groups in empowering the people living there. A sample of 100 people was taken for the study using random sampling method. A well structured questionnaire was used to collect the socio economic data, regarding the samples. An empowerment scale was used to study the level of empowerment



of the samples, along with a quality of life index to understand the extend of quality of life enjoyed by them. The level of empowerment was found to be higher among women and may be due to their active involvement in self help group. An intervention was also carried out among the women group. The women group was identified based on the concept of “Woman to Woman” approach. And was based on the assumption that these women can be the change agents and can bring significant impact on their family members as well as the neighbourhood. The effectiveness of the implemented programme was evaluated using a check list. Significant visible changes could be made on the life of the people, especially the women, on their attitude towards health, especially reproductive health, interest in extending the participation for more programmes etc

**Keywords:** Quality of life, SC settlements, Empowerment, Social intervention





# PROCEEDINGS



State Level Seminar on  
**NANOSCIENCE AND NANOTECHNOLOGY**

Date: 16-01-2019

Sponsored by the  
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*Organized by*  
Post Graduate & Research Department of Chemistry  
Fatima Mata National College, Kollam  
*In Association with*  
Academy of Chemistry Teachers (ACT)

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## CONTENTS

1. **Supramolecular Chemistry with DNA** 1  
*Reji Varghese*
2. **ANALYSIS OF NANO MATERIALS; UNRAVELING THE HIDDEN SECRETS** 3  
*Dr Renjith S*
3. **Ethylene diamine modified chitosan in heavy metal pollution mitigation: Removal of Pb(II) from aqueous medium** 5  
*V. Arun, M.G. Lekshmi, Vinu V. Dev, Sibin Antony, K. Anoop Krishnan*
4. **DFT investigations and molecular docking study of benzoxazole derivative** 10  
*Sheena Mary Y and Shyma Mary Y*
5. **THE MUD CRAB, SCYLLA SERRATA - AN INDICATOR OF HEAVY METAL POLLUTION LOAD OF ASHTAMUDI LAKE, KOLLAM, KERALA** 17  
*Lekshmi priya.V and Sherly williams E*
6. **Adsorptive removal of methyl red from aqueous solution using kaolinite: Kinetics and Isotherm studies** 21  
*Harsha Mahadevan, Midhu P. Alex, Sandhya Sudhakaran, Helan Priya Pious, K. Anoop Krishnan*
7. **DFT and molecular dynamics investigation of 1-(3-Chloro-4-fluorophenyl)-3-[3-(trifluoromethyl)phenyl]thiourea (ANF-2)** 25  
*Sheena Mary Y and Shyma Mary Y*
8. **Gold Cross-linked Molecularly Imprinted Conducting Polymer Decorated on Functionalized Carbon Nanotubes for Electrochemical Sensing of Sudan I** 33  
*Athira V S, Anirudhan T S*
9. **A green approach for the synthesis of polysaccharide based hydrogel for controlled release of tetracycline hydrochloride** 34  
*Surya R, Manohar D. Mullassery, Noeline B. Fernandez, Diana Thomas*
10. **Understanding the Citric Acid-Urea Co-Directed Microwave Assisted Synthesis and Ferric Ion Modulation of Fluorescent Nitrogen Doped Carbon Dots: A Turn On Assay for Ascorbic Acid** 38  
*J. S. Anjali Devi, R. S. Aparna, B. Aswathy, John Nebu, A. O. Aswathy, and Sony George*
11. **Carrageen strengthened pyrolysed rice husk filter in heavy metal pollution mitigation: Removal of Pb(II) and Cu(II) from aqueous medium** 39  
*Vinu V. Dev, P.S. Anjana, Sibin Antony, V. Arun, K. Anoop Krishnan*
12. **Investigation of the reactive properties of a thiourea derivative by spectroscopic and DFT calculations** 46  
*Shargina Beeguma, Dr. Sheena Mary Y., Dr.C Yohannan Panicker*

13.	ADSORPTION OF METHYLENE BLUE BY BIOCHAR-DERIVED FROM PLANT BIOMASS	47
	<i>Prerna Sharma, Nishita J. Srivastava, Anandhar D. Mallikarjuna, Sarita R.</i>	
14.	GREEN SYNTHESIS OF ZINC OXIDE NANOPARTICLES USING COLEUS AROMATICUS LEAF EXTRACT AND EVALUATION OF ITS ANTIBACTERIAL PROPERTIES	51
	<i>Santhi S. Jeyaraj, Aruna Mishra, Prakash G. Dhillon</i>	
15.	Hydroxyquinoline derivatives with bromine and iodine atoms: Theoretical investigation by DFT calculations, MD simulations and molecular docking studies	57
	<i>Sureshkumar B, Sharma Anil, Y. S. Sarda</i>	
16.	Synthesis of Chemosensors from Silver nano	64
	<i>DAREN BIS, ANJANA TL, ARATHI P NAIR, SELVA BHAGYAS, DEVICHANDHANA D, SANUPS, ANURAJ</i>	
17.	PHOTOCATALYTIC HYDROGEN EVOLUTION BY WATER SPLITTING USING HETERO BIMETALLIC METAL ORGANIC FRAMEWORK	68
	<i>Mirza PC, Ram Parvithran and S.M.A. Shibli</i>	

## Supramolecular Chemistry with DNA

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**Introduction:** Supramolecular chemistry refers to the domain of chemistry beyond that of molecules and focuses on the chemical systems made up of a discrete number of assembled molecular subunits or components. While traditional chemistry focuses on the covalent bond, supramolecular chemistry examines the weaker and reversible noncovalent interactions between molecules. These forces include hydrogen bonding, metal coordination, hydrophobic forces, van der Waals forces,  $\pi$ - $\pi$  interactions and electrostatic effects. Important concepts that have been demonstrated by supramolecular chemistry include molecular self-assembly, folding, molecular recognition, host-guest chemistry, mechanically-interlocked molecular architectures, and dynamic covalent chemistry. The study of non-covalent interactions is crucial to understanding many biological processes from cell structure to vision that rely on these forces for structure and function. Biological systems are often the inspiration for supramolecular research. In the presentation, individual supramolecular interactions with specific examples were discussed.<sup>(1-3)</sup>

**Electrostatic interactions:** Electrostatic interactions are between cations and anions. Electrostatic interactions can be either attractive or repulsive, depending on the signs of the charges. Favorable electrostatic interactions cause the vapor pressure of sodium chloride and other salts to be very low. The electrostatic interactions within a sodium chloride crystal are called ionic bonds. But when a single cation and anion are close together, say on the surface of a protein, or within a folded RNA, those are favorable non-covalent electrostatic interactions. Electrostatic interactions can be very strong, and fall off slowly with distance ( $1/r$ ).

**Dipole Interactions:** In a molecule composed of atoms of various electronegativities, the atoms with lowest electronegativities hold partial positive charges and the atoms with the greatest electronegativities hold partial negative charges. In a methanol molecule ( $\text{CH}_3\text{OH}$ ), the electronegative oxygen atom pulls electron density away from the carbon atom. In a water molecule, the electronegative oxygen atom pulls electron density away from the hydrogen atoms. The oxygen atom carries a partial negative charge. The hydrogen atoms carry partial positive charges. This phenomenon of charge separation is called polarity. Water is a polar molecule.

**Dipole-dipole interactions:** The strength of a dipole-dipole interaction depends on the size of each dipole and on their relative orientation. The interaction energy between two dipoles can be either positive or negative. Parallel end-to-end dipoles attract while antiparallel end to end dipoles repel.

**Dipole-induced dipole interactions:** A molecule with a permanent dipole moment will induce a dipole moment in a second molecule that is located nearby in space. This phenomenon is called polarization. The strength of a dipole-induced dipole interaction depends on the size of the dipole moment of the first molecule and on the polarizability of the second molecule. Polarizability is a measure of the ease with which electrons are shifted by an external electronic field. Molecules with  $\pi$  electrons, such as phenylalanine and tryptophan, are more polarizable than molecules such as isoleucine that lack  $\pi$  electrons. Dipole-induced dipole interactions are important even between molecules with permanent dipoles. A permanent dipole is altered/modulated by the dipole of an adjacent molecule. For example, the dipole of one water molecule will influence the electron distribution of an adjacent water molecule. The dipole of a water molecule will induce a change in the dipole of a nearby water molecule, compared to the permanent dipole of an isolated water molecule.



## DFT investigations and molecular docking study of benzoxazole derivative

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**Abstract**  
The synthesis, FT-IR, FT-Raman spectral analysis of an antimicrobial active benzoxazole derivative, 5-(4-methylphenyl)acetamido]-2-(4-tert-butylphenyl) benzoxazole (MPATB) is reported. The localization of HOMO, LUMO plots in the title compound over the title molecule shows the charge transfer in the molecular system through the conjugated paths. The electrophilic and nucleophilic sites are revealed from the molecular electrostatic potential map. The first hyperpolarizability sites are revealed from the molecular electrostatic potential map. The first hyperpolarizability sites of the title compound is greater than that of the standard nonlinear optical material urea and of the title compound and its derivatives are good objects for further research in nonlinear optical analysis. The docked title compound forms a stable complex with thymidylate synthase and got a binding affinity value of -8.5 kcal/mol and the title compound can be a lead compound for developing new anti-cancerous drug.

**Keywords:** Benzoxazole, DFT, Molecular docking.

**1. Introduction**  
Heterocyclic compounds such as benzoxazoles have attracted attention due to their diverse pharmacological and biological properties like antibacterial, antifungal, anti-tubercular, anti-tumor and antiviral [1,2]. Studies of reactive properties of newly synthesized organic molecules with potential important biological activities are very important for the development and improvement of methods for water purification. Namely, molecules that are active components of pharmaceutical products are synthesized to be very stable, thus natural conditions and conventional purification methods are not enough effective for their degradation [3]. Unfortunately, due to various reasons drugs are entering the environment and are accumulating especially in the water resources, where they are toxic to aquatic organisms. So far these types of compounds have been detected in all types of waters [4].

## 2. Experimental

The chemicals and solvents were purchased from Sigma Aldrich (Munich, Germany) and Fisher Scientific (Pittsburgh, PA, USA); they were used without purification. Silica gel HF<sub>254</sub> chromatoplates (0.3 mm) were used for thin layer chromatography, and the mobile phase was chloroform/methanol (10:0.5). Melting point was recorded on a Stuart Scientific SMP1 instrument (Bibby Scientific Limited,

Staffordshire, UK) and is uncorrected. NMR spectra were recorded on a Varian Mercury 400 MHz NMR spectrometer (Palo Alto, CA, USA) trimethylsilane (TMS) was used as an internal standard. The mass spectra was recorded on a Waters ZQ Micromass LC-MS spectrometer (Milford, MA, USA) using the ESI(+) method. The FT-IR spectrum was recorded using KBr pellets on a DR/Jasco FT-IR 6300 spectrometer. The FT-Raman spectrum was obtained on a Bruker RFS 100/s, Germany. For excitation of the spectrum the emission of Nd:YAG laser was used, excitation wavelength 1064 nm, maximal power 150 mW, measurement on solid sample. The spectral resolution after apodization was 2 cm<sup>-1</sup>.

Firstly, 5-amino-2-(4-tert-butylphenyl)-benzoxazole was synthesized by heating 0.02 mol 2,4-diaminophenol.2.HCl with 0.02 mol 4-tert-butylbenzoic acid in 25 g polyphosphoric acid (PPA) and stirring for 3-4 h. At the end of the reaction period, the residue was poured into an ice/water mixture and the solution was neutralized with 10% NaOH. The resulting precipitate was filtered, washed with distilled water, dissolved in boiling ethanol with 0.2 g charcoal, and filtered off. Then distilled water was added to the filtrate slowly in order to stimulate crystallization. The crude compound was

obtained by filtering and drying the crystalline material. Then, 4-methylphenyl acetic acid (0.5 mmol) and thionylchloride (1.5 ml) were refluxed in benzene (5 ml) at 80°C for 3h. excess thionylchloride was removed *in vacuo*. The 4-methylphenyl acetic acid chloride was dissolved in ether (10 ml) and this solution added during 1 h to a stirred, ice-cold mixture of 5-amino-2-(4-tert-butylphenyl)benzoxazole (0.5 mmol), sodiumbicarbonate (0.5 mmol), diethylether (10 ml) and water (10 ml). The mixture was kept stirred overnight at room temperature and filtered. The precipitate was washed with water, 2M HCl and water, respectively and finally with ether to give compound. The product was re-crystallized from ethanol-water as needles which are dried *in vacuo*.

## 3. Computational details

The molecular geometry optimization, polarizabilities and natural bond orbital analysis for the title compound are calculated by density functional using B3LYP/6-311++G(d,p) [5] level of theory using Gaussian09 software [6]. The calculated scaled wave numbers are scaled by using scaling factor as reported in literature [7]. With the help of potential energy distribution analysis [8] and Gaussview program [9] the vibrational assignments were carried out.

Jaguar 9.0 program [10], as implemented in Schrödinger Materials Science Suite 2015-4, was also used for the DFT calculations of ALE, Fukui functions and BDEs with B3LYP exchange-correlation functional [11], together with 6-311++G(d,p), 6-31++G(d,p) and 6-311G(d,p) basis sets, respectively. For MD

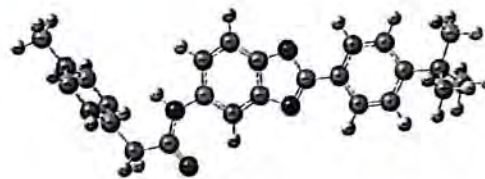
simulations Desmond program [12], also as implemented in Schrödinger Materials Science Suite 2015-4, was used with OPLS 2005 force field [13] within NPT ensemble class. Simulation time was set to 10 ns, while the whole system was modeled by placing one MPATB molecule in the cubic box with ~3000 water molecule. Other parameters include cut off radius set to 12 Å, temperature to 300 K and pressure to 1.0325 bar. Solvent was treated with simple point charge (SPC) model [14]. Noncovalent interactions were determined by using the method of Johnson [15], as implemented in Jaguar 9.0 program. In all cases when Jaguar and Desmond were used, input and output files were manipulated by Maestro graphical user interface application for Schrödinger Materials Science Suite 2015-4.

## 4. Results and discussion

In the following discussions, the rings, C<sub>41</sub>-C<sub>45</sub>, C<sub>11</sub>-C<sub>15</sub>, C<sub>16</sub>-C<sub>20</sub>, C<sub>21</sub>-C<sub>25</sub>, C<sub>26</sub>-C<sub>30</sub>, C<sub>31</sub>-C<sub>35</sub>, N<sub>11</sub>-C<sub>21</sub>, O<sub>11</sub>-C<sub>21</sub>-C<sub>26</sub> and C<sub>1</sub>-C<sub>2</sub>-C<sub>3</sub>-C<sub>4</sub>-C<sub>5</sub> are designated as PhI, PhII, PhIII and PhIV, respectively.

### 4.1 IR and Raman spectra

According to literature [16], the NH vibrations are expected in the following regions: stretching mode: 3500-3300 cm<sup>-1</sup>; deformation modes: around 1500, 1250 and 750-600 cm<sup>-1</sup>. For the title compound, the NH stretching modes are assigned at 3440 cm<sup>-1</sup> in the IR spectrum, 3449 cm<sup>-1</sup> in the Raman spectrum and at 3453 cm<sup>-1</sup> theoretically and the NH deformations are assigned at 1507, 1263, 646 cm<sup>-1</sup> theoretically and experimentally bands are observed at 1498, 644 cm<sup>-1</sup> in the Raman spectrum and 644 cm<sup>-1</sup> in the IR spectrum. The NH stretching mode

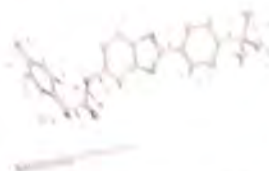


... of the IR spectrum. ... Raman spectrum ... stretching modes ... deformation modes ...

... of the IR spectrum. ... Raman spectrum ... stretching modes ... deformation modes ...

... of the IR spectrum. ... Raman spectrum ... stretching modes ... deformation modes ...

... of the IR spectrum. ... Raman spectrum ... stretching modes ... deformation modes ...



Atom	BDE (kcal/mol)
1	111.11
2	111.11
3	111.11
4	111.11
5	111.11
6	111.11
7	111.11
8	111.11
9	111.11
10	111.11
11	111.11
12	111.11
13	111.11
14	111.11
15	111.11
16	111.11
17	111.11
18	111.11
19	111.11
20	111.11

Results presented in Figure indicate that it is not likely for MPATB molecule to be prone to autoxidation mechanism since all calculated BDE values for hydrogen atoms (not are higher than 92 kcal/mol) although there are two bonds cleaved with 17 and 117 with BDE values close to 92 kcal/mol. This further indicates that MPATB molecule is stable in the open air and in the presence of oxygen. Of the remaining single bonds, bonds there are two with the lowest BDE values, around 70 kcal/mol each. Those bonds are cleaved with numbers 14 and 17 and they could be the locations where degradation could start.

In order to investigate which atoms of MPATB molecule have pronounced interactions with water molecules, we have calculated RDE as obtained after MD simulations. RDE, g(r), gives the probability of finding a particle in the distance  $r$  from another particle [32]. According to the calculated RDEs there are five carbon atoms and four non-carbon atoms with significant interactions with water molecules. Carbon atoms with significant interactions with water molecules are C1, C5, C11, C47 and C53. Of these five, three of them, C1, C5 and C53 have lower peak distances (between 3.5 Å and 4 Å), than atoms C11 and C47 (that have peak distances between 4.5 Å and 5.0 Å). On the other side two carbon atoms with the highest g(r) values are carbon atoms C11 and C53. The fact that carbon atoms C47 and C53 have pronounced interactions with water molecules is very important because the BDE value for the abstraction of nearby hydrogen atom is close to 92 kcal/mol. This further indicates that autoxidation mechanism for MPATB molecule is hard to be expected since oxidation and hydrolysis could compete at the mentioned

undecile location. Concerning the non-carbon atoms the most important RDE is calculated for hydrogen atom H17, for which the highest g(r) value is somewhat higher than 0.9, while the peak distance is located at below 2 Å. Other atoms with significant interactions with water include hydrogen atom H7, nitrogen atom N35 and oxygen atom O39. Oxygen atom O39 has the highest g(r) value of almost 1.0, while its peak distance is located at around 2.7 Å. The importance of nitrogen atom N35 lies in the fact that this atom is also recognized as important reactive center according to the ALE results.

#### 4.6 Molecular docking studies

Based on the structure of a compound, PASS (Prediction of Activity Spectra) [33] is an online tool which predicts different types of activities. PASS analysis of the title compound predicts thymidylate synthase activity with probability to be active (Pa) value of 0.754. Thymidylate synthase (TS) is a key enzyme in the synthesis of 2'-deoxythymidine-5'-monophosphate, an essential precursor for DNA biosynthesis. For this reason, this enzyme is a critical target in cancer chemotherapy [34]. Thus we choose thymidylate synthase and used as target for docking study. High resolution crystal structure of thymidylate synthase was downloaded from the RSCB protein data bank website with PDB ID: 3TMS. All molecular docking calculations were performed on Auto Dock-Vina software [35]. Amino acid Trp101 forms two  $\pi$ -sigma,  $\pi$ - $\pi$  T-shaped,  $\pi$  alkyl interaction with CH<sub>3</sub> group, phenyl rings respectively. Phe149 forms  $\pi$ - $\pi$  T-shaped and Tyr164 forms  $\pi$ -stacked interactions with phenyl ring. Ser131 shows H bond with benzoxazole ring. The docked ligand forms a stable complex with thymidylate synthase) and got a binding affinity value of

-6.5kcal/mol. These studies show that the title compound can be used for developing new anti-cancerous drug.

#### 5. Conclusion

5-[4-methylphenyl]benzoxazole (2-(1H-benzoxazol-2-yl)phenyl)benzoxazole was synthesized and characterized by experimental and theoretical methods. The structure, vibrational wave numbers, frontier molecular orbital, MEP, NLO and NBO analysis of the title compound is carried out by DFT level using

the B3LYP/6-311++G(d,p) basis set. The stability and intermolecular interaction have been interpreted by NBO analysis. The title compound binds at the active site of the substrate by weak non-covalent interactions and the amino acid Trp101 forms two  $\pi$ -sigma,  $\pi$ - $\pi$  T-shaped,  $\pi$  alkyl interaction with CH<sub>3</sub> group, phenyl rings respectively. Phe149 forms  $\pi$ - $\pi$  T-shaped and Tyr164 forms  $\pi$ -stacked interactions with phenyl ring. Ser131 shows H bond with benzoxazole ring.

#### References

1. M. Arsović, O. Terzić, Arpač, I. Yildiz, F. Kaynak, Omurlug, E. Aki, I. Yalcin, U. Abbasoglu, SAR and QSAR Environ. Res. 19 (2008) 589-612.
2. M. Arsović, O. Terzić, Arpač, F. Kaynak, Omurlug, S. Ozgen, Z. Naturforsch. 68C (2013) 453-460.
3. A. Galubović, B. Abramović, M. Šerpanović, M. Grubić Brožić, S. Armaković, I. Veljković, B. Babić, Z. Došlić, Z. Popović, Mater. Res. Bull. 48 (2013) 1363-1371.
4. B. Abramović, S. Kler, D. Šojić, M. Lamešić, T. Radović, D. Vione, J. Hazard. Mater. 198 (2011) 123-132.
5. A.D. Becke, Phys. Rev. A38 (1988) 3098-3100.
6. Gaussian 09, Revision C.01, M.J. Frisch, G.W. Trucks, H.B. Schlegel, G.E. Scuseria, M.A. Robb, J.R. Cheeseman, G. Scalmani, V. Barone, B. Mennucci, G.A. Petersson, H. Nakatsuji, M. Caricato, X. Li, H.P. Hratchian, A.F. Izmaylov, J. Bloino, G. Zheng, J.L. Sonnenberg, M. Hada, M. Ehara, K. Toyota, R. Fukuda, J. Hasegawa, M. Ishida, T. Nakajima, Y. Honda, O. Kitao, H. Nakai, T. Vreven, J.A. Montgomery, Jr., J.E. Peralta, F. Ogliaro, M. Bearpark, J.J. Heyd, E. Brothers, K.N. Kudin, V.N. Staroverov, T. Keith, R. Kobayashi, J. Normand, K. Raghavachari, A. Rendell, J.C. Burant, S.S. Iyengar, J. Tomasi, M. Cossi, N. Rega, J.M. Millam, M. Klene, J.E. Knox, J.B. Cross, V. Bakken, C. Adamo, J. Jaramillo, R. Gomperts, R.E. Stratmann, O. Yazyev, A.J. Austin, R. Cammi, C. Pomelli, J.W. Ochterski, R.L. Martin, K. Morokuma, V.G. Zakrzewski, G.A. Voth, P. Salvador, J.J. Dannenberg, S. Dapprich, A.D. Daniels, O. Farkas, J.B. Foresman, J.V. Ortiz, J. Cioslowski, D.J. Fox, Gaussian, Inc., Wallingford CT, 2010.
7. J.B. Foresman, P.A. Pittsburg in: E. Frisch (Ed.), Exploring Chemistry with Electronic Structure Methods: a Guide to Using Gaussian, 1996.
8. J.M.L. Martin, C. Van Alsenoy, GAR2PED, a Program to Obtain a Potential Energy Distribution from a Gaussian Archive Record, University of Antwerp, Belgium, 2007.
9. R. Dennington, T. Keith, J. Millam, Gaussview, Version 5, Semichem, Inc., Shawnee Mission, KS, 2009.
10. Schrödinger Materials Science User Manual, 2014, Schrödinger Press.
11. A.D. Becke, J. Chem. Phys. 98 (1993) 5648-5652.
12. D. Shivakumar, I. Williams, Y. Wu, W. Damm, J. Shelley, W. Sherman, J. Chem. Theory Comput. 6 (2010) 1509-1519.
13. H.L. Banks, H.S. Beard, Y. Cao, A.E. Cho, W. Damm, R. Farid, A.K. Felts, T.A. Halgren, D.T. Mainz, J.R. Maple, R. Murphy, D.M. Philipp, M.P. Repasky, L.Y. Zhang, B.J. Berne, R.A. Friesner, E. Gallucci, R.M. Lew, J. Comput. Chem. 26 (2005) 1752-1780.
14. H.J. Berendsen, J.P. Postma, W.F. van Gunsteren, J. Hermans, Interaction models for water in relation to protein hydration, in: Intermolecular forces, 1981, Springer, p. 331-342.
15. A. Otero-de-la-Roza, E.R. Johnson, J. Contreras-García, Phys. Chem. Chem. Phys. 14 (2012) 12165-12172.

16. N.B. Colthup, L.H. Daly, S.E. Wiberly, Introduction of Infrared and Raman Spectroscopy, Academic Press, New York, 1975.
17. S.H.R. Sebastian, M.A. Al-Alshakhi, A.A. El-Emam, C.Y. Panicker, J. Zitko, M. Dolezal, C. Ven Alsenoy, J. Mol. Struct. 1119 (2016) 188-199.
18. Y.S. Mary, H.T. Varghese, C.Y. Panicker, M. Dolezal, Spectrochim. Acta A 71 (2008) 725-730.
19. G. Socrates, Infrared Characteristic Group Frequencies, John Wiley and Sons, New York, 1991.
20. J.B. Bhagyasree, J. Samuel, H.T. Varghese, C.Y. Panicker, M. Arisoy, O. Temiz-Arpaci, Spectrochim. Acta A 115 (2013) 79-91.
21. N.P.G. Roeges, A Guide to the Complete Interpretation of Infrared Spectra of Organic Structures, John Wiley and Sons, New York, 1994.
22. T. Joseph, H.T. Varghese, C.Y. Panicker, K. Viswanathan, M. Dolezal, T.K. Manojkumar, C. Ven Alsenoy, Spectrochim. Acta A 113 (2013) 203-214.
23. G. Varsanyi, Assignments of Vibrational Spectra of Seven Hundred Benzene Derivatives, Wiley, New York, 1974.
24. B. Kosar, C. Albayrak, Spectrochim. Acta A 78 (2011) 160-167.
25. R.J. Parr, L.V. Szentpaly, S. Liu, J. Am. Chem. Soc. 121 (1999) 1922-1924.
26. E. Scrocco, J. Tomasi, Adv. Quantum Chem. 11 (1978) 115-193.
27. J.B. Bhagyasree, J. Samuel, H.T. Varghese, C.Y. Panicker, M. Arisoy, O. Temiz-Arpaci, Spectrochim. Acta A 115 (2013) 79-91.
28. C. Adant, M. Dupuis, J.L. Bredas, Int. J. Quantum Chem. 56 (1995) 497-507.
29. T. Andersson, A. Broo, E. Evertsson, J. Pharm. Sci. 103 (2014) 1949-1955.
30. P. Lienard, J. Gavartin, G. Boccardi, M. Meunier, Pharm. Res. 32 (2015) 300-310.
31. J.S. Wright, H. Shadnia, L.L. Chepelev, J. Comput. Chem. 30 (2009) 1016-1026.
32. R.V. Vaz, J.R. Gomes, C.M. Silva, J. Supercrit. Fluids 107 (2016) 630-638.
33. A. Lagunin, A. Stepanchikova, D. Filimonov, V. Poroikov, Bioinformatics 16 (2000) 747-748.
34. M.G. Rose, M.P. Farrell, J.C. Schmitz, Clin. Colorectal. Cancer 1 (2002) 220-229.
35. O. Trott, A. J. Olson, J. Comput. Chem. 31 (2010) 455-461.

## THE MUD CRAB, *SCYLLA SERRATA* - AN INDICATOR OF HEAVY METAL POLLUTION LOAD OF ASHTAMUDI LAKE, KOLLAM, KERALA.

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### Introduction

The second largest backwater lake in Kerala Ashtamudi Lake is well known for its houseboats and backwater resorts. Ashtamudi wetland was included in the list of wetlands of international importance. The lake is splendid with a variety of finfishes and shellfishes. Ashtamudi Lake, is prone to several kinds of toxic aquatic pollutants. Among the wide range of pollutants, heavy metals play a prime role in disturbing the delicate balance of the ecosystem. The nature of heavy metal contamination in the water and sediment samples of Ashtamudi lake has been reported by Razeena *et al.*, (2012) Sherly *et al.*, (2015), Suma *et al.*, (2012) and many others. Many organisms especially fishes are harmed when heavy metals accumulate inside them. Pollutants especially heavy metals can be transferred through the upper classes of the food chain once accumulated by an aquatic organism and paves way for biomagnifications. Fishes especially shellfish do not have any mechanism to prevent bioaccumulation, which makes it as a good indicator to the problem of heavy metal pollution. Studies on the bioaccumulation of various pollutants in different organs of fishes of Ashtamudi lake has been extensively studied by Chinnadurai *et al.*, (2016), Sherly *et al.*, (2015), Razeena *et al.*, (2014) and many others. The mud crabs of genus *Scylla* are exceptionally important due to their large size, better nutritive value and can export in live condition, hence it receives great demand in the domestic as well as export market. The main aim of the present study was to determine the accumulation status of selected heavy metals on the targeted fish species - *Scylla serrata*, of Ashtamudi Lake, Kollam.

### Materials and methods

Three study sites site 1- Kureepuzha, site 2 - Perumon and site 3- West Kallada of Ashtamudi

were selected for the present study. *Scylla serrata* of about 3 to 6 cm in carapace width and 220 to 270 gm weight (60 numbers) were collected from each study site for one year (February – 2016 to January 2017). The live specimens after brought to the laboratory were clearly washed with tap water to remove mud. The specimens were further identified using standard identification keys for the conformation of the species (FAO, 1995).

Muscles were dissected out, taken into petridishes and kept in a hot air oven. The temperature was maintained at 600°C for a period of 48 –72 hours. Samples were fine powdered using mortar and pestle after complete drying. 0.5 gm of dried powder of each tissue samples were then digested in open beakers on a hot plate by adding nitric acid and perchloric acid in (4:1) ratio. After that the samples were kept on hot plate and the temperature gradually allowed to rise to 60 °C continue adding both acids in (4:1) ratio till the sample become colourless. The digested samples were allowed to cool. Then transferred to 25 ml volumetric flasks, and made up to mark with de-ionised water. The digests were store in plastic bottles for the analysis of Cadmium, Chromium, Copper, Lead and Zinc using an atomic absorption spectrophotometer (AAS , Pinaacle 900H ) as described by APHA (1998). Metal concentrations were calculated in mg/kg. Data analysis in the tissue samples was performed using statistical package of SPSS 22. Significant differences between heavy metals concentration in various sites, determined using One- Way analysis of variance (ANOVA) followed by Fisher's LSD (Least significantly difference) post hoc test . The level of significance was  $p < 0.01$ .

**Results and Discussion**

The mean values of Cadmium at site 1 and 2 were 1.104 mg/kg and 1.5 mg/kg respectively. The maximum permissible limit of Cadmium in fresh water crabs according to FAO was 0.5 mg/kg. The samples collected from site 1 and 2 exceeds this limit with respect to their mean values. In case of site 3 the values were not detected. For Chromium, the allowable limit is 0.2 mg/kg. In the present study, the Site 1 showed a mean value of 1.60 mg/kg and site 2 with a mean value of 1.0 mg/kg, which was also found exceeded the FAO limit, whereas for site 3 the values were not detected. The maximum permissible limit of Copper in fresh water crabs according to FAO was 30 mg/kg and the samples of the three study sites are safe with respect to this limit. The respective mean values of Copper for site 1, 2 and 3 were 8.85 mg/kg, 5.3 mg/kg, and 2.7 mg/kg. The maximum allowable limit for Lead is 0.5 mg/kg whereas the present investigation showed a mean value of 8.14 mg/kg at site 1 and 2.8 mg/kg at site 2. The permissible limit for Zinc is 40 mg/kg and all the study sites are safe concerning Zinc. The values for site 1, 2 and 3 were 15.50 mg/kg, 13.0 mg/kg, and 8.2 mg/kg respectively. The accumulation of heavy metals in the muscle samples of *Scylla serrata* of site 1 were in the decreasing order of Zn > Cu > Pb > Cr > Cd. The decreasing order of heavy metal accumulation in site 2 samples was Zn > Cu > Pb > Cr > Cd. With respect to the Site 3 samples, the most abundant element was Zinc followed by Copper, and all other three heavy metals - Cadmium, Chromium and Lead was not detected in muscle samples of *Scylla serrata*. The decreasing order of heavy metal accumulation with respect to sites is site 1 < site 2 < site 3. Comparison of the elemental

analysis in the muscle samples of *Scylla serrata* of the three study sites with reference to FAO table 1. The heavy metal analysis in the muscle samples of *Scylla serrata* of three study sites with respect to their mean values are shown in figure.

The results of the One way analysis of variance (ANOVA) showed that selected heavy metals such as Cadmium (F = 17.820), Chromium (F = 130.748), Copper (F = 119.606), Lead (F = 58.955) and Zinc (F = 52.526) were found to be different in their values with respect to the sites and showed significance at 1% level (p < 0.01). The results of the Fisher's LSD (Least significant difference) Post hoc multiple comparisons further reveals that site 1 and 2 accumulation of heavy metal Cadmium, with respect to heavy metals Copper and Lead, site 1 significantly differ from site 3 with respect to the heavy metals Chromium and Zinc, all three sites were found to be significantly different among each other (Table 2)

**Conclusion**

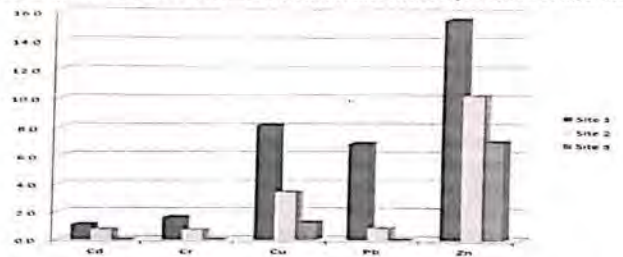
Above mentioned results further reveals that the samples of *Scylla serrata* collected from site 1- Kureepuzha are more polluted with heavy metal contamination when compared with other sites. The decreasing order of heavy metal accumulation with respect to sites is site 1 < site 2 < site 3. The analysis of the statistical results confirms the pollution status of the Lake. The study further reveals that the bioaccumulation levels on *Scylla serrata* with respect to Cadmium, Chromium and Lead at site 1 and 2 are significantly higher. Hence, this study is very relevant in relation to the pollution status of the Lake as a whole.

**Table 1: Comparing the elemental analysis in the muscle samples of *Scylla serrata* with international standard**

Heavy metals	FAO limits (mg/kg)	Present study - mean values (mg/kg)			Inference
		Site 1	Site 2	Site 3	
Cadmium	0.5	1.10	1.5	Not detected	Site 1 and 2 above permissible limit
Chromium	0.2	1.60	1.0	Not detected	Site 1 and 2 above permissible limit

Heavy metals	FAO limits (mg/kg)	Site 1	Site 2	Site 3	Inference
Copper	30	8.85	5.3	2.7	All sites below permissible limit
Lead	0.5	8.14	2.8	Not detected	Site 1 and 2 above permissible limit
Zinc	40	15.50	13	8.2	All sites below permissible limit

**Figure showing the heavy metal accumulation in the muscles of *Scylla serrata* of three study sites.**



**Table 2: Analysis of variance (One-Way ANOVA) of heavy metals of the muscles of *Scylla serrata* comparing three sites of the Ashtamudi Lake.**

Heavy metals	Study sites			F value comparing study sites	P Value
	Site 1 (Mean ± SD)	Site 2 (Mean ± SD)	Site 3 (Mean ± SD)		
Cadmium	1.104 ± 0.608 <sup>a</sup>	0.725 ± 0.515 <sup>a</sup>	.00 ± .00 <sup>b</sup>	17.820	< 0.001*
Chromium	1.604 ± 0.386 <sup>a</sup>	0.675 ± 0.171 <sup>b</sup>	.00 ± .00 <sup>c</sup>	130.748	< 0.001*
Copper	8.141 ± 1.471 <sup>a</sup>	3.383 ± 1.105 <sup>b</sup>	1.225 ± 0.616 <sup>b</sup>	119.606	< 0.001*
Lead	6.850 ± 2.730 <sup>a</sup>	0.816 ± 1.045 <sup>b</sup>	.00 ± .00 <sup>b</sup>	58.955	< 0.001*
Zinc	15.50 ± 2.489 <sup>a</sup>	10.191 ± 2.461 <sup>b</sup>	6.958 ± 0.701 <sup>c</sup>	52.526	< 0.001*

\* = p < 0.01, The mean difference is significant at 1% level; SD - Standard deviation  
<sup>a, b, c</sup> - Means within rows with differing subscripts are significantly different using Fisher's LSD post hoc test.

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**REFERENCES**

1. APHA. (2012). Standard Methods for Examination of Water and Wastewater. 22nd ed. American Public Health Association/American Water Works Association/Water Environment Federation, Washington D.C., USA.
2. Chinnadurai, S., Mohamed, K.S., Sharma J., and Venkatesan V. (2016). Assessment of bio-accumulation of bacteria in oysters from shellfish growing waters in Ashtamudi Lake (Kerala, India): A RAMSAR wetland. Journal of Regional studies in marine science, 7 118 - 122

3. FAO. (1984). Species identification sheets for fishery purposes. Food and Agriculture Organization of the United Nations. Rome, 1984.
4. FAO (Food and Agriculture Organization). (2003). Retrieved 2012. From Heavy Metal Regulation Faolex: <http://faolex.org/docs/pdf/eri42405.pdf>
5. Razeena, K. L., and Sherly, W. E. (2014). Bioaccumulation of Heavy Metals in an Estuarine Fish *Liza parsia* of Ashtamudi Lake-Southwest Coast of Kerala, India. *The International Journal of Science and Technoledge.*, 2 (3): 169 - 171
6. Sherly, W.E., Lekshmi, P.V., Razeena, K.L. (2015). Morphological alterations caused by pollution on gills and fins of *penaeus monodon*. *European Journal of Biomedical and Pharmaceutical sciences.* 2: 569-575.
7. Suma, S., Manoj, S.V., Chithra, P.G. (2012). Analysis of effluents discharged to ashtamudi lake from china clay industries. *International Journal of Chemistry and Research.* 3: 0976-5689.

## DFT and molecular dynamics investigation of 1-(3-Chloro-4-fluorophenyl)-3-[3-(trifluoromethyl)phenyl]thiourea (ANF-2)

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### Abstract:

In the present study, the HOMO and LUMO analysis is used to determine the charge transfer within the molecule. The first hyperpolarizability of the title compound is 48.09 times that of the standard NLO material urea. The maximum negative region is localized over the C=S group and 1,3-disubstituted phenyl ring and the maximum positive region is localized on NH groups indicating a possible site for nucleophilic attack. Average local ionization energies have been mapped to the electron density surface in order to detect molecule sites where electrons are least tightly bound. Other possible reactive centers of the title molecule have been detected by calculation of Fukui functions. In order to investigate the possibility for autoxidation and hydrolysis of investigated molecule, we have calculated bond dissociation energies and radial distribution functions. Charge hopping properties of electrons and holes have been assessed using the Marcus semi-empiric approach and the results were compared with urea and thiourea molecules. The docked ligand forms a stable complex with prostaglandin E synthase and has a binding affinity value of -6.5kcal/mol and the title compound can be a lead compound for developing new analgesic drug.

**Keywords:** DFT; Thiourea; ALIE; BDE; RDF; Molecular docking.

### 1. Introduction

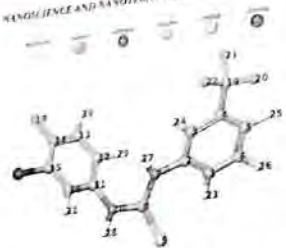
Biological activities of 1,3-disubstituted thiourea derivatives have been the subject of various studies. Within this group, the highest antibiofilm [1], antiviral [2] and tuber-culostatic [3] potency was observed for thioureas containing electron-withdrawing (e.g. halogen) functionalities at the *ortho/para*- position of the aromatic ring [4]. Pharmaceutical molecules based on the biologically active molecules are constantly polluting all types of waters and present great danger for the aquatic organisms [5]. Although various methods for purification of water are available, degradation of mentioned type of compounds is still difficult and inefficient employing conventional approaches. Scientific community is for some time committed to development of improved methods for their degradation and advanced oxidation processes are seen as both economical and efficient alternative [6]. Understanding in details reactive properties of biologically active molecules is prerequisite for the improvement of methods for their degradation. From the experimentation aspect this can be tedious task so DFT calculations and molecular dynamics

(MD) simulations are frequently employed to initially assess the reactive and degradation properties. Namely, by calculation of bond dissociation energies (BDE) can show molecule sites prone to autoxidation and indicate bonds that are the weakest, while MD simulations indicate the influence of solvent to the investigated molecule. The calculation of these quantities has been conducted in this work as well.

### 2. Computational Details

Firstly, conformational analysis has been conducted with the MacroModel program as implemented in Schrödinger Materials Science Suite 2015-4 [7]. By its default settings total of 96 structures have been detected and all of these structures have been optimized with Jaguar 9.0 [8] program, also as implemented in Schrödinger Materials Science Suite 2015-4 at B3LYP/6-31G(d) level of theory in order to refine geometries and chose five structures with the lowest energies. Five structures with lowest energies have been further optimized at B3LYP/6-31G(d,p) level of theory with finer grid density and increased integral accuracy.





Finally, the lowest energy structure has been chosen for detailed investigation of reactive properties. Jaguar 9.0 [7] program has been used for DFT calculations of average local ionization energy (ALIE) surfaces, Fukui functions and BDE. For these purposes a B3LYP exchange-correlation functional [9] has been used with 6-311++G(d,p) basis set for ALIE surface, 6-31+G(d) for Fukui functions and 6-311G(d,p) for BDE. Radial distribution functions (PDF) have been calculated after MD simulations performed with Desmond [16] program, also as implemented in Schrödinger Materials Science Suite 2015-4. For MD simulations OPLS 2005 force field [11] and NPT ensemble class have been used. Simulation time was 10 ns, while cut-off radius was 12 Å. System was modeled by placing one ANF-2 molecule in the cubic box with ~3000 water molecules. Solvent was treated with simple point charge (SPC) model [12]. Intramolecular noncovalent interactions have been investigated using the method of Johnson et al. [13]. To simulate the amorphous phase and in such way to obtain possible pair configurations 32 molecules of ANF-2 were treated with MD simulations with OPLS 2005 force field in the cubic box with simulation time of 10 ns. Same methodology was applied for the obtaining of amorphous phase for urea and thiourea molecules, but with 256 molecules placed in cubic box, due to the fact that these molecules are much smaller. Again, cut-off radius of 12 Å was used.

**3. Results and discussion**

**3.1 Nonlinear optical properties**

Nonlinear optical effects is due to the interaction of electromagnetic fields in various media to

produce new fields altered in frequency, phase amplitude or other propagation characteristics [14]. For the title compound, the polarizability, first hyperpolarizability and second hyperpolarizability are respectively,  $3.3946 \times 10^{-31}$ ,  $6.2517 \times 10^{-30}$  and  $24.627 \times 10^{-39}$  esu and these values of the investigated molecule clearly reveal that they have nonlinear optical behavior with non-zero values. The reported value of the first hyperpolarizability of phenyl thiourea derivatives is  $1.86 \times 10^{-30}$  esu [15] and the first hyperpolarizability of the title compound is 48.09 times that of the standard NLO material urea [16].

**3.2 Frontier molecular orbital analysis**

HOMO and LUMO energy values are very important parameters for quantum chemistry and HOMO is the outermost orbital, tends to give electrons and act as an electron donor while the LUMO accepts electrons [17]. According the B3LYP/6-31G(d,p) method, the HOMO and LUMO energy values are -7.22 and -4.551eV.



The ionization energy and electron affinity can be expressed as:  $I = -E_{\text{HOMO}} = 7.325$ ,  $A = -E_{\text{LUMO}} = 4.551\text{eV}$  [18]. The hardness  $\eta$  and chemical potential  $\mu$  are given the following relations  $\eta = (I-A)/2$  and  $\mu = -(I+A)/2$ , where  $I$  and  $A$  are the first ionization potential and electron affinity of the chemical species [19]. For the title compound, HOMO-LUMO energy  $E = 2.774\text{eV}$ , Ionization potential,  $I = 7.325\text{eV}$ , Electron affinity  $A = 4.551\text{eV}$ , global hardness  $\eta = 1.387\text{eV}$ , chemical potential  $\mu = -5.938\text{eV}$ , global electrophilicity index  $\omega = \mu^2/2\eta = 12.71$

**3.3 Molecular Electrostatic Potential**



MEP map illustrates the charge distribution of molecules three dimensionally and it gives the reactive sites of the molecule. This map gives the visualization of variably charged regions of a molecule and the knowledge of the charge distribution is used to determine how the molecules interact with one another and physiochemical property relationships [20]. In the MEP map the different values of the electrostatic potential at the surface are represented by different colors with potential values increases in the order red < orange < yellow < green < blue. The red, orange and yellow regions of the MEP are negative potential regions related to electrophilic reactivity. The maximum negative region is localized over the C=S group and 1,3-dsubstituted phenyl ring and the maximum positive region is localized on NH groups indicating a possible site for nucleophilic attack. These sites give information about the region from which the compound can has intermolecular interactions with most reactive sites for both electrophilic and nucleophilic attack.

**3.4 ALIE surfaces and Fukui functions**

ALIE values have been mapped to the electron density surface and the representative surface of ANF-2 molecule has been presented in Figure. This useful quantum molecular descriptor was introduced by Sjoberg et al. [21] and determines the molecule locations where



electrons are most easily removed, i.e. locations that are possibly prone to electrophilic attacks. ALIE is defined as sum of orbital energies weighted by the orbital densities according to the following equation:

$$I(r) = \sum_i \frac{\rho_i(\vec{r})\epsilon_i}{\rho(\vec{r})} \quad (1)$$

where  $\rho_i(\vec{r})$  represents the electronic density of the  $i$ -th molecular orbital at the point  $\vec{r}$ ,  $\epsilon_i$  represents the orbital energy and  $\rho(\vec{r})$  is the total electronic density function.

Results in Figure indicate that one location is significantly prone to electrophilic attacks. That is sulfur atom S9 and for the removal of electrons in its near vicinity 165 kcal/mol of energy is necessary. On the other side the electrons are the most tightly bound in the near vicinity of hydrogen atoms H28 and H31. These locations could have significant interactions with water molecules, which is going to be confirmed by MD simulations and calculated RDFs. In Figure one detected intra-molecular non-covalent interaction has been illustrated, between sulfur atom S9 and hydrogen atom H23.

To further determine which locations of the title molecule could be possible reactive centers we will refer to Fukui functions. This descriptor shows how electron density throughout the molecule changes with addition or removal of charge, allowing one to locate areas prone to electrophilic or nucleophilic attacks. Finite difference approximation is used in Jaguar program for calculation of the Fukui functions according to the following equations:

$$f^+ = \frac{(\rho^{N+1}(r) - \rho^N(r))}{\delta} \quad (2)$$

$$f^- = \frac{(\rho^{N-1}(r) - \rho^N(r))}{\delta} \quad (3)$$

where  $N$  denotes the number of electrons in the reference state of the molecule and  $\delta$  represents the fraction of electron, which is set to be 0.01 [22].



Color code in above Figure is as following. Purple color is positive color and in case of  $f^-$  function it indicates molecule areas where electron density increases with the addition of charge. On the other side, red color is negative color and in the case of  $f^+$  function it shows molecule areas where electron density decreases with the removal of charge. Results presented in above Figure indicate that concerning Fukui  $f$  function there are two locations where electron density increases with the addition of charge and therefore prone to electrophilic attacks. Beside sulfur atom S9,  $f^-$  function recognizes carbon atom C16 as possibly prone to electrophilic attacks. On the other side,  $f^+$  function indicates the rest of the molecule possibly prone to nucleophilic attacks, as red color is distributed across the molecule.

3.5 Natural Bond Analysis

The natural bond orbital (NBO) calculations were performed using NBO 3.1 program [23] to understand various second-order interactions in the molecular system. The second-order perturbation theory analysis of Fock-matrix in NBO basis shows strong intra-molecular hyper conjugative interactions are formed by orbital overlap between  $n(S)$ ,  $n(N)$ ,  $n(Cl)$ ,  $n(F)$  and  $\sigma^*(C-N)$ ,  $\pi^*(C-C)$ ,  $\sigma^*(C-S)$ ,  $\sigma^*(C-F)$  bond orbital which result in intra-molecular charge transfer causing stabilization of the system.

The various important intra-molecular hyper conjugative interactions are:  $C_4-S_9$  from  $N_7$  of  $n_1(N_7) \rightarrow \sigma^*(C_4-S_9)$  which increases electron density 0.48288e and weakens the respective bonds  $C_4-S_9$  leading to stabilization of 68.90kJ/mol;  $N_7-C_4$  from  $S_9$  of  $n_1(S_9) \rightarrow \sigma^*(N_7-C_4)$  which increases the electron density 0.06207e and weakens the respective bonds  $N_7-C_4$  leading to stabilization of 12.09kJ/mol;  $C_4-S_9$  from  $N_{10}$

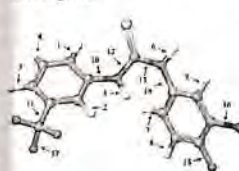


of  $n_1(N_{10}) \rightarrow \sigma^*(C_4-S_9)$  which increases electron density 0.48288e and weakens the respective bonds  $C_4-S_9$  leading to stabilization of 67.42kJ/mol;  $C_{14}-C_{13}$  from  $Cl_{17}$  of  $n_1(Cl_{17}) \rightarrow \pi^*(C_{14}-C_{13})$  which increases the electron density 0.46998e and weakens the respective bonds  $C_{14}-C_{13}$  leading to stabilization of 13.09kJ/mol;  $C_{14}-C_{11}$  from  $F_{18}$  of  $n_1(F_{18}) \rightarrow \pi^*(C_{14}-C_{11})$  which increases electron density 0.43698e and weakens the respective bonds  $C_{14}-C_{11}$  leading to stabilization of 21.60kJ/mol;  $C_{19}-F_{22}$  from  $F_{20}$  of  $n_1(F_{20}) \rightarrow \pi^*(C_{19}-F_{22})$  which increases the electron density 0.10312e and weakens the respective bonds  $C_{19}-F_{22}$  leading to stabilization of 12.72kJ/mol;  $C_{19}-F_{20}$  from  $F_{22}$  of  $n_1(F_{22}) \rightarrow \sigma^*(C_{19}-F_{20})$  which increases the electron density 0.06207e and weakens the respective bonds  $C_{19}-F_{20}$  leading to stabilization of 12.60kJ/mol.

The natural hybrid orbital with higher energies are  $n_1(S_9)$ ,  $n_1(Cl_{17})$ ,  $n_1(F_{18})$ ,  $n_1(F_{20})$ ,  $n_1(F_{21})$  and  $n_1(F_{22})$ . The energy values of these orbital are respectively, -0.19884, -0.33765, -0.42637, -0.42376, -0.41733 and -0.42439 a.u. The p-characters are nearly 100% and low occupation numbers for these orbital are 1.87411, 1.92492, 1.91319, 1.93051, 1.93131 and 1.93148. The orbital with lower energies high occupation numbers are:  $n_1(S_9)$ ,  $n_1(Cl_{17})$ ,  $n_1(F_{18})$ ,  $n_1(F_{20})$ ,  $n_1(F_{21})$  and  $n_1(F_{22})$  with energies -0.69927, -0.93461, -1.04846, -1.05905, -1.05996, -1.06075 a.u. and p-characters, 17.93, 17.66, 30.30, 29.17, 99.98 and 29.05% respectively. High occupation numbers, 1.98601, 1.99361, 1.98857, 1.98707, 1.98756, and 1.98711. Thus, a very close to pure p-type lone pair orbital participates in the electron donation to the  $n_1(N_7) \rightarrow \sigma^*(C_4-S_9)$ ,  $n_1(S_9) \rightarrow \sigma^*(N_7-C_4)$ ,  $n_1(N_{10}) \rightarrow \sigma^*(C_4-S_9)$ , and  $n_1(Cl_{17}) \rightarrow \pi^*(C_{14}-C_{13})$  interactions in the compound.

3.6 Degradation properties based on autoxidation and hydrolysis

It is important to understand degradation properties of potential drug candidates in order to be able to develop safe pharmaceutical formulations [24]. One solution for this are forced degradation studies which are long and expensive procedures. Luckily, principles of molecular modeling offer possibilities to initially assess the degradation properties by DFT calculations and MD simulations. DFT calculations can be used to calculate BDEs (Figure) which indicate which molecule locations are candidates for the start of autoxidation process. On the other side MD simulations can be used to calculate RDF thanks to which influence of solvent molecules to each atom of investigated compound can be investigated.



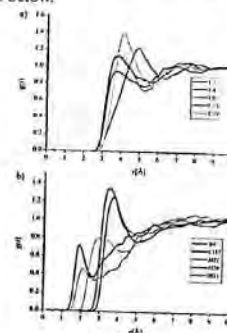
Atom	Bond BDE (kcal/mol)
1	111.80
2	118.50
3	119.51
4	119.30
5	91.79
6	91.91
7	117.14
8	120.06
9	129.06
10	93.37
11	107.81
12	99.65
13	69.42
14	85.46
15	125.99
16	89.24
17	114.00

Formation of radical of organic biologically active molecule occurs with formation of peroxy radical and reaction can proceed only if the formed peroxy radical is able to abstract hydrogen atom from another molecule [25]. On the other side, hydrogen atoms can be abstracted only at certain molecule locations, where BDE values have adequate values. According to the work of Wright et al. [26] for BDE values ranging from 75 to 85 kcal/mol the sensitivity of molecule towards the mechanism of autoxidation is the highest. However, the BDE values ranging from 87 to 92 kcal/mol should also be taken into account since BDE values of all peroxy radicals are in this range and are practically independent of chemical surrounding.

Beside BDE values for hydrogen abstraction it is also useful to know BDE values of the rest of the acyclic bonds because this data can indicate which bonds are the weakest and where degradation could also start. Obtained

results concerning the BDE values indicate that investigated ANF-2 molecule could be sensitive towards the mechanism of autoxidation as the lowest BDE value for hydrogen abstraction is below 92 kcal/mol (bonds denoted with numbers 5 and 6). This value is close to the upper border value, but on the other side BDE values of the rest of the single acyclic bonds indicate that the weakest bonds are adjacent bonds denoted with numbers 12 and 13. Thus, according to the BDE values, degradation process could start in the near vicinity of nitrogen atoms.

RDF,  $g(r)$ , is the probability of finding a particle in the distance  $r$  from another particle and results concerning the interaction of ANF-2 molecule with water molecules are presented in Figure below.



In Fig. a it can be seen that five carbon atoms have significant interactions with water molecules. Carbon atoms C6 and C13 are very similar in terms of maximal  $g(r)$  values and peak distances which have approximate values of 1.1 and 3.5 Å, respectively. Carbon atom C1 is also similar to them, but with lower maximal  $g(r)$  value which has the value of around 0.9. Carbon atom C4 has the longest peak distance of almost 5 Å, while its maximal  $g(r)$  value is 1.2. In the case of carbon atoms, the highest maximal  $g(r)$  value has been calculated for atom C19, around 1.4, while its peak distance is around 4 Å. As expected, much more pronounced interactions with water molecules were calculated for non-carbon atoms. From the aspect of peak distance the most important RDFs are calculated for hydrogen atoms H27

and H28, with values of below 2 Å. On the other side the highest maximal  $\rho(r)$  values have been calculated for sulfur and chlorine atoms, with values of around 1.3, but with higher peak distances, somewhat higher than 3.5 Å. Hydrogen atoms H27 and H28 are important reactive centers from the aspect of RDEs so it could be expected that at these locations autoxidation mechanism is competing with hydrolysis. Since BDE values are significantly high, it is expected that investigated molecule is stable to the influence of open air and oxygen.

### 3.7 Charge hopping properties between ANF-2 molecules

Investigated ANF-2 molecule is based on the thiourea molecule. Thiourea molecule is analogues molecule to urea, which is used as standard NLO material and for the comparison of calculated hyperpolarizabilities. Therefore, beside hyperpolarizability, in this work we have calculated also some optoelectronic properties of ANF-2 molecule and compared it with urea and thiourea. We have decided to calculate quantities which principally determine the charge hopping dynamics between molecules. Those quantities are electron and hole reorganization energies ( $\lambda$  and  $\lambda_h$ , respectively) and transfer integral ( $t$ ). According to the Marcus semi-empiric approach these two quantities determine the charge hopping rate ( $k_{\pm}$ ) by the following expression:

$$k_{\pm} = \frac{4\pi^2}{h} \frac{1}{\sqrt{4\pi\lambda k_B T}} t^2 \exp\left[\frac{-\lambda}{4k_B T}\right] \quad (4)$$

Determination of the  $k_{\pm}$  is very useful as it is directly proportional to the mobility of charge carriers and diffusion coefficient. Thus, calculation of  $k_{\pm}$  allows one to initially assess the charge hopping properties of the investigated molecules. The larger the reorganization energies and lower the charge coupling is, the higher will be the values of  $k_{\pm}$ . Once the possible pairs of ANF-2 molecules were obtained by MD simulations, calculations of  $t$  have been performed for 60 randomly chosen pairs (half of the total number of pairs) and the average values have been taken.

Same procedure was conducted for obtaining charge hopping rates for urea and thiourea molecules. Results show that reorganization energy of electrons is the lowest in the case of ANF-2 molecules, thus indicating that charge hopping could be the highest in the case of

this molecule. Indeed, calculated  $k_{\pm}$  indicate that the highest value was obtained precisely in the case of ANF-2 molecule – about three times higher than the corresponding values of urea and thiourea molecules. On the other side, reorganization energy of holes for ANF-2 molecule is much higher than corresponding values of urea and thiourea molecules,

resulting in one order of magnitude lower  $k_{\pm}^+$ , comparing with urea and thiourea. Finally, the difference between  $k_{\pm}^-$  and  $k_{\pm}^+$  is the lowest in the case of precisely ANF-2 molecules. This result is important as difference in mobilities of charge carriers should not be too high due to the recombination.

### 3.8 Molecular docking

Based on the structure of a compound, PASS (Prediction of Activity Spectra) [27] is an online tool which predicts different types of activities. PASS analysis of the title compound predicts activities prostaglandin E synthase activity with probability to be active (Pa) value of 0.638. Microsomal prostaglandin E synthase is a membrane-bound terminal enzyme that exhibits the inhibitor of analgesia [28]. High resolution crystal structure of prostaglandin E synthase was downloaded from the RCSB protein data bank website with PDB ID: 4YL and all molecular docking calculations were performed on Auto Dock-Vina software [29]. The 3D crystal structure of aryl hydrocarbon receptor was obtained from RCSB Protein Data Bank and the protein was prepared for docking by removing the co-crystallized ligands, waters and co-factors and the Auto Dock Tools (ADT) graphical user interface was used to calculate Kollman charges and polar hydrogens. The docking protocol predicted the same conformation as was present in the crystal structure with RMSD value well within the reliable range of 2Å [30]. Amongst the docked conformations, one which binds well at the

active site was analyzed for detailed interactions in Discovery Studio Visualizer 4.0 software. The ligand binds at the active site of the substrate by weak non-covalent interactions. Amino acid Val105 forms interactions like  $\pi$ -sigma and  $\pi$ -alkyl with phenyl ring and alkyl with CF<sub>3</sub>. Leu104 shows halogen and alkyl interaction with CF<sub>3</sub>. Val108 forms alkyl interaction with CF<sub>3</sub> and Leu132 exhibit  $\pi$ -alkyl interaction with phenyl ring. The docked ligand forms a stable complex with prostaglandin E synthase and got a binding affinity value of -6.5kcal/mol. Thus the title compound can be a lead compound for developing new analgesic drug.

### 4. Conclusion

The nonlinearity of the title molecule is due to the extended  $\pi$ -electron delocalization over the thiourea group and hence the title molecule and its derivatives are good objects for further studies in nonlinear optical studies. Sulfur atom is recognized to be possibly prone to electrophilic attacks by both ALIE surfaces and Fukui  $f^+$  function. Additionally, Fukui  $f^-$  function also recognizes carbon atom C16 as possibly prone to electrophilic attacks. Only one intramolecular noncovalent interaction

### References

1. A. Bielenica, J. Stefańska, K. Stepień, A. Napiórkowska, E. Augustynowicz-Kopeć, G. Sanna, S. Madeddu, S. Boi, G. Giliberti, M. Wrzosek, M. Struga, Eur. J. Med. Chem. 101 (2015) 111-125.
2. S. Karakuş, S. GünizKüçükgülzel, I. Küçükgülzel, E. De Clercq, C. Pannecouque, G. Andrei, R. Snoeck, F. Sahin, O.F. Bayrak, Eur. J. Med. Chem. 44 (2009) 3591-3595.
3. D. Sriram, P. Yogeewari, M. Dinakaran, R. Thirumurugan, J. Antimicrob. Chemother. 59 (2007) 1194-1196.
4. G.P. Suresha, R. Suhas, W. Kapfo, D.C. Gowda, Eur. J. Med. Chem. 46 (2011) 2530-2540.
5. A. Golubović, B. Abramović, M. Šćepanović, M. Grujić-Brojčin, S. Armaković, I. Veljković, B. Babić, Z. Dohčević-Mitrović, Z. Popović, Mater. Res. Bull. 48 (2013) 1363-1371.
6. B. Abramovic, S. Kler, D. Sojic, M. Lausevic, T. Radovic, D. Vione, J. Hazard. Mater. 198 (2011) 123-132.
7. A.D. Bochevarov, E. Harder, T.F. Hughes, J.R. Greenwood, D.A. Braden, D.M. Philipp, D. Rinaldo, M.D. Halls, J. Zhang, R.A. Friesner, Int. J. Quantum Chem. 113 (2013) 2110-2142.
8. Schrödinger Materials Science User Manual. 2014, Schrödinger Press.
9. A.D. Becke, J. Chem. Phys. 98 (1993) 5648-5652.
10. D. Shivakumar, J. Williams, Y. Wu, W. Damm, J. Shelley, W. Sherman, J. Chem. Theory Comput. 6 (2010) 1509-1519.
11. J.L. Banks, H.S. Beard, Y. Cao, A.E. Cho, W. Damm, R. Farid, A.K. Felts, T.A. Halgren, D.T. Mainz, J.R. Maple, R. Murphy, D.M. Philipp, M.P. Repasky, L.Y. Zhang, B.J. Berne, R.A. Friesner, E. Gallicchio, R.M. Lew, J. Comput. Chem. 26 (2005) 1752-1780.
12. H.J. Berendsen, J.P. Postma, W.F. van Gunsteren, J. Hermans, Interaction models for water in relation to protein hydration, in Intermolecular forces. 1981, Springer. p. 331-342.

13. A. Otero-de-la-Roza, E.R. Johnson, J. Contreras-García, *Phys. Chem. Chem. Phys.* 14 (2012) 12165-12172.
14. Y.X. Sun, Q.L. Hao, W.X. Wei, Z.X. Yu, L.D. Lu, X. Wang, Y.S. Wang, *J. Mol. Struct. Theochem* 904 (2009) 74-82.
15. C.Y. Panicker, H.T. Varghese, A. George, P.K.V. Thomas, *Eur. J. Chem.* 1 (2010) 173-178.
16. C. Adant, M. Dupuis, J.L. Bredas, *Int. J. Quantum. Chem.* 56 (1995) 497-507.
17. G. Gece, *Corros. Sci.* 50 (2008) 2981-2922.
18. S.H.R. Sebastian, M.A. Al-Alshaikh, A.A. El-Emam, C.Y. Panicker, J. Zitko, M. Dolezal, C. Van Alsenoy, *J. Mol. Struct.* 1119 (2016) 188-199.
19. R.G. Parr, R.G. Pearson, *J. Am. Chem. Soc.* 105 (1983) 7512-7561.
20. I. Fleming, *Frontier Orbital and Organic Chemical Reactions*, John Wiley and Sons, Berlin, 1976.
21. P. Sjoberg, J.S. Murray, T. Brinck, P. Politzer, *Canadian J. Chem.* 68 (1990) 1440-1443.
22. A. Michalak, F. De Proft, P. Geerlings, R. Nalewajski, *J. Phys. Chem. A* 103 (1999) 762-771.
23. E.D. Glendening, A.E. Reed, J.E. Carpenter, F. Weinhold, NBO Version 3.1, Gaussian Inc Pittsburgh, PA, 2003.
24. M. Li, *Organic chemistry of drug degradation*. 2012: Royal Society of Chemistry.
25. T. Andersson, A. Broo, E. Evertsson, *J. Pharm. Sci.* 103 (2014) 1949-1955.
26. J.S. Wright, H. Shadnia, L.L. Chepelev, *J. Comput. Chem.* 30 (2009) 1016-1026.
27. A. Lagunin, A. Stepanchikova, D. Filimonov, V. Poroikov, *Bioinformatics* 16 (2000) 747-748.
28. S. Chandrasekhar, A.K. Harvey, X.P. Yu, M.G. Chambers, J.L. Oskins, C. Lin, T.W. Seng, S.J. Thibodeaux, B.H. Norman, N.E. Hughes, M.A. Schiffler, M.J. Fisher, *J. Pharmacol. Exp. Ther.* 358 (2016) 635-644.
29. O. Trott, A. J. Olson, *J. Comput. Chem.* 31 (2010) 455-461.
30. B. Kramer, M. Rarey, T. Lengauer, *Struct. Funct. Genet.* 37 (1999) 228-241.

## A green approach for the synthesis of polysaccharide based hydrogel for controlled release of tetracycline hydrochloride

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**Abstract**  
The *in situ* loading study of tetracycline hydrochloride in acrylamide grafted  $\beta$ -cyclodextrin was carried out by microwave assisted free radical polymerization using ceric ammonium nitrate as redox initiator. The stability of tetracycline hydrochloride at pH 2.4 and 7.4 was studied. The *in vitro* release study shown that the maximum release of drug was at pH 2.4.

**Keywords:** Tetracycline hydrochloride;  $\beta$ -cyclodextrin; Acrylamide; Controlled release

**Introduction**  
Natural polymers are preferred for medical application over synthetic polymers because of their biodegradability, lowcost, easy availability and nontoxicity [1,2]. However, they possess the drawbacks such as uncontrolled hydration, microbial contamination, and drop in viscosity during storage etc. The chemical composition of natural and synthetic polymers modifies the chemical properties of these natural polymers by hybridization. A grafted copolymer is a macromolecular chain with one or more species of block connected to main chain as side chain(s) having the main polymer backbone commonly referred to as the trunk polymer and branches of another polymeric chain emanating from different points along its length [3].

Cyclodextrins are a family of cyclic oligosaccharides composed of  $\alpha$ -(1, 4) linked glucopyranose subunits. Cyclodextrins have been found as potential candidates because of their ability to alter physical, chemical and biological properties of guest molecules through the formation of inclusion complexes. Cyclodextrin molecules are relatively large with a number of hydrogen donors and acceptors and, thus, in general they do not permeate lipophilic membranes.  $\beta$ -cyclodextrin based hydrogels are widely used in biomedical applications as drug delivery systems because they increase the aqueous solubility, stability and bioavailability of drugs.  $\beta$ -cyclodextrin are known to be rarely hydrolyzed and only a small fraction of them is absorbed in the passage through stomach and small intestine. At the same time,  $\beta$ -cyclodextrin has several adverse effects like nephrotoxicity

and low aqueous solubility due to the relatively strong binding of the  $\beta$ -cyclodextrin molecules in the crystal state. This can be avoided by the grafting copolymerization.

The microwave assisted grafting has been widely applied in variety of polysaccharides, namely gellan gum [2], alginate [4], guar gum [5], xanthan gum [6] and many more. In the present study, the grafted copolymerization of acrylamide on to  $\beta$ -cyclodextrin was carried out by the microwave irradiation using ceric ammonium nitrate as a redox initiator. The Ce(IV) induced grafted copolymerization of vinyl monomers onto polysaccharide substrate [7, 8]. The main constraint of graft copolymerization is the formation of concurrent homopolymer resulting in low grafting yield. Apart from the redox initiator induced graft polymerization, microwave assisted grafted copolymerization can also be employed. The microwave irradiation is characterized by rapid transfer of energy in the bulk of reaction mixture. The microwave assisted graft copolymerization requires a very short reaction time and proceeds even in the absence of any redox initiator [9].

Present study explores the application of cyclodextrin based hydrogel for controlled release study of tetracycline hydrochloride. Tetracycline hydrochloride (TCH) is broad spectrum antibiotic, but it is mainly active against gram negative bacteria. Tetracycline can be effectively used against cancer, rheumatoid arthritis, osteomyelitis etc. Tetracyclines are less toxic in nature, but these are adsorbed

very poorly in human body. Therefore, a controlled drug vehicle is needed for the static bioavailability of drug. So many studies have been reported on the controlled delivery of TCH to the human body.

### Materials and methods

#### Materials

Analytical grade of tetracycline hydrochloride (TCH) was purchased from Sisco Research Laboratories Pvt. Ltd., Maharashtra, India.  $\beta$ -cyclodextrin ( $\beta$ -CD) was purchased from Tokyo Chemical Industry Co Ltd., Tokyo, Japan. Acrylamide (AAM) was purchased from Merck Life Science Pvt. Ltd., Mumbai, India. Ceric ammonium nitrate (CAN) was obtained from Merck Specialties Pvt. Ltd., Mumbai, India. Acetone (density = 0.788-0.792 g/mL) was bought from Spectrochem Pvt. Ltd., Mumbai, India. All other chemicals used were of reagent grade. Throughout the experiment, Millipore water was used.

#### Preparation of TCH loaded polymer by *in situ* method.

*In situ* polymerization in the context of drug delivery implies the development of drug delivery systems within the polymerization mixtures. TCH loaded copolymer were prepared according to the following method. About 5 mg TCH dissolved in 120 mL water, to this add 1g  $\beta$ -CD. 5g of AAM was mixed with 30 mL of water and added to the above and stirred for 1 h. 300 mg of CAN dissolved in 30 mL water and added to the above dispersion. The dispersion was irradiated by microwave for 2 min. It was left for overnight and then precipitated using acetone. It was further washed with 30% aqueous ethanol to remove unreacted monomer and other reagents. The grafted polymer then dried at 40 °C to a constant weight and converted to fines [10].

#### TCH stability study at pH 2.4 & pH 7.4

The stability of TCH was studied at pH 2.4 & pH 7.4. Sample of TCH (5 mg) was incubated at 37°C in 100 mL of phosphate buffer (pH 7.4) and in 100 mL of citrate buffer (pH 2.4). At a scheduled time intervals, sample were

withdrawn from each solution and assayed by UV spectrophotometer at 276nm in order to measure the ampicillin concentration.

#### Swelling study of polymer.

A small previously weighed piece of the material ( $W_1$ ) was immersed in 50 mL buffer (pH 2.4 & pH 7.4) and left to swell for 2h then, the swollen piece was recovered [11] and excess water was removed carefully with a tissue paper and reweighed ( $W_2$ ). The swelling index can be calculated as:

$$\text{Swelling index} = \frac{W_2 - W_1}{W_1}$$

Where  $W_1$  and  $W_2$  are the weight of swollen and dry polymers.

#### In-vitro drug release study

About 0.1 g drug loaded polymer was put in different pH conditions of 2.4 of citrate buffer & 7.4 of phosphate buffer. Placed in a water bath shaker at a stirring speed of 100 rpm maintained at a constant temperature of 37°C. The concentration of drug released at a particular time intervals can be measured by UV spectrophotometer at 276nm.

#### Result and discussion

In the copolymerization of AAM-g- $\beta$ -CD, ceric ammonium nitrate is a common reagent employed to initiate the free radical graft polymerization. At first ceric ions attack on  $\beta$ -CD and form  $\beta$ -CD-ceric complexes. The ceric (IV) ions in the complexes are then reduced to ceric (III) ion by oxidizing hydrogen atom and thereby creating a new free radical on to  $\beta$ -CD backbone. A critical amount of free radical is required for the free radical formation. The grafting of AAM on to  $\beta$ -CD is effected by having free radical reacted with the monomer unit via covalent bond. The reaction is terminated through combination of two free radical. During the *in situ* copolymerization, ampicillin is enter in to the grafted polymer. The drug made only weak interaction with the polymer. The reaction sample can be subjected to M.W irradiation to induce rapid energy transfer in its bulk there by shortening the reaction time. M.W is considered as a catalyst which synergies with ceric ion in graft polymerization.

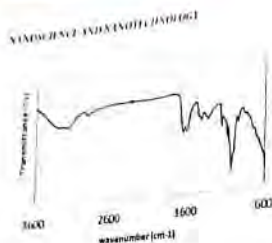


Fig.1. FTIR of acrylamide-cyclodextrin hydrogel

In FTIR, vibration frequency at 1030-1082  $\text{cm}^{-1}$  was observed in the spectra of  $\beta$ -CD, which was characteristic of a C-O-C vibration [7]. The band at 1628  $\text{cm}^{-1}$  was due to the first overtone of the O-H bending. Marked changes were observed in the spectra of cyclodextrin-acrylamide polymer compared to  $\beta$ -CD. The bands at 1651 and 1602  $\text{cm}^{-1}$  were attributed to amide-I (C-O stretching) and amide-II (N-H bending) conferred by AAM[5]. The peak at 3188-3499  $\text{cm}^{-1}$  was explained due to the overlap of N-H stretching band of amide group and O-H stretching band. A shoulder at around 1450  $\text{cm}^{-1}$  was due to the C-N stretching vibration and a peak at 1022  $\text{cm}^{-1}$  due to  $\text{CH}_2$  group which occurred during grafting reaction.

Grafted copolymerization of vinyl monomer increased swelling power due to the introduction of free hydrophilic groups. Due to these hydrophilic groups, strong interchain hydrogen bonding takes place between the grafted side chains of acrylamide. The 3-D network that can hold more water in it. From the swelling study it is observed that the maximum swelling was at pH 2.4 (335%) and minimum at pH 7.4 (178.8%). The maximum release of drug was at pH 2.4. This is due to the maximum swelling index of polymer at this pH.

The stability study of TCH was also conducted and stability of TCH depended on the pH of the medium. Stability study was carried out at two different pH of 2.4 and 7.4 (Figure not shown). Among these two pH conditions the rapid degradation was found to occur at a pH of 2.4. After 48 hrs, about 30% of drug was get burnt. Whereas for pH=7.4, degradation was occurring slowly and even after 48 hrs, about

82% of the drug was retained.

*In-vitro* release study was performed in phosphate buffer solution pH 7.4 and citrate buffer solution pH 2.4. Releases of drug at certain intervals are measured by UV spectrophotometer. The results are presented in Fig.2. There was only 4.5% release was occurred at the pH 7.4. But at pH 2.4 there was controlled release of drug was takes place in an interval of 1800 minute. Release mechanism of drug is controlled by diffusion as well as erosion mechanism.

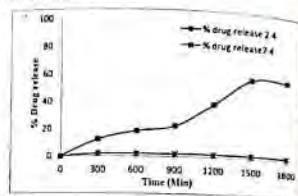


Fig.2. In Vitro release kinetics of TCH

To determine the mechanism of drug release, the initial portion of % drug release Vs. time profile have been fitted to the empirical equation proposed by Ritger and Pepas(1987)  $M_t/M_\infty = Kt^n$ , where  $M_t/M_\infty$  is the fraction of drug release at time  $t$ ,  $K$  is the kinetic rate constant and  $n$  is the diffusional exponent characterizing the mechanism of drug release. Here  $n = 0.38$ , i.e. anomalous / non Fickian type of diffusion is occur [12]. In non-Fickian / anomalous transport, both diffusion as well as macro molecular relaxation time scales are similar and both will control the overall rate of penetrant absorption. Non-Fickian release is described by two mechanism-coupling of drug diffusion and polymer relaxation. The net cumulative effect of drug's solubility influenced by its structure, molecular weight and other physical parameters.

#### Conclusion

TCH was loaded on AAM- $\beta$ -CD through *in situ* method by the microwave irradiation using ceric ammonium nitrate as a redox initiator. The maximum *in vitro* release of TCH occurs at pH 2.4. And also the maximum swelling index of polymer showed in the same pH. The release of drug followed non-Fickian diffusion controlled drug release process.

#### NANOSCIENCE AND NANOTECHNOLOGY

#### References

1. T.R.Bhardwaj, M.Kanwar, R.Lal, A.Gupta, *Drug Development and Industrial Pharmacy*, 2000, 26, 1025-1038.
2. V.Vijan, S. Kaity, S. Biswas, J. Issac, A. Ghosh, *Carbohydrate polymer*, 2012, 90, 496-506.
3. Zohuriaan, M.J. Mehr, *Iranian polymer Journal*, 2005, 14, 235-265
4. G.Sen, R.P.Singh, S.Pal, *Journal of Applied Polymer Science*, 2012, 115, 63-71
5. V.Singh, A. Tiwari, D.N.Tripathi, R. Sanghi, *Carbohydrate polymer*, 2004, 58, 1-6
6. A.Kumar, K. Singh, M. Ahuja, *Carbohydrate polymer*, 2009, 76, 261-267
7. P.Adhikari, K.N.Tiwari, R.P.Singh, *Journal of Applied Polymer Science*, 2007, 107, 773-778.
8. A. Mishra, M. Bajpai, *Journal of Macromolecular Science Part A: Pure and Applied Chemistry*, 2006, 43, 315-326.
9. V.Singh, R. Sethi, A. Tewari, V. Srivastava, R. Sanghi, *Carbohydrate polymer*, 2003, 54, 523-525.
10. R.C. Mundagri, S.A. Patil, T.M. Aminabhavi, *Carbohydrate polymer*, 2007, 69, 130-141.
11. A. V. Singh, L. K. Nath, M. Guha, *Carbohydrate polymer*, 2011, 86, 872-876.
12. P. Ritger, N.A. Peppas, *Journal of Controlled Release*, 1987, 5, 37-42.

# Investigation of the reactive properties of a thiourea derivative by spectroscopic and DFT calculations

Oral Presentation X

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## ABSTRACT

Thiourea derivatives display remarkable antitubercular, antiviral, antimalarial and anti-inflammatory activities. A thiourea derivative, 1-(4-chloro-3-nitrophenyl)-3-(3,4-dichlorophenyl)thiourea has been synthesized and spectroscopic characterization has been performed by FT-IR and FT-Raman techniques. The aforementioned spectra was theoretically obtained which were then compared with experimentally obtained data. The molecular structural parameters and vibrational wave numbers of the title compound have been investigated theoretically using Gaussian09 [1] with B3LYP/6-31G(d,p) basis set. Potential energy distribution is calculated for the normal modes of vibrations using GAR2PED program [2]. Beside spectroscopic characterization the aim of this study also encompassed detailed computational investigation of global and local reactive properties. The NLO analysis, NBO analysis, frontier molecular orbital analysis and MEP are done with the help of Gaussian software. Important local reactivity properties have also been obtained by analysis of molecular electrostatic potential (MEP) and local average ionization energy (ALIE) surfaces. The vibrational spectral analysis of the title compound is reported. For the title compound, the N-H, C-N, NO<sub>2</sub>, CCl, C=S and the phenyl rings vibrational modes are all in good agreement with the reported values of similar derivatives. The natural bond orbitals (NBO) calculations shows the strong interaction  $n_1(O_{20}) \rightarrow \pi^*(N_{19}-O_{21})$  has the highest E(2) value 93.53 kJ/mol. Almost 100% p-character was observed in lone pairs of S<sub>10</sub>, Cl<sub>18</sub>, Cl<sub>17</sub>, O<sub>20</sub>, O<sub>21</sub> and Cl<sub>24</sub>.

The Homo-Lumo analysis are frequently used to initially indicate the interaction of molecule with other species. It is evident from the frontier molecular orbital plot that there is a charge transfer within the molecular system from the thiourea group to the nitro substituted phenyl ring.

NLO properties of the title compounds has been calculated and the dipole moment is 6.7768 Debye, polarizability is  $3.4876 \times 10^{-23}$  e.s.u, and the first and second order hyperpolarizabilities are  $8.4096 \times 10^{30}$  and  $-30.880 \times 10^{-37}$  e.s.u. Here, the first hyperpolarizability of the title compound is 64.69 times that of the standard NLO material urea [3]. The C-N bond lengths in the title compound are in between a single and double bond and hence there is an extended  $\pi$ -electron delocalization over the thiourea group which is responsible for the nonlinearity of the system.

MEP analysis is also reported. The different values of the electrostatic potential are represented by different colors and potential increases in the order of red < orange < yellow < green < blue. The red, orange and yellow regions of the MEP are negative potential regions related to electrophilic reactivity. From the MEP map of the title compound, the maximum negative region is localized over the C=S group and oxygen atoms and the maximum positive region is localized on NH groups and nitrogen atom of NO<sub>2</sub> group indicating a possible site for nucleophilic attack. ALIE results show that the most important molecule site from the aspect of electrophilic attacks is characterized by low ALIE value (S<sub>10</sub>) and the molecule site where electrons are most tightly bound are characterized by high ALIE value. The molecular docking studies reveal that docked ligand form stable complexes with the target protein and show inhibitory activity against it.

## References

1. R. Dennington, T. Keith, J. Millam, "Gaussview, Version 5" J. Semichem Inc., Shawnee Mission, KS, 2009.
2. J.M.L. Martin, C. Van Alsenoy, "GAR2PED, a Program to Obtain a Potential Energy Distribution from a Gaussian Archive Record" University of Antwerp, Belgium, 2007.
3. C. Adant, M. Dupuis, J. L. Bredas, "Ab initio study of the nonlinear optical properties of urea electron correlation and dispersion effects" *Int. J. Quantum Chem.* 56, 1995, 497-507.

## ADSORPTION OF METHYLENE BLUE BY BIOCHAR-DERIVED FROM PLANT-BIOMASS

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### Abstract

In this work, biochar derived from banana stem has been employed for the removal cationic dye, methylene blue from aqueous solutions. Sorption characteristics of the as-fabricated low cost biochar for the removal of dye was studied in batch conditions. Biochar exhibited good sorption performance over the pH range 9. Langmuir and Freundlich adsorption isotherm models were fitted to the experimental data. From the regression analysis, Freundlich was found to be the best fit model suggesting multilayer adsorption.

Keywords: Biochar, Methylene blue, adsorption isotherms

### Introduction

Over the past few decades increased use of synthetic dyes led to a major reason for environmental pollutions. They have complex aromatic molecular structures that make them more stable and more difficult to biodegrade. The solubility of dyes in water effluents possesses serious risks to crop, aquatic life and human health. Different separation techniques like precipitation, ion-exchange, adsorption, coagulation / flocculation, ozonation, membrane separation and liquid- liquid extraction have been used to remove dye from wastewater. Adsorption process is considered to be an effective separation technique compared to other methods for wastewater treatment in terms of cost, simplicity of design and high adsorption capacity

In recent time, researchers are focusing on the production of low cost naturally available agricultural solid waste based adsorbents. However, to produce effective high capacity adsorbents comparative to commercial activated carbon researchers paved more attention to biochar. Biochar is a porous, carbon-residue derived from the thermal conversion of waste biomass under limited oxygen or anaerobic condition [1]. "Biochar" is a recently coined term emerging in conjunction with the renewable fuel Soil amelioration, and carbon sequestration. So far the most standardized definition of biochar is regulated by International Biochar Initiative (IBI) guidelines, which states that 'the biochar is a solid material obtained from the thermochemical conversion of biomass in

an oxygen-limited environment' [2]. It can be utilized as an adsorbent for the removal of toxic contaminants from wastewaters or polluted soils [3-8]. Relatively high levels of matrix-bound carbon in biochar, along with a high degree of porosity and large surface area, helps to play vital roles in the adsorption of heavy metals and other pollutants from contaminated environments [9,10,11,12].

The presence of functional groups on the surface of biochars impart adsorption potential for toxic substances, (As), nickel (Ni), copper (Cu), cadmium (Cd), and lead (Pb) in heavy metal contaminated soils [13,14]. Therefore, possible reductions in sources may be accomplished if biochar is present in the soil. However, biochar properties are highly variable and biochar quality is also influenced by the feedstock materials and pyrolysis conditions. The skeletal structure of biochar consists mainly of carbon and minerals of different pore sizes. Micropores are responsible for surface area and high absorptive capacity, while mesopores are important for liquid-solid adsorption processes, and macropores are important for aeration, hydrology, movement of roots, and bulk soil structure. The size and pattern of pores in biochar depends on the composition of the feedstock materials and the temperature adopted during biochar formation. The porous structure of biochar is composed of numerous aromatic compounds and other functional groups that are produced from lignin-based biomasses.



Due to its abundant availability, economic feasibility and the presence of various functional groups that were useful to produce biochar composite, in this study we have chosen banana stem waste as precursor for the production of biochar. We demonstrate facile fabrication of a eco-friendly biochar using banana stem. The adsorption behaviour of cationic dye on to magnetic biochar were studied under different experimental conditions using batch method. The operating parameters such as pH, initial concentration and contact time were investigated in detail. The adsorption equilibrium was evaluated by Langmuir and Freundlich isotherm models. The prepared biochar was characterized by various analytical techniques and studied the physio-chemical properties of the fabricated composite.

2. Materials and Methods

2.1. Materials

Biomass waste banana stem were collected from a farm in Kollam. Methylene blue was chosen as the adsorbate for the study because of its potent toxicity to water resources. For the purpose, methylene blue was purchased from E. Merck India. Other reagents solution were used for the present study were also procured from E. Merck India. The reagents used in the study were all analytical grade reagents.

2.2. Biochar preparation

Banana stem was properly washed, cut into small pieces, dried, powdered and sieved before the use. 10 g of the powdered banana stem was weighed and transferred to silica crucible. The crucible was kept in a preheated muffle furnace, where nitrogen flow was maintained for 15 minutes continuously. The material was completely dried at 350 °C. for 12h. During the process hemicelluloses undergoes limited volatilization and carbonization [15]. After heating for the pre-planned time, the crucible was transferred to a nitrogen filled desiccator. The char was again powdered, sieved and weighed.

2.3. Adsorption experiments

Adsorption experiments were performed in a batch reactor to determine the adsorption potential of the biochar sample produced in the laboratory. To determine the effect of pH, 2 g/L

of the biochar was added to the Erlenmeyer flask containing 50 mL of 10 mg/L and 25 mg/L of methylene blue solution. The pH of the suitable concentrations of HNO<sub>3</sub> and NaOH. The samples were then placed in a shaking incubator at 180 rpm and 30 °C for 4 h.

2.4 Adsorption isotherm models

In this work, the biochar was blended with 8 sets of methylene blue solutions of which concentrations were ranging from 10 mg/L to 200mg/L at 30 °C in a shaking water bath at 180 rpm. All the samples were equilibrated for 24 h and the equilibrium concentrations were determined using UV-Visible spectrophotometer at λ<sub>max</sub> 668 nm. The equilibrium data were then fitted into Langmuir and Freundlich isotherm models (Fig 1&2). The Langmuir isotherm model, which assumes homogeneous monolayer sorption, is written as:

$$\frac{C_e}{q_e} = \frac{1}{Q_0 b} + \frac{C_e}{Q_0}$$

Where Q<sub>0</sub> (mg/g) is the maximum sorption capacity, b is the Langmuir constant related to adsorption capacity and adsorption rate. When 1/q<sub>e</sub> is plotted against 1/C<sub>e</sub>, a straight line with slope 1/Q<sub>0</sub> and intercept 1/Q<sub>0</sub>b is obtained. The Freundlich isotherm model, which assumes heterogeneous adsorptive energies on the adsorbent surface is written as:

$$\log q_e = \log K_f + \frac{1}{n} \log C_e$$

where K<sub>f</sub> and n are the Freundlich constants related to adsorption capacity and intensity, respectively.

3. Result and Discussion

3.1 Effect of solution pH

The sorption of 10 and 25 mg/L of methylene blue onto the biochar dose of 2 g/L at different pH varying from 6.0 to 9.0 was studied. Data shown in Table 1. It was found that the sorption was low at lower pH. After that, the sorption percentage gradually increased reaching a maximum value of 99.2% and 98.1% for 10 mg/L and 25 mg/L at pH 9.0. The equilibrium pH lowered after adsorption, indicating the release of H<sup>+</sup> into the solution. Therefore the possible mechanism for

the sorption was a cation exchange mechanism. The polar functional groups like carboxylic groups on the biochar surface may exchange protons with the cations in the solution. The surface of prepared carbon samples contains an excess of H<sup>+</sup> ions competing with cationic methylene blue for adsorption sites, which reduces adsorption at lower pH. These acidic sites were deprotonated and surface becomes negatively charged at alkaline pH which strongly attracts the cationic dye and increases adsorption capacity [16]. Apart from the cation exchange mechanism, there is a possibility that the electron rich graphene surface on the char exerts electrostatic attraction for the cations in the solution. The char surface being porous, an intraparticle diffusion of cations may occur which get trapped very well in these pores.

3.2 Adsorption isotherms

The sorption onto the biochar is influenced by the structural and chemical properties of the sorbent surface as well as the sorbate. Adsorption also depends on the pore size distribution, specific surface area, polarity and functionality of the biochar surface. A better understanding of the sorbent-sorbate interaction is made possible from the isotherm studies. The concentrations 10, 25, 50, 100, 150 and 200 mg/L of methylene blue solution were chosen for the isotherm study with an adsorbent dose of 2 g/L. The calculated isotherm parameters are given in Table 2. The sorption data fits

very well with the Freundlich model with high regression coefficient. The Freundlich constant n, was found to be less than one, suggesting that the adsorption sites on the biochar is not homogeneous.

Conclusion

This study demonstrates the facile fabrication of biochar from low-cost abundant banana stem waste. Taking advantage of surface structure and functionalities of the biochar, the isotherm studies of the adsorption of methylene blue on to biochar was conducted. The optimum pH for the adsorption of methylene blue was found to be 9.0. The variation in the amount adsorbed from 37.4 to 11.9 mg g<sup>-1</sup> respectively indicates that it is effective to carry out the adsorption with 2g L<sup>-1</sup> sorbent dose than with higher dosages. The regression coefficient was found to be higher for Freundlich isotherm model, suggesting that the adsorption sites on the magnetic biochar were not homogeneous.

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Table 1: Effect of adsorbent dose on the adsorption of 100 mg/L methylene blue solution

pH	Adsorption (%)
6	74.0
7	88.4
8	93.2
9	95.3

Table 2: The isotherm parameters for the adsorption of methylene blue onto biochar

Isotherm Constants	Pb(II)
Freundlich	
K <sub>f</sub>	12.5
1/n	0.273
R <sup>2</sup>	0.997
Langmuir	
Q <sup>0</sup> (mg/g)	32.05
b	0.30
R <sup>2</sup>	0.5512

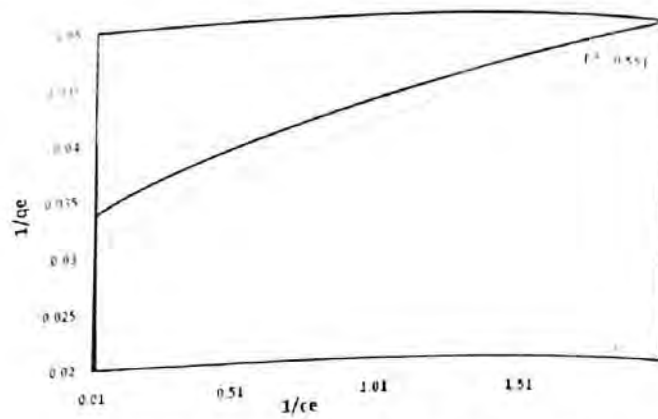


Fig.1 Langmuir adsorption isotherm

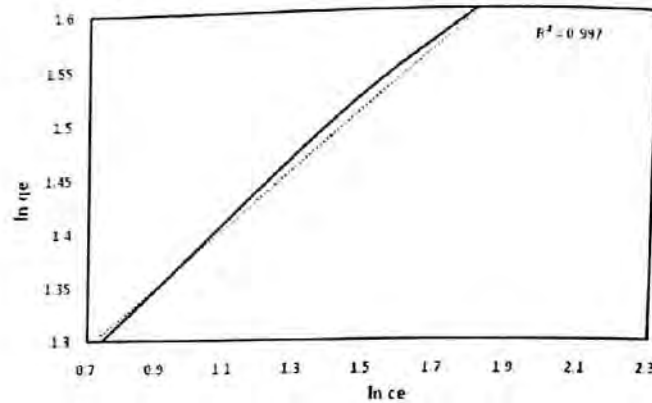


Fig 2. Freundlich adsorption isotherm

Reference

1. M. Inyang, E. Dickenson, The potential role of biochar in the removal of organic and microbial contaminants from potable and reuse water: A review, *Chemosphere*, 2015,134 ,232-240.
2. IBI. Standardized product definition and product testing guidelines for biochar that is used in Soil. International Biochar Initiative; 2013. p.1-48.
3. Trakal L, et al. Biochar application to metal-contaminated soil: evaluating of Cd,Cu, Pb and Zn sorption behavior using single- and multi-element sorption experiment, *Plant Soil Environ*, 2011,57(8),372-80.
4. Beesley L, Moreno-Jiménez E, Gomez-Eyles JL. Effects of biochar and greenwaste compost amendments on mobility, bioavailability and toxicity of inorganic and organic contaminants in a multi-element polluted soil, *Environ Pollut*, 2010,158(6),2282-7.
5. Zheng W, et al. Sorption properties of greenwaste biochar for two triazine Pesticides, *J Hazard Mater*, 2010,181(1),121-6.
6. Cao X, et al. Dairy-manure derived biochar effectively sorbs lead and atrazine, *Environ Sci Technol*, 2009,43(9),3285-91.
7. Lima IM, McAloon A, Boateng AA. Activated carbon from broiler litter: process description and cost of production, *Biomass- Bioenergy*, 2008,32(6),568-72.
8. Chun Y, et al. Compositions and sorptive properties of crop residue-derived chars, *Environ Sci Technol*, 2004,38(17),4649-55.
9. Uchimiya M, et al. Influence of pyrolysis temperature on biochar property and function as a heavy metal sorbent in soil, *J Agric Food Chem*, 2011,59(6),2501-10.
10. Park JH, et al. Biochar reduces the bioavailability and phytotoxicity of heavy Metals, *Plant Soil* 2011, 348(1-2),439-51.
11. Trakal L, et al. Copper removal from aqueous solution using biochar: effect of chemical activation, *Arab J Chem*, 2014,7(1),43-52.
12. Uchimiya M, et al. Immobilization of heavy metal ions (CuII, CdII, NiII, and PbII) by broiler litter-derived biochars in water and soil, *J Agric Food Chem*, 2010, 58(9), 5538-44.
13. Berek A.K, Hue N, Ahmad A. Beneficial use of biochar to correct soil acidity, *Hana'Al' the food provider*, 9(September-October-November); 2011. p. 1-3.
14. Uchimiya M, et al. Immobilization of heavy metal ions (CuII, CdII, NiII, and PbII) by broiler litter-derived biochars in water and soil, *J Agric Food Chem* 2010,58(9),5538-44.
15. Cao, X., Harris, W., Properties of dairy-manure-derived biochar pertinent to its potential use in remediation, *Bioresource Technology* 2010,101(14), 5222-5228.
16. Hashem, F.S., Amin, M.S., Adsorption of methylene blue by activated carbon derived from various fruit peels, *Desalination and Water Treatment* 2015, 1944-3994.

## Hydroxyquinoline derivatives with bromine and iodine atoms: Theoretical investigation by DFT calculations, MD simulations and molecular docking studies

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### Abstract

In the present work, DFT characterization and molecular docking studies of 5,7-dibromo-8-hydroxy quinoline (DBHQ (1)) and 5,7-diiodo-8-hydroxy quinoline (DIHQ(2)) have been obtained theoretically. The HOMO-LUMO plots in the title molecules show the charge transfer in the molecular system through the conjugated paths. The electrophilic and nucleophilic sites are revealed from the molecular electrostatic potential maps. Thanks to the DFT calculations global and local reactive properties of title compounds have been obtained. MD simulations provided insights into the reactivity with water and with selected proteins. The molecular docking studies reveal that the ligands bind at the active site of the macromolecule and could restrict or block the functioning of Plasmodium falciparum dihydrofolate reductase-thymidylate synthase (PDHFR-TS), there by acting as antiprotozoal agents.

**Keywords:** DFT; Quinoline; ALIE; RDF; Docking.

### Introduction

Derivatives of quinoline are pharmaceutically and biologically important heterocyclic molecule containing a benzene ring and pyridine ring fused together at nearby two side carbon atoms and are widely used as a source to synthesis of numerous drugs, anti-bacterial, anti-filarial, anti-malarial, anti-fungal, cardiovascular, anti-tuberculosis and as receptor agonists [1-3]. Quinoline derivatives are used as NLO molecules, optical switching devices, photographic sensitizers and electrochemical sensing devices [4]. Taking into account the importance of computational studies for investigation of reactive properties of various organic molecules [5], in the present study of quinoline derivatives we have also performed DFT and MD studies. Global reactive properties have been investigated by visualization of frontier molecular orbitals and by calculation of well-established quantum molecular descriptors. Surfaces of molecular electrostatic potential (MEP) and average local ionization energies (ALIE) have been obtained in order to assess the reactive properties based on the charge distribution, while Fukui functions also served for identification of possibly important reactive

molecular sites. Understanding of degradation properties of pharmaceutical molecules is of great importance from the ecological aspects, since natural weather conditions are usually not enough for their degradation [6]. Oxidative processes are of great importance for degradation of organic molecules [7] and in this regard we have also calculated bond dissociation energies (BDE) for hydrogen atoms, since these quantities are connected with molecule's sensitivity towards autoxidation mechanism. Hydrolysis mechanism is also important since pharmaceutical molecules eventually end up in some type of water. Therefore, in order to understand molecules stability in water, MD simulations have been performed with the latest OPLS3 force field.

### 2. Computational Details

Jaguar 9.4 [8] program and Desmond [9] program have been also used for computational investigation of new quinoline derivatives. Namely, Jaguar was used for DFT calculations, while Desmond was used for MD simulations, both as implemented in Schrödinger Materials Science Suite 2016-4. B3LYP exchange-correlation functional [10]

has been employed for DFT calculations with Jaguar, with 6-311++G(d,p), 6-31+G(d,p) and 6-31G(d,p) basis sets, for the calculations of ALIE, Fukui functions and BDEs, respectively. OPLS3 [11] force field was employed for MD simulations. Simulation time was set to 10 ns, while temperature was set to 300 K. Pressure was 1.0325 bar, while cut off radius was 10 Å. System was of isothermal-isobaric (NPT) ensemble class, with simple point charge (SPC) model [12] used for the description of solvent. System was modeled by placing of one target molecule into the cubic box with ~2000 water molecules. The method of Johnson et al. [13] was used, as implemented in Jaguar program, for the determination and characterization of noncovalent interactions. Maestro GUI [14] was used for the preparation of input files and analysis of results in the case of Jaguar and Desmond programs.

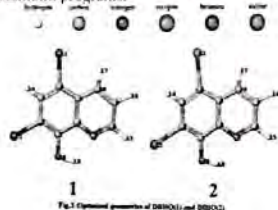


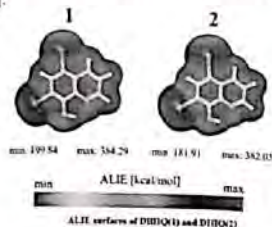
Fig. 2 Optimized geometries of DBHQ(1) and DIHQ(2)

### 3. Results and discussion

#### 3.1 ALIE surface, Fukui functions and noncovalent interactions

We have mapped ALIE values to the electron density surface in order to clearly detect molecule sites where electrons are least tightly bonded and therefore the molecule sites that are prone to electrophilic attacks [15]. Representative ALIE surfaces of two investigated quinoline derivatives have been presented in Figure. ALIE surfaces of DBHQ(1) and DIHQ(2) provided in Figure indicate that locations of bromine and iodine atoms are characterized by the lowest ALIE values and therefore it can be concluded that these molecule sites are prone to electrophilic attacks. However, it can be also seen that the lowest ALIE value of DIHQ(2) is much lower, for -18 kcal/mol, than the lowest ALIE value of DBHQ(1), thus indicating that

quinoline derivative with iodine atoms is much more sensitive towards electrophilic attacks. Maximal ALIE values (-382 kcal/mol) are in both cases located in the near vicinity of hydrogen atom of OH group, indicating location where electrons are the most tightly bonded to the molecules. It is also interesting to note that the lowest ALIE value of derivative with iodine atoms is practically matching the lowest ALIE value of the pristine quinoline, which we have reported in our previously submitted paper [16].

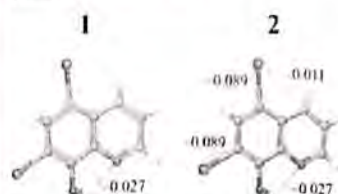


Analysis of electron density between atoms of DBHQ(1) and DIHQ(2) reveals formation of several noncovalent interactions (Figure) within quinoline derivative with iodine atoms. Namely, in the case of DIHQ(2) four noncovalent interactions have been determined, with the strongest one being between iodine and adjacent carbon atoms (with corresponding strengths of -0.089 electron/bohr<sup>3</sup>). Other two noncovalent interactions in the case of DIHQ(2) involve iodine I12 and carbon C10 atoms, which is the weakest noncovalent interaction, and nitrogen N7 and hydrogen H18 atoms. Only one noncovalent interaction formed in the case of DBHQ(1), between nitrogen N7 and H18 atoms, with the same strength as the corresponding noncovalent interaction in the case of DIHQ(2).

In this study Fukui functions have been calculated according to the following equations:

$$f^+ = \frac{\rho^{N+1}(r) - \rho^N(r)}{\delta}, \quad (2)$$

$$f^- = \frac{\rho^{N-1}(r) - \rho^N(r)}{\delta}. \quad (3)$$



where  $N$  stands for the number of electrons in reference state of the molecule, while  $\delta$  stands for the fraction of electron which default value is set to be 0.01 [17]. The values of calculated Fukui functions have been mapped to the electron density surface, in order to visualize locations where electron density increased/decreased after the addition/removal of charge (Figure). Positive color in Figure in the case of Fukui  $f^+$  functions is the purple one, and indicates molecule sites where electron density increases after the charge addition. On the other side negative color is the red one and in the case of  $f^-$  functions indicates molecule sites where electron density decreased after the removal of charge. In terms of position of positive color in the case of  $f^+$  functions it can be seen that quinoline derivatives are very similar. Namely, in both cases purple color of  $f^+$  function is located at two specific sites of the nitrogen containing six member ring (carbon atoms C8 and C10), designating them as the electrophilic molecule sites where electron density increases after the addition of charge. On the other side, although distribution of positive color in the case of  $f^-$  function differs significantly, the location of negative color which determines where electron density decreased after the removal of charge is again practically the same for both quinoline derivatives. Namely, in the case of  $f^-$  function for both molecules negative color is located in the near vicinity of carbon atom C5.

#### 3.2 Reactive and degradation properties based on autoxidation and hydrolysis

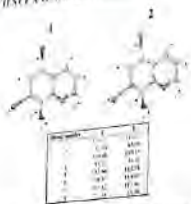
Computational investigations of organic molecules based on DFT calculations and MD simulations are of great importance for the understanding of their reactive properties [18]. Taking into account how oxidation reactions

are important as degradation pathways of pharmaceuticals and organic materials, in this work we have calculated BDE for hydrogen abstraction (H-BDE), since this quantity can indicate whether some organic molecule is sensitive or not towards autoxidation mechanism [19]. H-BDE values between 70 and 85 kcal/mol indicate sensitivity towards autoxidation mechanism. H-BDE values between 85 and 90 kcal/mol could also be of importance for autoxidation mechanism, but should be treated with caution, while H-BDE values lower than 70 kcal/mol are not appropriate for autoxidation mechanism [5]. Figure contains information about BDE values for all single acyclic bonds of DBHQ(1) and DIHQ(2).



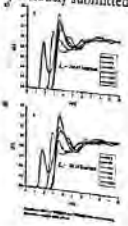
Figure 5: Fukui functions of  $f^+$  and  $f^-$  of the DBHQ(1) and DIHQ(2)

H-BDE values provided in Figure indicate that both newly synthesized quinoline derivatives are highly stable towards autoxidation mechanism. This also indicates that their degradation under natural conditions is hard and imposes the necessity of advanced oxidation processes for their efficient removal. The lowest H-BDE value of -93 kcal/mol for both derivatives is located on the hydrogen atom of OH group, however this is still higher than the upper border level of 90 kcal/mol. All other H-BDE values are much higher than the desired values and indicate that these molecules are stable in open air and in the presence of oxygen. Concerning the BDE values of the rest of the single acyclic bonds it is also evident that BDE values for the abstraction of iodine atoms are significantly lower (6-7 kcal/mol) than the BDE values for the abstraction of bromine atoms.



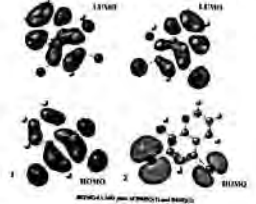
Besides oxidation reactions, hydrolysis is also important mechanism for the degradation of organic materials. Stability of organic molecules in water by explicit inclusion of water molecules can be computationally investigated thanks to the MD simulations. After MD simulations atoms with pronounced interactions with water can be determined by calculation of the radial distribution functions, which also has been done in this work, Figure.

In cases of both newly synthesized quinoline derivatives hydrogen atoms (H18) of OH group have the most pronounced interactions with water molecules. RDFs of these atoms are characterized with the two distinct solvation spheres. The first maximal g(r) values for the RDF of H18 in both cases are located at distance of around 1.7 Å. Other atoms of both derivatives with significant interactions with water molecules are oxygen atoms (O10), bromine/iodine atoms, and carbon atoms C8 and C9. In general, interaction energies of DBHQ(1) and DIHQ(2) with water according to MD simulations are very similar, further indicating that both of these derivatives have very similar stability in water. However, both of these quinoline derivatives are having higher interaction energies with water than pristine quinoline, for which we calculated interaction energy in our previously submitted article [16].



**3.3 Nonlinear optical properties**  
 Nonlinear optics explains the interaction of electromagnetic fields in various materials to produce new electromagnetic fields, altered in wavenumber and other physical properties of the molecular systems [20]. The calculated polarizability of DBHQ(1) and DIHQ(2) are  $2.397 \times 10^{-23}$  and  $2.2882 \times 10^{-23}$  esu. The dipole moments of DBHQ(1) and DIHQ(2) are respectively, 3.5783 and 3.8456 Debye. The first order hyperpolarizabilities are  $6.8987 \times 10^{-24}$  and  $8.3872 \times 10^{-24}$  for DBHQ(1) and DIHQ(2) which are comparable with the reported values of similar derivatives and these values are 53.07 and 64.52 times that of the standard NLO material urea [21]. The theoretically predicted second order hyperpolarizabilities are  $-8.062 \times 10^{-37}$  esu for DBHQ(1) and  $-9.311 \times 10^{-37}$  esu for DIHQ(2). Hence the title compounds and its derivatives are good objects for further studies of nonlinear optical properties.

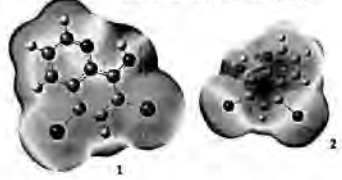
**3.4 Frontier molecular orbital analysis**



Frontier molecular orbitals are investigated in order to understand global stability and reactive properties of the title compounds. Visualization presented in Figure indicates the importance of iodine and bromine atoms, as HOMO is practically completely delocalized in the near vicinity of these atoms. This result designates iodine and bromine atoms to act as electron donor during the interactions with other molecules. HOMO is delocalized over the entire region of DBHQ(1) and except for the ring PhII of DIHQ(2). On the other side LUMO orbital is mainly delocalized over the entire rings of DBHQ(1) and DIHQ(2). Using information on the energies of HOMO and LUMO, useful and frequently used quantum-molecular descriptors such as the ionization

energy and electron affinity can be calculated according to the following simple relations:  $I = -E_{\text{HOMO}}$ ,  $A = -E_{\text{LUMO}}$ ,  $\eta = (-E_{\text{HOMO}} + E_{\text{LUMO}})/2$  and  $\mu = (E_{\text{HOMO}} + E_{\text{LUMO}})/2$  [22]. Parr et al. [23] proposed the global electrophilicity power of a ligand as  $\omega = \mu^2/2\eta$ . For the title compounds, energy difference between HOMO and LUMO, HOMO-LUMO gap, are equal to 2.873 eV for DBHQ(1) and 0.779 eV for DIHQ(2). Ionization potential, I, and electron affinity, A, are calculated to be 8.144 eV, 5.271 eV and 5.880, 5.101 eV for DBHQ(1) and DIHQ(2), respectively. The values of HOMO-LUMO gap and global hardness ( $\eta = 1.4365$  for DBHQ(1) and 0.3895 eV for DIHQ(2) are almost the same as in the case of other similar derivatives that we have previously investigated [24]. Although the stability parameters of these derivatives are practically the same, there are significant differences in the values of chemical potential and global electrophilicity. Also, the calculated electrophilicity of the DBHQ(1) and DIHQ(2) molecules are 15.66 and 38.701 eV, which is significantly lower than the value of electrophilicity of derivative in the work of Rajeev et al. [24], with the values of 28.29 and 24.40 eV, meaning that the title molecules are much more stable.

**3.5 Molecular electrostatic potential maps**



Molecular electrostatic potential (MEP) simultaneously displays molecular shape, size and electrostatic potential in terms of colour grading. MEPs map has been found to be a very helpful tool in the analysis of the correlation amide molecular structures with its physicochemical property relationship, including biomolecules and drugs [25]. It provides a visual technique to comprehend the relative polarity of the molecule as shown

in Figure. Different values of the electrostatic potential are represented by various colours, red<orange<yellow<green<blue. In the MEP maximum negative region represents the site for electrophilic attack indicated by red colour while the maximum positive region represents nucleophilic attack indicated by blue colour. From the MEP plot of the title compound it is clearly seen that oxygen and ring groups are most electronegative region suitable for electrophilic attack and hydrogen atoms are most electropositive region suitable for nucleophilic attack.

**3.6 Natural Bond Orbital (NBO) Analysis**

The natural bond orbitals (NBO) calculations were performed using NBO 3.1 program [26] as implemented in the Gaussian09 package at the DFT/B3LYP level. The strong interaction  $n_{\text{O}10} \rightarrow \pi^*(\text{C}_3-\text{C}2)$  has the highest E(2) value 37.87 kJ/mol and a very strong interaction has been in  $n_{\text{N}7} \rightarrow \sigma^*(\text{C}5-\text{C}_1)$  with an energy of 10.49 kJ/mol for DBHQ(1) and the strong interaction  $n_{\text{C}5} \rightarrow \pi^*(\text{C}9-\text{C}10)$  has the highest E(2) value 59.36 kJ/mol and a very strong interaction has been in  $n_{\text{N}7} \rightarrow \sigma^*(\text{C}9-\text{C}8)$  with an energy of 10.14 kJ/mol for DIHQ(2). Almost 100% p-character was observed in  $\pi$  bonding of C<sub>1</sub>-C<sub>6</sub>, C<sub>3</sub>-C<sub>2</sub> and the lone pairs of  $n_{\text{O}10}$ ,  $n_{\text{Br}13}$  and  $n_{\text{Br}12}$  for DBHQ(1) and in  $\pi$  bonding of C<sub>6</sub>-C<sub>1</sub>, C<sub>3</sub>-C<sub>2</sub> and the lone pairs of  $n_{\text{C}5}$ ,  $n_{\text{I}12}$  and  $n_{\text{I}13}$  DIHQ(2).

**3.7 Molecular docking studies**

Protozoal organisms are one of the leading agents of mortality in humans [27]. Two leading protozoal organisms viz.; Plasmodium falciparum and Entamoeba Histolytica cause Malaria and amoebiasis respectively [28]. PASS [29] is an online tool to predict the biological activity spectrum of a compound. PASS analysis of the compounds predicts the title ligands to be Antiprotozoal (Amoeba) agents with P<sub>s</sub> score of 0.96 and 0.91. To further establish their antiprotozoal activity, we decided to carry out molecular docking studies of the compound against Plasmodium falciparum dihydrofolate reductase-thymidylate synthase (PfDHFR-TS) [PDB ID: 3QGT]. The PDB structure 3QGT [30] was selected for docking as the reported structure has been established from X-ray

Crystallographic data with a good resolution of 2.3 Å. Further the enzyme has an attached co-crystallized inhibitor so has a well defined binding site which could be targeted. Molecular docking has recently been used as a convenient tool to get insights into the molecular mechanism of protein ligand interactions [31]. All docking calculations were performed on AutoDock-Vina software [32]. The 3D crystal structure of PfDHFR-TS was obtained from Protein Data Bank. Before docking the ligands, the protein was prepared by removing co-crystallized waters, ligands and co-factors. The AutoDockTools graphical user interface was used to calculate Geissteiger charges, add polar hydrogen and partial charges using Kollman united charges. The active site of the enzyme was defined to include residues of the active site within the grid size of 40×40×40 Å. The ligand was prepared for docking by minimizing its energy at B3LYP/SDD level of theory. The most popular algorithm, Lamarckian Genetic Algorithm (LGA) available in Autodock was employed for docking. The docking protocol was tested by docking the co-crystallized inhibitor onto the enzyme catalytic site which showed perfect synergy with the co-crystallized ligand with RMSD close to zero. Amongst the docked conformations the best scored conformation predicted by AutoDock scoring function was visualized in DSV, LigPlot and Pymol softwares for ligand-protein interactions.

The molecule binds at the catalytic site of the substrate by weak non-covalent interactions. Amino acid Ile164 forms hydrogen bond with the oxygen atom of hydroxy group attached to ligand DIHQ(2). Phe58 forms  $\pi$ - $\pi$  interaction with benzene ring of the ligand. DBHQ(1) forms one H-bond with NDP and one with Ile164 in addition to  $\pi$ - $\pi$  interaction with Phe58. Amino acids Phe58 Asp54 Ile112 Ile164 and NDP surround the ligand molecules and hold it by non-covalent and hydrophobic interactions. Docking scores of -6.7 and -6.3 kcal/mol for

DBHQ(1) and DIHQ(2) respectively. These results reveal that the ligands bind at the active site of the macromolecule and could restrict or block the functioning of Plasmodium falciparum dihydrofolate reductase-thymidylate synthase (PfDHFR-TS), there by acting as antiprotozoal agents.

#### 4. Conclusions

The nonlinear optical properties are also predicted theoretically and the calculated NLO properties of the title compounds are greater than that of urea and therefore the title compounds are good objects for further studies in nonlinear optics. The molecular calculations like natural bond orbitals, HOMO-LUMO and molecular electrostatic potential surface were also performed. ALIE surfaces indicate that introduced bromine and iodine atoms are the molecule sites with the lowest ALIE values and therefore the molecule sites that are prone to electrophilic attacks. It is interesting that the lowest ALIE value in the case of derivative with iodine atoms (DIHQ(2)) is practically the same as the lowest ALIE value of pristine quinoline. Derivative DIHQ(2) is characterized by four intra-molecular noncovalent interactions, among which the strongest are the ones including iodine and the adjacent carbon atoms. Fukui functions indicate rather similar situation for both derivatives, showing that the possibly important reactive sites could be carbon atoms C5, C8 and C10. H-BDE values indicate that the investigated derivatives are stable towards the autoxidation mechanism, while RDFs indicate that the hydrogen atom H18 of the OH group is having the most pronounced interactions with water molecules. Molecular docking studies suggest that the title compounds could restrict or block the functioning of Plasmodium falciparum dihydrofolate reductase-thymidylate synthase (PfDHFR-TS), there by acting as antiprotozoal agents.

#### References

1. M. Kidwai, K.R. Bhushan, P. Sapra, R.K. Saxena, R. Gupta, *Bioorg. Med. Chem.* 8(1) (2000) 69-72.
2. S. Tewari, P.M.S. Chauhan, A.P. Bhaduri, N. Fatima, R.K. Chatterjee, *Bioorg. Med. Chem. Lett.* 10 (2000) 1409-1412.
3. T. Narendar, S.K. Tanvir, M.S. Rao, K. Srivastava, S.K. Puri, *Bioorg. Med. Chem. Lett.* 15 (2005)

- 2453-2455.
4. B. Dekavaux-Nicot, J. Maynadie, D. Lavabre, S. Fery-Forgues, *J. Organometallic. Chem.* 692 (2007) 874-886.
5. P. Lienard, J. Gavartin, G. Boccardi, M. Meunier, *Pharm. Res.* 32(1) (2015) 300-310.
6. S. Armaković, S.J. Armaković, J.P. Šetrajčić, I.J. Šetrajčić, *J. Mol. Model.* 18(9) (2012) 4491-4501.
7. S.J. Armaković, S. Armaković, N.L. Finčur, F. Šibul, D. Vione, J.P. Šetrajčić, B. Abramović, *RSC Adv.* 5(67) (2015) 54589-54604.
8. A.D. Bochevarov, E. Harder, T.F. Hughes, J.R. Greenwood, D.A. Braden, D.M. Philipp, D. Rinaldo, M.D. Halls, J. Zhang, R.A. Friesner, *Int. J. Quantum Chem.* 113(18) (2013) 2110-2142.
9. D. Shivakumar, J. Williams, Y. Wu, W. Damm, J. Shelley, W. Sherman, *J. Chem. Theor. Comput.* 6(5) (2010) 1509-1519.
10. A.D. Becke, *J. Chem. Phys.* 98(7) (1993) 5648-5652.
11. E. Harder, W. Damm, J. Maple, C. Wu, M. Reboul, J.Y. Xiang, L. Wang, D. Lupyan, M.K. Dahlgren, J.L. Knight, *J. Chem. Theor. Comput.* 12(1) (2015) 281-296.
12. H.J. Berendsen, J.P. Postman, W.F. van Gunsteren, J. Hermans, *Interaction models for water in relation to protein hydration, in Intermolecular forces.* 1981, Springer, p. 331-342.
13. A. Otero-de-la-Roza, E.R. Johnson, J. Contreras-Garcia, *Phys. Chem. Chem. Phys.* 14(35) (2012) 12165-12172.
14. Schrödinger Release 2016-4: Maestro, Schrödinger, LLC, New York, NY, 2016. 2015.
15. J.S. Murray, J.M. Seminario, P. Politzer, P. Sjöberg, *Int. J. Quantum Chem.* 38(S24) (1990) 645-653.
16. B. Sureshkumar, Y.S. Mary, C.Y. Panicker, S. Suma, S. Armakovic, S.J. Armakovic, C. Van Alsenoy, B. Narayana, *Arabian Journal of Chemistry* (2017) communicated.
17. A. Michalak, F. De Proft, P. Geerlings, R. Nalewajski, *J. Phys. Chem. A*, 103(6) (1999) 762-771.
18. X. Ren, Y. Sun, X. Fu, L. Zhu, Z. Cui, *J. Mol. Model.* 19(6) (2013) 2249-2263.
19. S.W. Hovorka, C. Schöneich, *J. Pharm. Sci.* 90(3) (2001) 253-269.
20. D.M. Burland, R.D. Miller, C.A. Walsh, *Chem. Rev.* 94 (1994) 31-75.
21. C. Adant, M. Dupuis, J.L. Bredas, *Int. J. Quantum Chem.* 56 (2004) 497-507.
22. K. Fukui, *Science* 218 (1982) 747-754.
23. R.G. Parr, R.G. Pearson, *J. Am. Chem. Soc.* 105 (1983) 7512-7516.
24. R.T. Ulahannan, C.Y. Panicker, H.T. Varghese, R. Musiol, J. Josef, C. Van Alsenoy, J.A. War, T.K. Manojkumar, *Spectrochim. Acta* 150 (2015) 190-199.
25. J.A. War, K. Jalaja, Y.S. Mary, C.Y. Panicker, S. Armakovic, S.J. Armakovic, S.K. Srivastava, C. Van Alsenoy, *J. Mol. Struct.* 1129 (2017) 72-85.
26. E.D. Glendening, A.E. Reed, J.E. Carpenter, F. Weinhold, *NBO Version 3.1*, Gaussian Inc., Pittsburgh, PA, 2003.
27. World Health Organization, status 2014, [http://www.who.int/malaria/media/world\\_malaria\\_report\\_2013/en/](http://www.who.int/malaria/media/world_malaria_report_2013/en/).
28. W.E. Collins, G.M. Jeffery, *Clin. Microbiol. Rev.* 20 (2007) 579-592.
29. A. Lagunin, A. Stepanchikova, D. Filimonov, V. Porokov, *Bioinformatics* 16 (2000) 747-748.
30. J. Vanichtanakul, S. Taweekhai, J. Yuganiyama, T. Vilaivan, P. Chitnumsub, S. Kamchonwongpaisan, Y. Yuthavong, *ACS Chem. Biol.* 6(9) (2011) 905-911.
31. J.A. War, S.K. Srivastava, S.D. Srivastava, *Luminescence*, 32(1) (2017) 104-113.
32. O. Trott, A. J. Olson, *J. Comput. Chem.* 31 (2010) 455-461.



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**PREFACE**



Fatima Mata National College (Autonomous), Kollam has an embedded culture which nurtures and optimizes learners creativity so as to channelize their research achievements towards global demands. It steers ahead with the missionary zeal to be the quintessential educational brand in South India and at National level. The Post Graduation Research Department of Zoology believes in reinforcing this culture by organizing National and International events on a routine basis.

In this context, this year's International conference is scheduled at Fatima Mata National College, Kollam which hopes to address the focal theme on "*Innovations and Sustainable Research in Environment and Life Sciences*" during 7<sup>th</sup> - 9<sup>th</sup> August, 2018. Disciplinary and interdisciplinary paper presentations on the relevant technological, economic; social and governance dimensions will go a long way in adopting underlying technology and behavioral change towards research development in key areas of science. Digital tools will contribute to a new precedent for engagement across the health ecosystem – Human and Environment.

The dissemination and interactions at the sessions hopes to project the new trends and innovations within the student, faculty and research community in and around the world, South India specifically Kerala and Kollam. I look forward to hearing a range of interesting discussions, ideas, conclusions and proposals for the future. We hope that the deliberations in the conference and the papers published in the proceedings will provide a platform to share best practices, challenges and experiences in Sustainable Research. I, on the behalf of the Organizing Committee appeal all participants to utilize the platform in an intellectually enriching manner.

***Best wishes...***

***Dr. Antony Akhila Thomas***  
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**FATIMA MATA NATIONAL COLLEGE (AUTONOMOUS),  
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**MESSAGE**



The life of human persons and other species in the universe is highly reliant on the natural environment. Pope Benedict XVI wrote, “The way humanity treats the environment influences the way it treats itself, and vice versa. This invites contemporary society to a serious review of its life-style, which, in many parts of the world, is prone to hedonism and consumerism, regardless of their harmful consequences. What is needed is an effective shift in mentality which can lead to the adoption of new life-styles in which the quest for truth, beauty, goodness and communion with others for the sake of common growth are the factors which determine consumer choices, savings and investments. Every violation of solidarity and civic friendship harms the environment, just as environmental deterioration in turn upsets relations in society. Nature, especially in our time, is so integrated into the dynamics of society and culture that by now it hardly constitutes an independent variable.” (*Caritatisin Veritate* 51). Pope Benedict asks us to recognize that the natural environment has been gravely damaged by our irresponsible behaviour.

In recompense of the endangered environment, human mind and resources have to engage in sustainable research. It is true that we have a better ecological sensitivity and we are gradually making significant progress. The global

research input share, however, is very diminutive in the area of environment upkeep compared to other zones. Unfortunately, the innovations and explorations conducted today are mainly in those areas which ultimately contribute to the environmental dereliction.

The centres of excellence like Fatima Mata National Autonomous College have to contribute owing to an academic and moral responsibility they carry towards the humanity. This initiative by the Department of Zoology would not be a single episode but shall persist in perpetuating the initiatives; not just being an academic enterprise the real act may happen in and through our life commitment. I pray with Pope Francis, "O Lord, seize us with your power and light, help us to protect all life, to prepare for a better future, for the coming of your Kingdom of justice, peace, love and beauty. Praise be to you! Amen." (Laudato Si)

God bless everyone and our universe.

**Rev. Dr Rolden Jose Jacob**  
Manager

**FATIMA MATA NATIONAL COLLEGE (AUTONOMOUS),  
KOLLAM, KERALA**

**MESSAGE**



This “International Conference on Innovations and Sustainable Research in Environment and Life Sciences”, I believe, is an attempt to deliberate on the future of the ecosystem that will have large impact in different aspects of life. The relationships that exist between the concept of sustainable development and the practice of scientific research, technological innovation and industrial development are to be explored to make the world a better place to live in. It is imperative to establish a link between environment and research and development in Life Sciences.

The concept of sustainable development assumes complex configurations in the context of rapid expansion both horizontal and vertical. Ecology, natural resources and global changes have immediate bearings on the aspect of economic growth. The inevitable connect between the present and future generations demands a multidisciplinary approach.

For scientific research and technological development to play a positive role in improving the standard of living of humans and maintaining the health of the planet, they should be used as instruments to foster sustainable development. If, on the other hand, we continue to take the utilitarian and anthropocentric approach which considers nature as the main resource for the satisfaction of the needs of human beings, we will be digging our own graves. It is high time we took the eco-centric approach seriously and conceded that nature belongs to all the living beings. It is for us to strike a golden mean.

A new paradigm has to replace the old one. Our planet is confronted with a lot of new ecological challenges and increasing threats. All our steps towards progress should respect the fragile equilibrium between human activities and the protection of nature. The contemporary situation reveals that no current models of development can survive

because we have already stretched the carrying capacity of the Earth. Science and technology must help to provide us with new methodologies and new solutions.

The priorities for innovations should be determined by growth models both global and local; and focus on efficiency, reliability and resource-saving with a view to addressing the different stages of life cycles; regenerating the ecosystems; monitoring the environmental quality; preventing resources exhaustion; and reducing risks, to list only a few.

This International Conference, a laudable exercise under the aegis of the Department of Zoology of this College will prove a platform for airing views on a topic that demands immediate attention. Let me congratulate and wish the Department all success in the endeavour. Let brilliant ideas converge at this intellectual platform to make the world a robust hub for happy life and peaceful existence.

**Best Wishes ....**

**Dr Vincent B. Netto**  
Principal



### **EDITOR'S NOTE**

Expansion of higher education has often shown academic scores go haywire when faced with real world technologies. At Fatima Mata National College (Autonomous), we strive to set stage on a routine basis for building a collective inclusive platform for higher education. In this expedition, we may learn together and help one another as we seek to find a new way forward to a promising greener future.

Sustainability science has emerged over the last two decades as a vibrant field of research and innovation and is a field defined by the problems it addresses rather than by the disciplines it employs. Increasingly, however, a core sustainability science research program has begun to take shape that transcends the concerns of its foundational disciplines and focuses instead on understanding the complex dynamics that arise from interactions between human and environmental systems. Today, the field has developed a core research agenda and an increasing flow of results to address the pressing issues is palpable. Conserving resources and raw materials, mitigating climate change, and protecting air quality are the subjects of research efforts that bring together a myriad of disciplines as diverse as ecology and natural milieus, water and biodiversity, green chemistry, ecosystems, the geosciences, land-use planning and management of natural resources and wastes, as well as ecotechnologies, alternative energy, and clean transportation as they are the *dramatis personae*.

The three day International Conference on “*Innovations and sustainable research in environment and life sciences*” has generated promising ripples in the research community in the country. The conference would lead to a paradigm shift in the interdisciplinary understanding and sustainable co-operation among the stake holders.

***Dr. Sarlin P J***

Editor, Assistant Professor,  
PG & Research Department of Zoology



## **CONTENTS**

### **INVITED TALKS**

1. **THE JOURNEY – HUMAN EGG FROM FERTILISATION TO IMPLANTATION**  
**Dr. Herman Fernandes.....22**
2. **NEXT GENERATION SEQUENCING AND NEW BIOLOGY**  
**Achuthsankar S. Nair & Biji C. ....23**
3. **ENVIRONMENTAL IMPACT ASSESSMENT**  
**Shibu Krishnan C.....25**
4. **RESTORATION OF MARINE AND COASTAL BIODIVERSITY AND UNITED NATIONS  
SUSTAINABLE DEVELOPMENT GOALS: THE WAY FORWARD**  
**Biju Kumar, A.....28**
5. **INTRODUCTION TO ARTIFICIAL NEURAL NETWORK**  
**Imthias Ahamed T P.....33**
6. **BIODIVERSITY CONSERVATION FOR A SUSTAINABLE FUTURE**  
**Dr.Oommen V.Oommen, Dr. K.P.Laladhas, Dr. Preetha Nilayangode and Dr.  
Vijayasree A. S.....34**
7. **THE WAR AGAINST MOSQUITOES**  
**Dr. R Nishi.....36**

## **ORAL PRESENTATIONS**

8. SPECIES DIVERSITY OF DRAGONFLY ALONG THE WATERSIDE OF KALLAR RIVER  
BASE OF PATHANAMTHITTA DISTRICT, KERALA

Cincy Thomas<sup>1</sup>, Nelson P Abraham<sup>2</sup>, Bilcy K Cherian.....39

9. FATE AND TRANSPORT OF NUTRIENTS IN THE PADDY FIELDS OF NETRAVATI RIVER  
BASIN, INDIA ALONG WITH PHOSPHATE REMOVAL  
STUDIES.....43

Sandhya Sudhakaran, Elezabeth V. Abraham, Harsha Mahadevan, Sibin Antony,  
Vinu V. Dev , A. Krishnakumar, K. Anoop Krishnan

10. SPECIES DIVERSITY AND LARVAL HABITATS OF MOSQUITOES IN THE NEARBY  
AREAS OF MSM COLLEGE KAYAMKULAM

Deepthi G. Nair.....46

11. PATIO-TEMPORAL VARIATIONS IN ZOOPLANKTON COMMUNITY IN A TROPICAL  
RIVER IN SOUTHERN KERALA

Swapna.S.....49

12. HISTOPATHOLOGICAL CHANGES IN THE GILLS OF *Liza parsia* (MUGILIDAE)  
COLLECTED FROM KAYAMKULAM ESTUARY, KERALA WITH ERGASILID (COPEPOD)  
INFECTIONS

Dhanya. P, S. Amina.....52

13. FISH DIVERSITY OF AAYIRAMTHENGU REGION OF KAYAMKULAM BACKWATER,  
KERALA

<b>Remya R &amp; <sup>2</sup>S Amina.....</b>	<b>54</b>
<b>14. PREVALENCE AND DNA BARCODING OF GASTROINTESTINAL HELMINTHES IN <i>Gallus domesticus</i> FROM KOLLAM DISTRICT, KERALA.</b>	
<b>Jeena Prakash and Dr. Sainudeen Sahib.....</b>	<b>57</b>
<b>15. WATER QUALITY AND PUBLIC HEALTH RISK</b>	
<b>Dr.Dhanalekshmy.T.G.....</b>	<b>60</b>
<b>16. TOXIC EFFECTS OF COPPER AND ZINC ON CELL DIVISION AND CHROMOSOMAL MORPHOLOGY OF <i>Allium cepa</i></b>	
<b>Y Mumthas<sup>1</sup>, N G Deepthi and M T P Miranda.....</b>	<b>63</b>
<b>17. SIGNAL TRANSDUCERS AND ACTIVATORS OF TRANSCRIPTION<sup>3</sup> AS A MEDIATOR OF VEGF AND MMP-2 IN BREAST CANCER</b>	
<b>Prabha Pillai and Lakshmi S.....</b>	<b>66</b>
<b>18. NEW RECORD OF FREE-LIVING MARINE NEMATODE (NEMATODA: COMESOMATIDAE) FROM SOUTH WEST COAST OF INDIA</b>	
<b>Sinu J. V, M.T.P Miranda and A. Akhila Thomas.....</b>	<b>69</b>
<b>19. CARBON SEQUESTRATION BY MARINE NEMATODES IN THE BOTTOM SEDIMENTS OF ARABIAN SEA, THE NORTH-WESTERN EXTENSION OF TROPICAL INDIAN OCEAN ALONG THE WEST COAST OF INDIA</b>	
<b>Sinu J. V, M.T.P Miranda and A. Akhila Thomas.....</b>	<b>72</b>
<b>20. PLANT-EXTRACT-ASSISTED GREEN SYNTHESIS OF GOLD NANOPARTICLES USING <i>CURCUMA LONGA</i> EXTRACT</b>	

<b>Dhanyaraj. D, F. Shine, Shibu Joseph S.T &amp; A .Akhila Thomas .....</b>	<b>76</b>
<b>21. DETERMINATION OF LETHAL CONCENTRATION (LC 50) OF CHANNA STRIATA</b>	
<b>Suja. S and Sherly Williams. E.....</b>	<b>80</b>
<b>22. STUDIES ON THE SEASONAL VARIATION IN THE DIET COMPOSITION OF OXYURICHTHYS TENTACULARIS (VALENCIENNES, 1837)</b>	
<b>Fiona Paulose, Sherly Williams E.....</b>	<b>83</b>
<b>23. EFFECT OF GOLD NANOPARTICLES ON GILL HISTOLOGY OF OREOCHROMIS MOSSAMBICUS</b>	
<b>Shine. F, Akhila Thomas, Shibu Joseph S. T, and Dhanya Raj.....</b>	<b>86</b>
<b>24. STUDIES ON THE ANTENNAL LOBES OF THE STINGLESS BEE TETRAGONA IRIDIPENNIS (SMITH)</b>	
<b>Joseph Tom, Martin J Babu, Sahab NM, Sujitha CR, Akhila Vijayan.....</b>	<b>89</b>
<b>25. BRACHYURAN MANGROVE CRAB DIVERSITY OF PUTHUVYPE MANGROVE BELT, COCHIN, KERALA</b>	
<b>Apreshgi K.P. and Kurian Mathew Abraham.....</b>	<b>93</b>
<b>26. IN VITRO ANTIMICROBIAL ACTIVITY AND PHYTOCHEMICAL SCREENING OF LEAF EXTRACTS OF CALOTROPIS GIGANTEA L. AGAINST SELECTED PATHOGENIC MICROORGANISMS.</b>	
<b>Sreeja R.S And Manju K.G.....</b>	<b>98</b>
<b>27. MACROFAUNAL DIVERSITY ALONG AYIRAMTHENGU MANGROVES</b>	

<b>Latha C,Mumthas Yahiya* &amp;Divya Ms.....</b>	<b>101</b>
<b>28. A SURVEY ON THE HUMAN FOOD HABITS AND ITS INPUT ON HEALTH AT KARAVARAM PANCHAYAT, THIRUVANANTHAPURAM DISTRICT, KERALA</b>	
<b>Ponni J Mohan, Sherly Williams and Kanni J Mohan.....</b>	<b>104</b>
<b>29. PRODUCTIONS OF INDUSTRIAL ENZYMES FROM RED FLOUR BEETLE,TRIBOLIUM CASTANEUM(HERBST) AND THEIR POTENTIAL APPLICATION AS A DESTAINER</b>	
<b>Sonia John, Prabhakumari C,Santhosh S, Nair Sreecha Chandran, Vismaya N Kumar and Ruchitha R.....</b>	<b>107</b>
<b>30. PHYTOPLANKTON DIVERSITY AND WATER QUALITY ASSESSMENT OF TAPI RIVER AT UTRAN, SURAT (GUJARAT)</b>	
<b>Taruni Sarang, Kapila Manoj.....</b>	<b>111</b>
<b>31. EXTRACTION AND CHARACTERIZATION OF PECTIN FROM TWO DIFFERENT FRUIT PEEL WASTE</b>	
<b>Vismaya N Kumar, Prabhakumari C, Sonia John, Nair Sreecha Chandran, and Ruchitha R.....</b>	<b>115</b>
<b>32. PREDOMINANT HISTOLOGICAL ALTERATIONS IN AN EDIBLE SHELL FISH – <i>Scylla serrata</i> OF ASHTAMUDI LAKE, THE RAMSAR SITE, KOLLAM, KERALA.</b>	
<b>Lekshmi Priya.V and Sherly Williams. E .....</b>	<b>119</b>
<b>33. HISTOLOGICAL ALTERATIONS ON THE INTESTINE OF <i>ETROPLUS SURATENSIS</i> OF ASHTAMUDI LAKE ON EXPOSURE TO CERTAIN PESTICIDES</b>	

Nisha Thomas P and Glen Jose .....	122
<b>34. MICROBIOLOGICAL ASSESSMENT OF <i>RASTRELLIGER KANAGURTA</i> COLLECTED FROM THE LOCAL FISH MARKET OF PUNALUR</b>	
Dr. Jasmine Anand.....	125
<b>35. AN ANALYSIS ON THE HAEMOGLOBIN LEVEL IN COLLEGE STUDENTS: A DESCRIPTIVE CORRELATIONAL STUDY</b>	
Seethal Lal S, Sruthi S Babu, Teena Terry, Thazlin Enayath, Veena M. A., Vidhya R., Vismaya S. Akhila R. C.....	130
<b>36. MORPHOMETRIC ANALYSIS OF <i>Etroplus maculates</i></b>	
Dr. Seethal Lal S.....	133
<b>37. PROTECTIVE EFFICACY OF CURCUMIN AGAINST ROGORIN TOXICITY IN <i>L.ROHITA</i></b>	
Aidamol P, Biji gopal A. Akhila Thomas and Vijayasree a S.....	137
<b>38. ASSESSMENT INTO THE BIOPOTENTIATION IMPACT OF CURCUMIN ON <i>L.ROHITA</i> EXPOSED TO MALATHION</b>	
Biji Gopal , Aidamol, Antony Akhila Thoma sand Vijayasree A.S.....	140
<b>39. MONSOONAL WASH-OFF EFFECT ON PHYSICO-CHEMICAL PARAMETERS OF NATIONAL WATER WAY 3, NEAR TITANIUM PLANT INDUSTRIAL AREA, KOLLAM, KERALA</b>	
Athira Sivan and Kurian Mathew Abraham.....	143

- 40. SEASONAL VARIATIONS OF HYDROGRAPHICAL PARAMETERS IN VATTAKAYAL LAKE, KOLLAM DISTRICT, KERALA**  
**G. Remesh and S. Sainudeen Sahib.....149**
- 41. EVALUATION OF WATER QUALITY INDEX (WQI) OF PARAPPAR RESERVOIR IN KOLLAM DISTRICT, KERALA, INDIA.**  
**Shanimol B and Dr. Sainudeen Sahib**  
**S.....152**
- 42. ECOLOGICAL ASPECTS OF AYIROOR RIVER IN SOUTH INDIA WITH SPECIAL REFERENCE TO HYDROGRAPHICAL CHARACTERISTICS**  
**Ambili, T., Mumthas, Y., Reenamole, G.R ., Athira Raj and George D'Cruz,**  
**F.....156**
- 43. MALATHION INDUCED BIOCHEMICAL AND HISTOPATHOLOGICAL CHANGES IN THE GILL AND LIVER OF TILAPIA, *Oreochromismossambicus*(Peters)**  
**Vijayasree AS<sup>1</sup>, AAKhila Thomas<sup>2</sup>, Biji Gopal<sup>3</sup> and Aidamol**  
**P.....159**
- 44. A STUDY ON THE MONTHLY VARIATIONS OF SOME WATER QUALITY PARAMETERS AT SELECTED SITES OF NEYYAR RIVER, KERALA, INDIA**  
**Badusha, M, Santhosh, S.....162**

## **EXTENDED ABSTRACTS**

**45. EFFECTS OF MARINE YEAST FED DIET ON THE HISTOLOGY OF FENNEROPENAEUS INDICUS**

**P.J. Sarlin, Rosamma Philip.....167**

**46. EVALUATION OF PHYSICOCHEMICAL AND SENSORY PROPERTIES OF WINE FROM CITRUS MAXIMA FRUIT**

**Ancy Philip, Anjana Prakash, Archa S., Archana C.V., Arathy G. Nair, Arya B., Rajesh B.R., Pratap Chandran R.....169**

**47. PRODUCTION OF WINE FROM CANTALOUPE FRUIT USING *Saccharomyces cerevisiae***

**Neethu Franklin, Govind M. Suresh, Gowtham .G. Nair, Hitha K., Jennymol Joseph, Keerthana P., Rajesh B.R. and Pratap Chandran R.....170**

**48. PHYTOCHEMICAL SCREENING AND GC – MS ANALYSIS OF LEAF EXTRACT OF *Terminalia catappa L.***

**Rajesh B.R and Sreelekshmy S.G.....171**

**49. THE OENOLOGY OF MIXED FRUITS OF *MUSA ACUMINATA* AND *ANANAS COMOSUS***

**Enrika Joy Ajit, Dilna Dominic, Faseela Farook, Athira Promod, Bhagya M. S. Kumar, Blesy V.J., Rajesh B.R. and Pratap Chandran R.....172**



**50. AN ANALYSIS ON THE HEAVY METAL ACCUMULATION IN WATER AND CRAB, *Scylla serrata* FROM ASHTAMUDI LAKE, RAMSAR SITE, SOUTH INDIA.**

**Seethal Lal S and Dhanya Raj.....173**

**51. PHYSICOCHEMICAL ANALYSIS AND SENSORY EVALUATION OF *Carica papaya* WINE**

**Suhail Cholassery, Vidhu Krishna, Sreethu.V. S., Shabnam S R, Vandana.R.,  
Rajesh B. R. and Pratap Chandran R.....174**

**52. EVALUATION OF PHYSICOCHEMICAL CHARACTERISTICS OF COCONUT SPROUT WINE**

**Sreelekshmi Mohan M. R, Sayoojya K. P, Souparnika A.P, Sowparnika K,  
Pournami T. S, Rajesh B. R. and Pratap Chandran  
R.....175**

**53. TRACE METAL ACCUMULATION ANALYSIS IN CRAB, *Portunus sanguinolentus* FROM ARABIAN SEA.**

**Seethal Lal S and DhanyaRaj.....176**

**54. AN INVESTIGATION ON THE HEAVY METAL ACCUMULATION IN *Peneaus indicus* IN ASHTAMUDI LAKE**

**Seethal Lal S and Betsy. M. Miranda.....177**

**55. EVALUVATION OF THE TRACE METAL CONCENTRATION IN *Oxyurictchys tentacularis* FROM ASHTAMUDI LAKE**

**Seethal Lal S and Betsy. M. Miranda.....178**

**56. HSP70 IN FISH: AN EFFICIENT TOOL FOR BIOMONITORING AQUATIC TOXICANTS**

Sreelekshmy. S G, MTP Miranda. ....	179
<b>57. WATER HYACINTH: A POTENTIAL SUBSTRATE FOR CELLULASE PRODUCTION AND ITS APPLICATION</b>	
Jayalakshmi S, Sreelekshmy S G, Dhanyalakshmi C, Rajesh B R, Rekhakrishnan S.....	180
<b>58. OPTIMIZATION OF PROTEASE FROM FISH VISCERAL WASTE ANND ITS APPLICATION</b>	
Rekhakrishnan S, Sreelekshmy SG, Dhanyalakshmi C, Rajesh BR, Jayalakshmi S.....	181
<b>59. ISOLATION OF PROTEASE ENZYME FROM VISCERAL ORGANS OF SOME MARINE FOOD FISHES</b>	
Sreelekshmy SG and Rajesh BR.....	183
<b>60. NATURAL DYE FROM <i>THOTTEA DUCHARTREI</i> SIVAR., BABU &amp; INDU: A PROMISING WINDOW IN GREEN CHEMISTRY</b>	
Amrutha T.R., Athira M., Shaiju P.N.....	184
<b>61. LENGTH-WEIGHT RELATIONSHIP AND GROWTH CONDITION OF <i>MYSTUS GULIO</i> (HAM.) IN DIFFERENTMONTHS AND SEXES</b>	
Seethal Lal. S.....	185
<b>62. WE ARE NOT READY TO REPRODUCE IN A POLLUTED ENVIRONMENT- <i>MYSTUS GULIO</i></b>	
Seethal Lal. S., Jaya D.S. and Sherly Williams E.....	186

- 63. CHEMICAL PROSPECTING OF THE ROOTS OF *THOTTEASILQUOSA* (LAM.) DING HOU, WITH SPECIAL EMPHASIS ON ANTIOXIDANT, ANTICANCEROUS AND DNA DAMAGE INHIBITION PROPERTIES**  
Sumayya F., Athira M. & Shaiju P. N.....187
- 64. COPPER NANOPARTICLES FROM *MTHOTTEA SILIQUOSA* (LAM.) DING HOU: THE PROMISING PROSPECTS IN GREEN CHEMISTRY**  
Jibi K., Athira M. & Shaiju P. N.....188
- 65. STUDIES ON THE DIVERSITY OF MARINE ALGAE IN KOLLAM COAST: POST OCKHI SCENERIO**  
Saramya. S, Terresa Aji\* and Tessy Don.T.....189
- 66. STUDIES ON THE PHYSICO-CHEMICAL PARAMETERS OF THE POLACHIRA WETLAND IN KERALA**  
Suvi. S, S. Shibu And J. Sreeja .....190
- 67. THE CONTROLLED RELEASE STUDY OF THE ANTI-CANCEROUS DRUG 5-FLUOROURACIL FROM MESOPOROUS SILICA BASED DRUG DELIVERY SYSTEM.**  
Manohar D Mullassery<sup>1</sup> and Surya. R .....193
- 68. ANTIMICROBIAL PROPERTIES OF NANOCERIA**  
Dr Usha S<sup>1</sup>, Prabha Jyothi P S<sup>\*2</sup>, Smitha S<sup>3</sup>, Nisha J Tharayil.....196
- 69. STIMULATORY ROLE OF TRIIODOTHYRONINE IN HYDROMINERAL REGULATION IN FRESHWATER AND SALINITY ACCLIMATED CLIMBING PERCH, *ANABAS TESTUDINEUS***  
Leji.J .....199

- 70. MICROBIAL QUALITY ASSESSMENT OF BAIGAI, *BABYLONIA ZEYLANICA*(BRUGUIÈRE, 1789) LANDED IN KOLLAM, KERALA AT DIFFERENT STAGES OF PROCESSING**  
**Karthika Chandran A.\* and PramodKiran R.B.....202**
- 71. WATER QUALITY DYNAMICS IN AQUAPONICS**  
**Muneeer, A.\*, Jayesh B. P., Raji, S., Sobhankumar, K. and MithunSukumaran.....203**
- 72. EPIBIONT BACTERIA OF THE MARINE ALGAE *SARGASSUM WIGHTII* AGAINST THE FUNGAL PATHOGEN *ALTERNARIA ALTERNATE***  
**Naziya Rasheed , Mary Teresa P Miranda & Antony Akhila Thomas.....204**
- 73. HEAVY METAL POLLUTION IN WATERS OF LAKE VATTAKAYAL, CHAVARA, KOLLAM, KERALA.**  
**Indu. K And Dr. Sainudeen Sahib S.....207**
- 74. ISOLATION AND IDENTIFICATION OF POLY AROMATIC HYDROCARBON DEGRADING BACTERIA FROM OIL CONTAMINATED ENVIRONMENT.**  
**Vineetha S<sup>1</sup> and Anil Kumar T R.....216**

## **THE JOURNEY – HUMAN EGG FROM FERTILISATION TO IMPLANTATION**

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Life – when does it begin? Scientifically when the reproductive cells, sperm and egg unite to produce a new cell type called the Zygote, the process that is called fertilisation. The reproductive cells are produced in the reproductive organs, the testis and the ovaries.

This presentation is to understand the beginning of life and will take you through a very short journey of few days of the developing embryo from the zygote and the challenges it faces to implant to the uterine wall and then continue to develop as a foetus (baby).

Eggs are produced in the ovary and are released (ovulation) to be fertilised by sperm to start a new life. The production of egg or oogenesis is a process of oocyte production in the ovary, at ovulation one egg is released every month. Unlike sperm that are produced every day and are released at ejaculation through a process known as spermatogenesis.

When couples have not been able to achieve a clinical pregnancy after 12 or more months of regular unprotected sexual intercourse must seek medical advice. Fertility issues may be related to male or female factors or it can be unexplained and the couples are advised to seek medical advice. There are different treatment modalities that can assist them in conceiving a child, starting with Ovulation induction (OI), Intra-uterine insemination (IUI) or In-vitro fertilisation (IVF).

IVF is an assisted reproduction technology that has been developed to fertilise an egg outside the body (laboratory) and then the fertilised zygote is cultured in the laboratory environment till it develops into an embryo. As an IVF scientist my role is to culture zygote in an optimal environment to produce embryos that are suitable for transfer to the uterus and capable of implantation. Not all patients produce embryos that are viable and will have implantation potential. Also not all embryos created in the laboratory are capable of implantation even though they may appear to be morphologically normal.

Failure in implantation of transferred embryos has opened an avenue of research that is called embryo selection. Researchers have investigated metabolomics and proteomics which are non-invasive techniques to identify an embryo with high implantation potential. The alternative which is an invasive process is offered for genetic testing of the embryos called preimplantation genetic screening (PGS). For PGS the embryos undergo a micromanipulation procedure, called embryo biopsy, where few cells are extracted from individual embryo and sent for genetic screening. DNA from the cells are tested for chromosomal disorder or genetic diseases before transfer of embryos. PGS helps in identifying the embryos with chromosomal disorders i.e. Euploid (normal) and Aneuploid (abnormal) embryos. Genetically normal thus identified has improved implantation rates, increased live births and decreased miscarriage rates.

First IVF baby was born in 1978 and since then the technology has advanced with research in various aspects of clinical and laboratory process that investigated improvement in oocyte and sperm quality, microenvironment of the culture systems, efficacy of various drugs, air quality and controlled conditions in the laboratory, development in instrumentation, micromanipulation techniques, time lapse embryo scopes, and extended culture system for selection of most viable embryo.

The objective of the fertility clinic is to identify the factors affecting the fertility if any, assist them to achieve a healthy baby in shortest period of time.

## **NEXT GENERATION SEQUENCING AND NEW BIOLOGY**

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Science seeks to unravel the secrets of nature with each lap that earth takes around the sun. This curiosity driven science has witnessed many discoveries and breakthrough. They have used the giant telescope to microscope for their investigations. At times, intellectual-scopes have also have been used by scientists. Biologist once relied on microscope to investigate sub-cellular secrets of the cell. Today they are acquainted with computational microscope to do the same. The next generation sequencing (NGS) technologies serve as a computational microscope for unveiling our molecular level understanding of life. Many a time, it is interesting to note the variation in individual traits from curly hair or the long nose to the hazel eyes or sharp looks. Not only the physical traits but also the day to day activities of every cell is being controlled by the secret code engraved deep inside the nucleus of cell. It is this code responsible for the unique traits in every individual. For example, the hazel eyes of honorable Member of Parliament Sasi Tharoor or the blue eyes of Bollywood actress Aiswarya Rai implies the inherent variation in the secret code. DNA is responsible for the unique traits which is passed on to offspring through parents and this macromolecule determine the variation in gene accountable for the look of hair or eye. Have you ever wished to cross-examine what is happening inside the cell? At present, the high throughput sequencing technology help to reveal the molecular understanding of cell. Similarly, the measurement of activities of genes under a particular circumstance inside a cell is also possible. NGS have strengthened the field of Biology to come out with a complete molecular profile of an organism. This indeed revolutionized clinical diagnosis and development of improved plant crop varieties for better health. Though biological data are in general heterogeneous which extend from genetic sequences to interaction of proteins, the NGS data could generate less-biased molecular level identification of the genes and disease predictions accurately.

In 2011, Nicholas Volker become first human being salvaged by genome sequencing. At the age of 2, Nick got admitted Hospital of Wisconsin, located in Milwaukee. He had a rare new disease on his digestive track making him sickest patient in the hospital. Nic's doctors took the unusual courage of sequencing his genome to discover the biological coding mistake causing his illness. Finally they could identify a mutation in XIAP gene linked to defect in immune system. They further used Immunotherapy treatment to save the child. Thus the advancement in genomics made it possible to use a person's genes to treat a rare disease. This incident has been portrayed in the scientific detective story "One in a Billion: The Story of Nic Volker and the Dawn of Genomic Medicine". A part from the clinical applications, NGS technologies can be employed in the field of gene expression profiling, genome annotation and the study of epigenetic modification. In terms of functional genomics research, the main application of NGS technologies are Whole Genome Sequencing (WGS), Transcriptome sequencing (RNA-seq) or Analysis of epigenetic modifications and genome annotation. The various next generation application and different methods are shown below

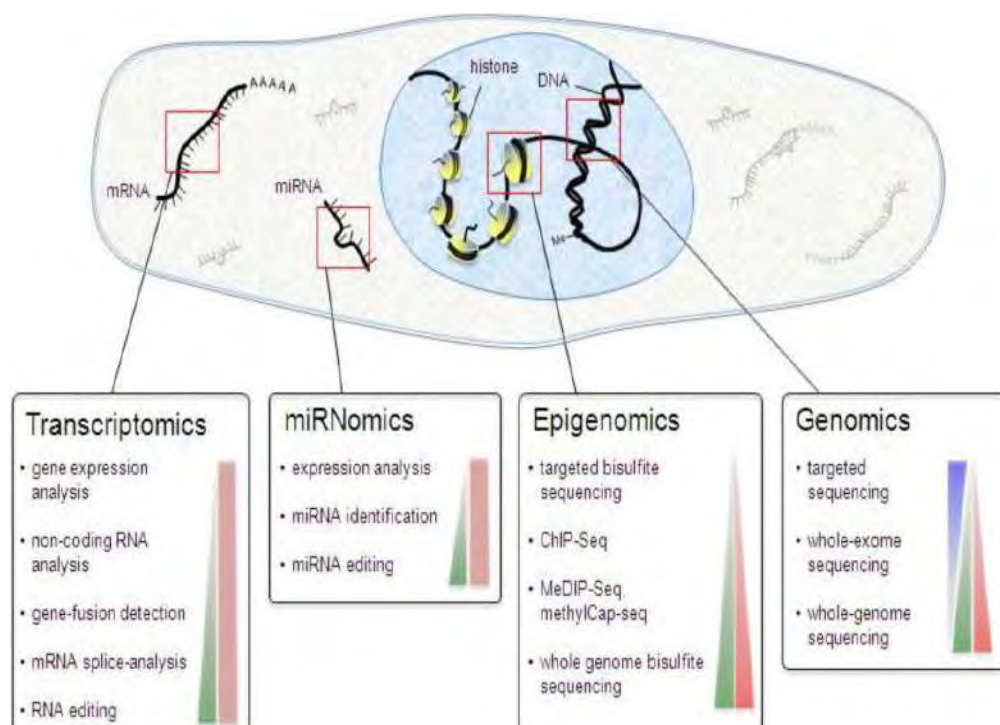


Figure: Next-generation sequencing applications, Schematogram depicting the different methods for transcriptomic, miRNomic, epigenomic and genomic studies.

(Source: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4009863/>)

## **ENVIRONMENTAL IMPACT ASSESSMENT**

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Nature has always fascinated us with a lot of mysteries. Conservation and protection of our environment has been an inseparable part of our ancient heritage and culture. But, now-a-days due to various anthropogenic activities, the waste products discharged into the biosphere is degrading our environment at a faster rate, which is totally unsustainable. Hence, the need of the hour is that both preservation of nature and development should go hand in hand (which is the basis of sustainable development). As a result, the concept of Environmental Management came as a response to the increasing seriousness of the human impact on our environment. Some of the major environmental management tools are Environmental Management System (EMS), Eco Labelling of Products, Life Cycle Assessment (LCA), Waste Minimization Programmes, Environmental Impact Assessment (EIA), Environmental Auditing etc.

**EIA** can be defined as the process of identification, evaluation and mitigation of potential impact of proposed projects, plans & programs on different environmental / social/ cultural / economic components for sustainable development.

**GLOBAL EVOLUTION OF EIA:** EIA was first introduced in the United States (1969) in the form of United States National Environmental Policy Act (US NEPA) & later countries throughout the world made similar laws. • Japan (1972) • Canada (1973) • New Zealand, Columbia, Australia (1974) • Brazil, France (1976) • Thailand, Philippines (1978) • Srilanka, Kuwait (1984) • European Community (1985) • Netherlands (1986) • World Bank (1987) • Italy, United Kingdom, Turkey, Ireland (1988) • Asian Development Bank (1990) • **India**, Bolivia, Chile, Austria (1994) • Armenia, Iceland, Uganda (1995).

In India, prior to 1994, developmental projects were assessed based on

1. Technical feasibility.(whether the project is feasible)
2. Cost-Benefit analysis (cost of the project and benefit to the society). Hence it can be concluded that in India prior to 1994, all environmental impacts were expressed in terms of source costs valued in monetary terms.

It was on 27<sup>th</sup> January 1994 the Govt. of India promulgated EIA notification, under Environmental Protection Act (EPA) 1986, making Environmental Clearance mandatory for expansion or modernization of any project or for setting up new projects. This EIA notification consisted of three schedules.

1. **Schedule I** (List of projects requiring environmental clearance from the Central Government).
2. **Schedule II** (Application Form).
3. **Schedule III** (Composition of Expert Committee).

The Ministry of Environmental and Forest (MoEF), Govt. of India (1997) made Public Hearing/Consultation mandatory for environmental clearance and the same was given as **Schedule IV** (Procedure for Public Hearing).



Consequently the numbers of projects that were received by the MoEF for obtaining environmental clearance increased over the years and there was a need for environmental protection rules to be more stringent. Realizing this changing paradigm, the MoEF notified the new EIA legislation (Notification) on 14<sup>th</sup> September 2006 which is followed in India right now.

#### **Salient features of 2006 EIA Government of India Notification**

- List of developmental project and activities which require prior environmental clearance (Given in Schedule I) was expanded and this was made applicable for expansion / modernization (by more than 50% of existing capacity) of the said project.
- A state level Environmental Impact Assessment Authority (**SEIAA**) (consisting of three members) to be constituted by the Government of India in consultation with the state Government concerned.
- All developmental projects requiring prior environmental clearance (Given in Schedule I) were categorized under two heads (based on the extend of potential impact).
- Expert Committee (EC) as per 1994 EIA Notification was re-designed as Expert Appraisal Committee (EAC) as per 2006 EIA Notification.

**EIA PROCESS:** The processes involved in EIA are explained below.

1. **Project Description:** It is the condensed description of all aspects of the project showing project boundary, site layout so and so forth. The submission of a project proposal signifies the commencement of the EIA process.
2. **Screening:** This is the process of scrutinizing the application seeking whether a project requires environmental clearance as per the Statutory Notification.
3. **Scoping and Consideration of Alternatives:** This stage identifies the key issues and impacts (Terms of References) that should be further investigated. Since developmental projects vary widely, Terms of Reference cannot be standardized. All the available options / alternatives with respect to project site or cutting edge (latest) technology also should be considered for the developmental project.
4. **Baseline Studies:** Baseline data describes the existing environmental status (water quality, air quality, flora, fauna, social setup etc.) of the identified study area/areas. Thus includes primary data (in-situ) and collected secondary data if available.
5. **Impact Prediction, Assessment & Mitigation Measures:** Predicting the magnitude of impacts of a developmental project and evaluating/assessing their significance is **core to the whole EIA process**. Mitigation step in EIA recommends the actions to reduce and avoid the potential adverse environmental consequences of developmental activity. Finally the alternatives should be ranked for selecting the best environment friendly and economically viable one.
6. **Preparation of EIA report:** An EIA report should provide clear information to the decision maker on the different environmental scenarios without the project, with the project, and with project alternatives.
7. **Public Hearing:** After the completion of EIA report, it is a pre-requisite that the public must be informed and consulted on the proposed development. The State Pollution Control Board or the District Collector or his nominee shall conduct the Public Hearing before the proposals are sent to MoEF for obtaining Environmental Clearance.
8. **Receiving the EIA report & Decision Making:** After going through the EIA report and Public Hearing report, the decision whether the proposed project is approved, rejected or needs further change, is taken by the EAC.
9. **Monitoring of Environmental Clearance Condition:** .The industry/proponent is required to file once in six months a report demonstrating the environmental compliance, if the project is approved. Monitoring the environmental clearance condition is carried out during both the construction and the operation phase of the development project.

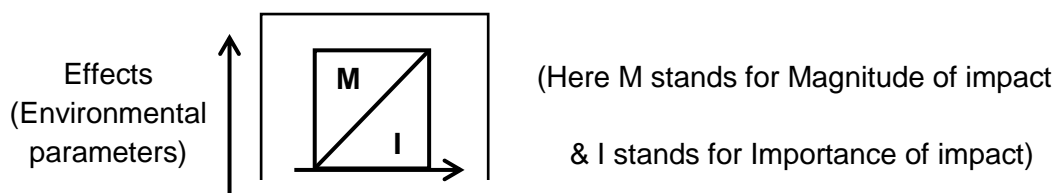
Environmental impacts of projects includes a broad range of impacts (i.e. air, water, soil, cultural impacts, social impacts, economic impacts). The above impacts may be simple or complex, beneficial or adverse, direct or indirect, short term or long term & so and so forth. **To predict and assess the impacts** of developmental projects there are

various methods (also known as **EIA methodologies**): 1. Checklist method 2. Overlay method 3. Matrix method 4. Network methods 5. Expert opinion (Ad-hoc method)

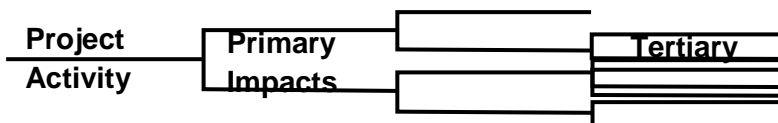
**1. Checklist method:** Checklist is a complete list of environmental factors potentially affected by the project. This method helps us only to get a qualitative idea about the impacts.

**2. Overlay method:** Overlay method consist of using a base map of the project area and overlaying on this map different impact characteristics of the proposed project of the same area. Today GIS (Geographical Information System) technique is commonly used for overlaying a number of impacts maps to produce a composite map.

**3. Matrix method:** This method is commonly used in EIA and can be considered as an improvement over the checklist method. Here we use an interaction matrix between Causes (means project activities) and Effects (means environmental pollution). The most common matrix used is **Leopold Matrix** which is shown:



**4. Network methods:** He activities along with corresponding Causes and Effects (also known as Cause-Effect flow diagrams). There are two network methods namely Event Tree Analysis and Fault Tree Analysis. **Event Tree Analysis** starts with an **Secondary** event (i.e. any project activity) and uses forward logic to describe all possible effects. **Fault Tree Analysis** starts from a failure event (Environmental Impact) and uses backward logic to describe all possible causes for the failure.



**5. Expert Opinion (Ad-hoc method):** This method is useful when time is limited and the information available regarding impacts are very less. Here we rely on expert's opinion to assess the impacts.

From July 2014 onwards, Ministry of Environment, Forest and Climate Change (MoEFCC) has launched an **Online Application System** for submission and monitoring of applications for Environmental Clearance. **This is a move towards making Environmental Clearance process more transparent and efficient.** From December 1, 2015 onwards the Kerala State Government has also put in place online application system under the single window scheme for granting Environmental Clearance for various projects.

Even as there are several laws in force to guarantee the safety of the ecology and the environment, it is no secret that rampant environment destructions are taking place through human interventions by violating these laws. Recently the decision to review the green laws [ □ 1927 Indian Forest Act □ 1972 Wild Life (Protection) Act □ 1974 Water (Prevention and Control of Pollution) Act □ 1980 Forest (Conservation) Act □ 1981 Air (Prevention and Control of Pollution) Act □ 1986 Environmental (Protection) Act ] by the High Level Committee (HLC) setup by the Govt. of India (in the year 2014) has set the ground rules for an unequal battle between environment and development. Whether the decision to review the existing green laws, is a move to favour the industry? Only the future can come up an answer; but at what cost?

# **RESTORATION OF MARINE AND COASTAL BIODIVERSITY AND UNITED NATIONS SUSTAINABLE DEVELOPMENT GOALS: THE WAY FORWARD**

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## **I. INTRODUCTION**

*Marine and coastal ecosystems, which include natural assets such as marine living resources and a range of important habitats including as mangroves, coral reefs, seagrass beds, seaweed beds, coastal tidal marshes, and seamounts are crucial for human well-being and sustainable development. They provide humans with food, water, medicines, construction materials, energy, transport, shoreline stabilization, coastline protection and erosion prevention, climate regulation, oxygen production, maintenance of biodiversity, as well as recreation, aesthetic, cultural, religious and spiritual services. Marine and coastal ecosystems act as carbon sinks absorbing annually about one-fourth of the total annual anthropogenic emissions of carbon dioxide. They provide a vital basis for the livelihoods of many coastal communities, particularly resource-dependent communities in developing countries. The ecosystem services marine and coastal ecosystems provide have substantial economic value estimated by studies on the order of trillions of US dollars annually (UN, 2017).*

**KEYWORDS:** *Elasmobranch, Indian Ocean, IUCN Red List, CITES, conservation*

## **II. STATUS AND TRENDS**

Marine and coastal ecosystems are increasingly threatened, degraded and destroyed by marine- and land-based human activities. Major adverse impacts to ecosystems stem from climate change, unsustainable extraction of marine resources, physical alteration and destruction of marine and coastal habitats and landscapes and marine pollution. These impacts may increase further in the absence of countermeasures, especially given the projected global population growth to 9.7 billion people by 2050 (UN DESA, 2015).

As of now about 30 percent of fish stocks are estimated as fished at a biologically unsustainable level and therefore overfished (FAO, 2016). Further, the rate of fishing and non-fishing mortality of marine organisms are also on the increase, especially as bycatch of fishing vessels, especially of commercial trawlers. In addition, many populations have been reduced to remnant status, such that they no longer play a significant role in the ecosystem. Major marine ecosystems have already been degraded or are being used unsustainably. Between 20 and 35 per cent of mangroves have been lost since 1980. Coral reefs around the world have been in a state of continual decline over the past 100 years, and especially over the past 50 years. Studies estimate that approximately 19 per cent of the world's coral reefs are severely damaged with no immediate prospects of recovery, more than 60 per cent are under immediate threat and all coral reefs could face functional extinction by 2050. It has been predicted under some climate change scenarios that up to 60 per cent of the current biomass in the ocean could be affected, either positively or negatively, resulting in disruptions to many existing ecosystem services (UN, 2017). This will impact human as well, with the increased vulnerability of local communities to extreme weather events due to undermined natural protection barriers and damage or destruction of human settlements and infrastructure; the displacement of local communities, increased food insecurity and decreased availability of freshwater; and reduced sources of livelihood and employment.

As marine and coastal ecosystems provide important economic, socio-cultural and environmental benefits, their sustainable management, protection, conservation and restoration are crucial. Restoring and protecting the health of

Oceans and coasts also contribute to strengthening the resilience and adaptive capacity of both natural and human systems to climate change and other threats.

Because individual stressors interact, managing each activity that impacts marine ecosystems in isolation will be insufficient to achieve ocean health and resilience. The United Nations Convention on the Law of the Sea (UNCLOS) provides the legal framework within which all activities in the oceans and seas must be carried out, including for the conservation and sustainable management of marine living resources, marine biological diversity and the protection and the preservation of the marine environment.

Several efforts are undertaken to identify and describe marine areas in need of conservation while the criteria for such identification differ. One example is the global process to facilitate the description of ecologically or biologically significant marine areas (EBSAs) through regional workshops under the Convention on Biological Diversity (CBD). Thus far, these workshops described more than 200 areas meeting the EBSA scientific criteria. Other efforts undertaken include those by FAO for the identification of vulnerable marine ecosystems (VMEs) and by IMO to identify particularly sensitive sea areas (PSSAs).

Diverse area-based measures and management tools can be used to sustainably manage, protect, conserve and restore marine ecosystems, including for example the application of ecosystem approaches, marine spatial planning, integrated coastal zone management and the establishment of marine protected areas, consistent with international law and based on best available scientific information, including representative networks. The main purpose of these measures is to sustainably manage, protect, conserve and restore coastal and marine areas and resources, including underwater cultural heritage, while also supporting economically valuable activities and having important social impacts.

Area-based measures are being integrated in national development plans and strategies and referred to in various instruments at the global, regional and national levels. Many initiatives adopt a suite of management tools in an integrated, cross-sectoral manner, including area-based management tools, environmental impact assessments, management of land-sea interactions, watershed and catchment planning and management, resource management, gear restrictions and promotion of cleaner production and environmentally sound technologies, as well as pollution prevention and control.

Few countries in the world apply the ecosystem-based management approach to fisheries. On a regional scale, the regional seas conventions and action plans, regional fisheries bodies and large marine ecosystem projects are also advancing ecosystem approaches from their different perspectives. Ecosystem approaches have the potential to support a variety of other management tools, including marine spatial planning, to provide a framework for cross-sectoral cooperation and coordination of national and international measures. At the national and regional levels, integrated coastal zone management (ICZM) evolved from the practical need to plan and manage the various economic activities that occur in the coastal areas, regulate human behaviour, coordinate policy and management interventions, and integrate the use of coastal waters into land-use planning. ICZM is considered to be one of the tools to apply an ecosystem approach to coastal areas.

Marine spatial planning (MSP) is another important tool to apply ecosystem approaches and represents a public process of analysing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic and social objectives that have been specified through political processes. Marine protected areas (MPAs) have become a mainstream tool for conserving marine biodiversity, and are advanced under several global and regional instruments, including the CBD, the Future we want and several regional seas conventions and action plans, as well as regional fisheries management conventions. MPAs can accomplish a broad range of objectives from habitat and species protection, fisheries outcomes, securing livelihoods and food security, sustainable uses, cultural objectives, public education and outreach, and application of the precautionary and ecosystem approaches. MPAs have also had a role in revitalizing management by communities of their adjacent marine resources. MPAs can represent an effective tool to mitigate and adapt to climate change impacts and to increase the resilience of social and ecological ecosystems. MPAs can prohibit all activities in an area, prohibit certain activities or restrict certain activities within an area through, for example time/area closures, gear restrictions,

fishing quotas, specific licenses and permits. In addition to government-established MPAs, which are often under government management, either fully or partly, indigenous and local community conserved areas, and private protected areas also form an important part of the overall conservation effort. There are now 14,688 MPAs covering almost 15 million square kilometres, or 4.12% of the oceans, up from 3.4% per cent in 2014. Only one per cent is protected in no-take marine reserves, which offer a higher degree of protection and more benefits.

In recent years, the international community has become increasingly aware of the range of services provided by marine ecosystems and of the rich biodiversity of pelagic and benthic ecosystems beyond the limits of national jurisdiction, namely in the high seas and the Area. Many UN organizations have ongoing activities in support of managing, protecting, conserving and restoring coastal and marine ecosystems. These include: practical area-based and science-based management tools; policy guidance and capacity building to support implementation of ecosystem-based management and governance; developing Member States' capacities in the integration of climate change adaptation and coastal hazards preparedness; outlook systems for specific weather-climate phenomena (El Niño) which can affect ecosystems at global scale; developing guidelines, training materials and tools; identifying species biodiversity on national, regional and global scales; creating a database repository of relevant management measures to protect vulnerable species and ecosystems; examining the impacts of climate change and the effects of marine pollution on ecosystems; developing environmental regulations to manage the effect of deep-sea bed mining and many other activities.

Efforts are also being made with regard to strengthening MPA effectiveness and equitable sharing of MPA costs and benefits among relevant stakeholders; establishment of regional networks and information sharing portals with regard to capacity building and experience sharing; offering of training courses on area-based management tools; continuous tracking of progress made with regard to the conservation of coastal and marine areas, including global MPA coverage; implementation of various programmes, including on fostering cooperation for sustainable use of marine ecosystems, preventing the loss and degradation of coastal habitats; fostering sustainable fisheries; preventing, controlling and managing alien invasive species; enhancing the science-policy interface; managing the human-biodiversity interface; and integrating biodiversity and ecosystem services into development and finance planning. Finally, there have been significant efforts aimed at facilitating progress towards the Aichi Biodiversity Targets in marine and coastal areas, which overlap and align very closely with some of the targets under SDG 14 as well as other SDGs.

### **III. CHALLENGES AND OPPORTUNITIES**

One of the major challenges to the sustainable use of marine biodiversity is that biodiversity hotspots tend to attract human uses and become socio-economic hotspots. Hence biodiversity-rich areas often have a disproportionately high representation of ports and coastal infrastructure and intensive coastal land uses, including fishing and other activities. The 66 Large Marine Ecosystems (LME) of the world, for example, are the most productive regions and the greatest pressures are generated upon them. While ICZM and MPAs are commonly applied, and despite local success stories, biodiversity in coastal areas continues to decline with intensifying pressures. The successful implementation of ICZM remains a challenge. Some reasons cited for this include competing jurisdictions and decision-making, conflict between different activities and users, and inadequate governance.

In addition, many areas that are protected or are planned to be protected through area-based management tools are located in areas removed from where commercial activities occur or may not adequately protect the species, communities and habitats most threatened. MPAs can also fail to reach their full potential as a consequence of factors such as illegal harvesting, regulations that legally allow detrimental harvesting, or movement of animals outside MPA boundaries because of continuous habitat or inadequate size of the MPA. Management effectiveness of MPAs remains one of the largest problems. There is also no agreed or standardised methodology yet to track progress on equitable management of MPAs. MPAs are often not integrated into broader governance and management frameworks and limited connectivity among MPAs does not benefit ecosystem processes, functions and productivity. The socio-economic costs and benefits created by MPAs need to be further investigated and the need for more equitable sharing of social and economic benefits derived from MPAs could be addressed.

There is an opportunity to increase the integration of area-based measures into national strategies related to sustainable development. In this context, there is a need for improvement and better use of appropriate planning tools and approaches for mainstreaming ecosystem approaches into national strategies. Another opportunity is to consider the challenges of climate change in area-based management plans and their monitoring activities. Disaster risk reduction and management could be an integral element of integrated coastal area management. Long-term sustainable observation networks and reliable predictive tools constitute essential elements of early warning systems which aim to protect coastal regions and people living there.

Further application of area-based management measures can enhance cross-sectoral cooperation and create synergies in achieving SDG14 targets and other SDGs. Sharing knowledge and practices more systematically can help address coordination challenges. Cooperation can also be facilitated and stimulated by global-level dialogue and experience-sharing across regions. A good example is the cooperation between some regional seas organizations and regional fisheries management organizations/arrangements, which proves to be useful in advancing ecosystem approaches.

Effective enforcement measures, including traditional and community-based measures, but also new technologies, such as satellites, need to be in place to back-stop area-based management tools. Enforcement could be improved by reaching national and local agreements with related institutions and stakeholders, complementing roles and sharing expertise and capacities. Institutional arrangements that ensure and enhance surveillance, monitoring and effective control and enforcement need to be established. Stakeholders, especially local communities, are often not sufficiently involved in the development, designation and management of protected areas. Tools are lacking for the equitable sharing of social and economic benefits derived from area-based management measures. Meaningful alternative livelihoods must be made available to local communities, which should be an integral part of national development agendas.

Clear legislative and policy frameworks must be in place to foster community organization and to allow for their full participation in the management of marine resources as stewards. It is also of great significance to apply a gender perspective to the sustainable use and management of marine and coastal resources, in recognition of the very often significant role played by women in small-scale fisheries and aquaculture and, overall, in the value-chain from catch and harvesting to consumption and marketing.

Managing ecosystems sustainably involves balancing sustainable use and biodiversity conservation. Yet, often there seems to be no clear process for addressing the different knowledge gaps and ensuring that sound advice is available for management. There is a need for a better understanding of ecosystem processes and functions and their implications for ecosystem conservation and restoration, ecological limits, tipping points, socio-ecological resilience and ecosystem services. There is also a gap in terms of understanding species and biodiversity of marine resources. Assessments and research on marine and coastal ecosystems and the ecosystem services they provide should be maintained and expanded, including with regard to socioeconomic aspects and possible future impacts on ecosystems and their resilience to them.

The importance of measuring changes to marine ecosystems has been recognized to be crucial to inform future management policies. By appropriately valuing especially natural assets, all activities that exploit them (directly and indirectly) could contribute to their sustenance. Data collection, access and sharing should be supported, including through observation networks and inventories. The use of traditional and ecological knowledge from local communities should be enhanced as relevant indigenous and traditional knowledge systems and the collective actions of indigenous and local communities can complement scientific knowledge in support of effective implementation. Clear and measurable objectives are required to evaluate the effectiveness and impact of area-based measures, including how land-based human activities impact their effectiveness, and area-based measures should be subject to periodic reviews. Baselines should be established to enable informed and integrated ocean management. This paper analyses the status of marine biodiversity of India, its status.

#### **IV. REFERENCES**

FAO (2016): *The State of World Fisheries and Aquaculture*. Food and Agriculture Organisation, Rome.

UN (2017). The First Global Integrated Marine Assessment. World Ocean Assessment I. Edited by United Nations, Division for Ocean Affairs and the Law of the Sea, Office of Legal Affairs. Cambridge University Press, Cambridge.

UN DESA (2015). World Population Prospects: The 2015 Revision, United Nations.

## **INTRODUCTION TO ARTIFICIAL NEURAL NETWORK**

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In this talk, I will give a gentle introduction to Artificial Neural Network (ANN) in such a way that audience with minimal mathematical background will understand the basic principles of ANN. In general ANN can be used to solve several pattern recognition problems and function approximation problems in several research areas. This talk will explain how ANN can be used to solve some problems in the area of life science.

ANN can be viewed as a black box which will give an output for a given input. ANN learns from examples or training data there are several learning paradigms. Supervised learning, unsupervised learning and reinforcement learning are some of them. In the case of supervised learning each element of the training data consist of an input and target output. Supervised learning is like learning from a teacher. In unsupervised learning, the target output is not given. It is like learning without a teacher. In many situations, we are able to learn without teacher! In certain cases, we may not have a teacher but a critic. In such situations Reinforcement Learning can be used. Nobody tells us how to behave in a new society, we learn from the critics. No book, will teach you how to balance a cycle, we learn from our falls (failures). Supervised learning is suitable, when we have sufficient input-output example. Reinforcement Learning can be used to solve multi-stage decision making problems. The audience will get an intuitive idea about the various learning paradigms by attending this talk. There are several training tool. This talk will familiarize the participant with a powerful tool, MATLB, to train a Neural Network.

When a researcher has to use ANN for a particular application, he should be aware of the various possible neural networks that could be used, various training algorithms and how to prepare the data so that, ANN will learn from the data given and will be able to generalize from the data. This talk will be an attempt to expose the researchers of various possibilities and get initiated to learning and applying ANN



## **BIODIVERSITY CONSERVATION FOR A SUSTAINABLE FUTURE**

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Biodiversity is the basis for sustainable livelihoods. The theme of the International Year of Biodiversity 2018, "Celebrating 25 Years of Action for Biodiversity" was chosen to mark the 25th anniversary of the entry into force of the Convention on Biological Diversity and to highlight progress made in the achievement of its objectives at the national and global levels. According to the United Nations Food and Agriculture Organization, 40% of the world's economy is based directly and indirectly on the use of biological resources. It is therefore not surprising that sustainable use of biological diversity is one of the three objectives set out in the Convention's first article, and that Decision V/24 frames sustainable use as one of the Convention's cross-cutting issues.

The need to mainstream biodiversity into economic growth and development is being increasingly recognized and is now also firmly embedded in the Sustainable Development Goals. Biodiversity plays a very important role in maintaining natural cycle and ecological balance. The Convention of Biological Diversity (CBD) defined biodiversity as the variability among living organisms from all sources including; inter alia, terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part. Biodiversity, literally, is the foundation upon which human civilization has been built. In addition to its intrinsic value, biodiversity provides goods and services that underpin sustainable development in many important ways, thus contributing to poverty alleviation. First it supports the ecosystem functions essential for life on Earth, such as the provision of fresh water, soil conservation, and climate stability. Second, it provides products such as food, medicines and materials for industry. Finally, biodiversity is at the heart of many cultural values. In total, biodiversity is life insurance for sustainable development.

Sustainable development, according to the Brundtland Report of 1987, is development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs. Poverty eradication the change in unsustainable patterns of production and consumption and the protection and management of natural resources base of economic and social development are constantly cited as the over-arching objectives and essential requirements for sustainable development. Loss of biodiversity, therefore limits sustainable development and for a more general usage to address the 2010 target, it is the long term reduction of abundance and distribution of species, ecosystems and genes and the goods and services they provide. The Hague Ministerial Declaration from the Conference of the Parties (COP 6) to the Convention on Biological Diversity, 2002 recognized first the need to mainstream the conservation and sustainable use of biological resources across all sectors of the national economy, the society and the policy-making framework. Poverty eradication, changing unsustainable practices, protecting and managing the natural resource base are essential requirements for Sustainable development.

Biodiversity conservation and sustainable development are two inter-related branches focusing on social progress, economic growth and environmental protection on one side, and ecosystem conservation on the other. Conservation includes the efforts carried out in protected areas such as national parks and community reserves, and in other areas with rich and important biodiversity where conservation is not the main focus. It is in these latter productive landscapes where sustainability is needed most. Sustainable agriculture, sustainable fisheries and sustainable management of natural resources are the main approaches for preserving these landscapes for long-term social, economic and ecological benefits. Biodiversity policy and conservation activities are informed, enhanced and driven by research and technology. The need to address biodiversity as a key element of sustainable development is presented from the perspective of different sectors as Agriculture, Fisheries, Protection of traditional knowledge etc. People are at the centre of sustainable development and some of the community conservation practices adopted are bought out along with conservation of the oceans, seas and marine resources for sustainable development.

The vision of Strategic plan for biodiversity 2011-2020 states that by 2050, biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people. This vision can be realized only with the active engagement of Governments, civil society, NGO's, industries and each one of us.

One of the landmark results of the Earth Summit held in Rio de Janeiro in 1992 was the Convention on Biological Diversity. The Biodiversity Convention calls upon parties to conserve and sustainably use biological diversity while equitably sharing the benefits of the use of genetic resources. These goals are key elements of sustainable development.

The CBD has proven not only to be at the heart of sustainable development but also to be capable of making the shift from policymaking to implementation. Governments have the obligation at the upcoming World Summit for Sustainable Development to make commitments to sustainable use of natural resources, based on sound, scientifically-based management, that provides benefits to local people as well as contributing to habitat conservation. The conservation and sustainable use of biodiversity are possible only when economies take into account existing knowledge of the cultural and biological systems in which they operate and when they include benefit sharing as one of their goals. In the context of globalization, biodiversity becomes a capital on which governments can and should build to achieve sustainable levels of social and economic organization – a precondition for sustainable development. Preserving species diversity is one of the most challenging and vital aspects of the sustainable development agenda.

## THE WAR AGAINST MOSQUITOES

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### ABSTRACT

The war against mosquitoes was started ever since man realized the damage caused by these ubiquitous creatures. Every one is aware about how chemical pesticides were used earlier in attempting to bring these creatures under control. It is now clear that these pesticides have caused more problem than can be imagined. They polluted the environment and also brought in more resistant varieties thus aggravating the problem. The emergence of new bio-pesticides brought some relief but the mosquitoes continue to have the last laugh. A combination of several methods of control has been put into use but to no avail. Several diseases are still being caused by these vectors. Diseases like Malaria, Dengue, Chikungunya, Japanese Encephalitis, Filariasis, Zika etc are still being reported from several parts of the world. Integrated Pest Management techniques are also being tested. Biological control methods using several predators have been put into use.

Among the natural predators used for mosquito control are the following: Mosquitoes that eat mosquitoes: *Toxorhynchites* sp., *Lutzia* sp. *T. moctezuma*. These have been tested against *Culex quinquefasciatus*.

Aquatic Insects: *Anisops bourieri* kirkaldy, *Diplonchus indicus*, *Sphaerodema annulatum*, *Laccotrephes griseus*, *Ranatra* sp., Naiads of Dragon fly, Tiger beetle, *Cicindela octoqutta* have all been reported. Crustaceans: *Macrobrachium lamarrei*, *Mesocyclops obsoletus*. Planarian, *Dugesia dorotocephala*; Leech, *Herpobdelloidea*

Fishes - *Gambusia affinis*, the mosquito fish; Guppy- *Poecilia reticulata*, *Mollinesia sphenops*, *Kuhlia taeniurus*, *Aplocheilichthys blochii*, *Oryzias melastigma*, *Grass carp*, *ctenopharyngodon idella*, *Esosmus danrica*, *Catla catla*, *Macropodus cupanus*, *Ambly pharyngodon melettinus*, *Tilapia* etc. Among the amphibians a good example is *Rana tigrina*. Among mammals, the bat, *Myotis* sp is reported be a good predator of mosquitoes. Among the microbial pesticides are the nematodes, viruses, bacteria and certain protozoans. Mermithid nematode, *Romanomermis culcivorax*. Among the fungi are *Coelomyces indicus*, *Lagenidium giganteum*, *Metarhizium anisopliae*, *Entomophthera destreuns*, *E. conglomerata*, *Culicinomyces clavosporus*, *Beaverla bassiana*, *Be.tenella*.

Protozoan Parasites: *Nosema algerae*, *Helicosporidium*. Mosquitocidal toxins of bacilli and their genetic manipulation have been effectively used for biological control of mosquitoes. Among the effective bacteria are *Bacillus thuringiensis Serotype H-14*, *Bacillus alvei*, *Bacillus sphaericus*, *Bacillus brevis*, *Bacillus thuringiensis var. israelensis* etc. Modified mosquitoes may be considered a tool for mosquito control. Proper monitoring of mosquito populations, targeted mosquito control with insecticides, monitoring insecticide resistance and preventing mosquito bites using repellants, etc., are important and unavoidable aspects of mosquito control programs. Oxitec, Ltd (Oxford Insect Technologies) has developed OX513A, genetically engineered strain of *Aedes aegypti* to suppress wild *Aedes aegypti* populations in areas where diseases like Dengue, Chikungunya and Zika are prevalent. Modification of mosquito eggs to contain a protein called "Tetracycline repressible activator variant" that inhibits mosquitoes attaining adulthood unless they get a regular supply of the antidote Tetracycline is the technique involved. Mosquitoes are regularly fed Tetracycline when they are produced in vast requisite numbers for field trials. On being released into the environment, the protein becomes active, as they are no longer being fed the antidote.

Yet another technique introduced is the use of bacteria, *Wolbachia pipientis* into *Aedes aegypti*. This can reduce its ability to transmit diseases like dengue and Zika . This is a method by which vector competence can be reduced. This can be used to infect laboratory reared *Aedes aegypti* males. When these mate with wild females, they become

sterile. As this technique is not genetic modification it may be welcomed by the populace who are against GM mosquitoes. Here only an alteration of mosquito takes place. Different strains of *Wolbachia* may be used for different types of mosquito population. Biological control agents are not an alternative to insecticidal control. Biological control methods may be slow and may cost a bit more than pesticide use but if we make enough efforts, we can make them work.

**KEY WORDS:** *Mosquito control, Biological control, Aedes aegypti, Zika virus, Malaria, Wolbachia, Dengue*

## **ORAL PRESENTATIONS**

## SPECIES DIVERSITY OF DRAGONFLY ALONG THE WATERSIDE OF KALLAR RIVER BASE OF PATHANAMTHITTA DISTRICT, KERALA

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**ABSTRACT:** Dragonflies are charismatic group of insects in the ecosystem by acting as predator to various insects and also act as pollution indicator. This study aims to understand species diversity of dragonfly along the waterside of Kallar riverbase of Pathanamthitta district, Kerala. The survey was carried out by field visit during the months of April 2014 to October 2014. In the selected area permanent transects were laid and observations on dragonflies was done. 15 species of dragonflies were identified during six month period of study. 14 species from the family Libellulidae and one are from Gomphidae. The species diversity was calculated using Shannon index and Simpson's index.

**KEYWORDS:** Dragonfly, Diversity, Kallar

**INTRODUCTION:** Dragonflies belongs to order Odonata, so they are collectively called Odonates, are one of the most common insects flying over forest, fields, meadows, ponds and rivers. About 6000 and subspecies to 630 genera in 28 families are known from all over the world (Tsuda 1991), out of which 499 species and subspecies of Odonata under 139 genera in 17 families are represented in India (Prasad and Varshney 1995). India is highly diverse with more than 500 known species. The life history of Odonates is closely linked with water bodies (Subramanian 2005). The insect order containing the dragonflies (Anisoptera) and damselflies (Zygoptera). The two groups are easy to spot: dragonflies are robust in appearance and resting or feeding holds its four wings straight out from its body. The hind wings are broader at the base than the fore wings. Damselflies are slender in appearance and rest with wings held up vertically. Their wings may or may not be stalked at the bases. The aquatic nymph of dragonfly is also different from damselflies (Norma Je2002). There are mainly four families in order Anisoptera. Family: Gomphidae, Ashenidae, Cordulegasteridae, Libellulidae.

Agro-environmental schemes are a significant tool in biodiversity conservation (Ovenden, *et al.*, 1998). The linking of biodiversity and agro-environment is an important steps towards achieving a more sustainable agricultural. Dragonflies are very valuable insect and the knowledge of the fauna is important for decision making about environmental protection and crop management (Rowe, 2003). The adult species visit important crop fields in search of their food and in this way help in controlling insect pest of these crops. (Yasumatsu *et al.*, 1975, Yunus *et al.*, 1980, Khaliq and Yousaf, 1995).

### MATERIALS AND METHODS

**STUDY AREA:** To study the dragonfly diversity and abundance the study was mainly carried along the waterside of Kallar river base of Pathanamthitta district, Kerala. It is located at 9<sup>o</sup> 14 North latitude and 76<sup>o</sup> 52 East longitudes and it has an average elevation of 51 feet. The normal rain fall in this region is 2833.3mm. The major rain contribution is from south-west monsoon.

**OBSERVATION AND SURVEY:** The survey was carried out by field visit during the months of April 2014 to October 2014. Transect method is used for studying the dragonflies. In the selected area permanent transects were laid along the Kallar riverside having a length of 100 meters to study the dragonfly. Observations on dragonflies done during midday. The transects are visited and counted two days in a month. During the counting, care was taken to avoid double-counting of dragonflies. Estimate the transect length using passes.

When large numbers of dragonflies are present, an exact count is not possible. When many individuals of same species are patrolling, it can be difficult to keep track of the numbers. Divided the sections into smaller parts and count the individuals present in each. It is useful to record numbers in a notebook (use tally marks) or into a voice recorder. This information can be transferred to recording forms later, but double check to avoid transcription errors. Individual specimens were photo documented and these images were cross checked with standard references and field guides on odonates such as Fraser (1933 and 1934), Subramanian (2005 and 2009) and Kiran and Raju (2013).

**DATA ANALYSIS**

Species diversity like Shannon diversity (H') and Simpson diversity (D) were calculated

**2.3.1 Diversity indices**

Shannon Wiener Index (H'): Diversity was calculated by using the following formula

$$H' = -\sum p_i \ln p_i$$

Where H' = Shannon Wiener's Index of species;  $p_i = n_i / N$ ,  $n_i$  = Number of individuals of a i'th species; N = Number of individuals summed over all species; ln = Natural log

Simpson's index (D): The measure equals the probability that two entities taken at random from the dataset of interest represent the same type.

$$D = \frac{1}{\sum_{i=1}^s p_i^2}$$

D obtains small values in data sets of high diversity and large values in data sets of low diversity

**OBSERVATION AND RESULT**

**TABLE 1: List of Dragonflies from the Waterside of Kallar river base of Pathanamthitta district, Kerala**

No.	Species Observed	No. of species in each month							
		April	May	June	July	Aug	Sept	Oct	Total
<b>I</b>	<b>Libellulidae</b>								
1	<i>Brachythemis contaminata</i>	4	3			1	2		10
2	<i>Bradinyopyga geminata</i>			3				5	8
3	<i>Crocothemis servilia</i>	1	2						3
4	<i>Diplocodes trivialis</i>	9	8	6	7	10	16	4	60
5	<i>Neurothemis tullia</i>	2	1				1	1	5
6	<i>Orthetrum pruinosum</i>	1	2			1		1	5
7	<i>Orthetrum sabina</i>	3	1				1		5
8	<i>Pantala flavescens</i>				2	3		4	9
9	<i>Rhodothermis rufa</i>	4	2	1	2	3		1	13
10	<i>Rhyothemis variegata</i>	12	9	8	11	25	32	18	115
11	<i>Tramea basilaris</i>	2	1				1		4
12	<i>Trithemis aurora</i>	8	7	4	4	5	4		32
13	<i>Tithemis festiva</i>	2	1				1		4
14	<i>Urothemis signata</i>	2	2			2			6
<b>II</b>	<b>Gomphidae</b>								
15	<i>Ictinogomphus rapax</i>	3	2			2	3	1	11

Total	53	41	22	26	52	61	35	
	94		48		113		35	290

**TABLE2: Diversity measures of Dragonflies along the Waterside of Kallar river base of Pathanamthitta district, Kerala**

Sl.no	Month	H'	D <sub>s</sub>
1	April	2.217	0.120
2	May	2.19	0.122
3	June	1.314	0.272
4	July	1.16	0.381
5	August	1.559	0.280
6	September	1.389	0.403
7	October	1.82	0.143

#### 4. CONCLUSION

In this study total 15 species of dragonflies belonging to 14 genera were identified. Maximum number of species belongs to Libellulidae family, which was represented by 15 species. Gomphidae family was represented by 1 species. Many earlier workers supported the dominance of family Libellulidae in the Indian subcontinent. Each month shows variation in number of each species. Climatic conditions affect the diversity of dragonfly, especially temperature, humidity, rainfall, etc. During the study period, rainfall occurs during the month of June, July and October. Temperature was highest during April and May. Species number is highest during the month of September and least during June. During April, May, August and September the climate was favorable for dragonfly to survive in this system, number of species increased at this time. Diversity in this ecosystem was least during June, July and October, due to the rainy season. It cause a decrease in the number of dragonfly

On the basis of diversity measures; Shannon index (H') comparing dragonfly diversity in each month and the species diversity is highest in April being 2.2 17 and lowest in July being 1. 16. Simpson's index (D) was minimum (0.120) indicating high diversity in June. (Table: 2)The most abundant species in this ecosystem are Rhyothemis variegata, Diplocodes trivialis and Trithemis aurora. Crocothemis servilia is the least species in number. From this study we can say that Rhyothemis variegata is a seasonal species. Because Rhyothemis variegata can be seen in large groups only during Onam season (Aug - Sept). In the beginning of the survey this species is found least in number (April – May). The least number of Brachythemis contaminata indicate that the water bodies around study area is not much contaminated.

This results show that the studied area provides homes for some of the dragonflies and the area is very much diverse in dragonfly. High species diversity of dragonfly in this area can be attributed to the high diversity of plants and water.

#### 5. References

- [3]Fraser, F.C. 1933. *The Fauna of British –India including Ceylon and Burma Odonata. Vol I.* Tylor and Francis Ltd.,London, 436 pp
- [4]Fraser, F.C. 1934. *The Fauna of British –India including Ceylon and Burma Odonata. Vol II.* Tylor and Francis Ltd.,London, 442 pp
- [5]Khaliq.A. and Yousaf.M. 1995. *Population and feeding capacity of dragonflies on insect peste of cotton.* Frasieria (S.A.B.O) 1 (1&2):1:3.
- [6]Kiran, C.G and Raju. D.V.(2013). *Dragonflies and Damselflies of Kerala (Keralathile Thumbikal).* Tropical Institute of Ecological Sciences. 156pp.
- [8]Norma Jean. 2002. *Dragonflies, Introduction to Dragonflies and Dasetflies.* West Virginia University Extention Service.



- [9]Ovenden . G.N, Swash A.R.H and Smallshire.D. 1998. *Agri-environment schemes and their contribution to the conservation of biodiversity in England. Journal of Applied Ecology*, 35:955-960.
- [10]Prasad.M. and Varshney.R.K. 1995. *A check list of Odonates in India including data or larval studies*. *Oriental insects* 29:385-428.
- [11]Rowe.R. 2003. *Dragonflies: Behaviour and Ecology of Odonata*. *Australian J. Entomol.* 42(2), 210-211.
- [12]Subramanian, K.A. (2005). *India –A Lifescape, Dragonflies of India- A Field Guide*. Vigyan Prasar, India Offset Press, New Delhi, 118 pp.
- [13]Subramanian.K.A. 2009. *Dragonflies of India-A field guide*. VigyanPrasar, Department of Science and Technology, Govt. of India. 168pp.
- [14]Tsuda.S. 1991. *A distributional list of world Odonata*. Osaka. 362pp.
- [15]Yasumatsu . K.T, Navavichit.S. and Tirawat. 1975. *Approaches towards an integrated control of rice pest. Part I. Survey of natural enemies of important rice pest in Thailand*. *Tech. Bull. Pl. prot. Serv., Thailand*, No.24,21 pp.
- [16]Yunus .M., Yousaf.M. and Jilani.G. 1980. *Insect and spider mite pest of cotton in Pakistan. Final Rept.P.L.480 Proj.,Deptt. Entomol. Univ.Agric.Faisalabad*.256 pp.

## **FATE AND TRANSPORT OF NUTRIENTS IN THE PADDY FIELDS OF NETRAVATI RIVER BASIN, INDIA ALONG WITH PHOSPHATE REMOVAL STUDIES**

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### **ABSTRACT**

The present work discusses the hydrochemistry of paddy fields in Netravati river basin, Karnataka, India during post-monsoon season (2017) along with phosphate removal studies. About 14 water and sediment samples collected from the study area and analysed for various physic-chemical parameters with respect to nutrient dynamics. It is observed that the pH of water and sediment vary between 4.98 to 7.82 and 4.49 to 6.66, respectively. The electrical conductivity varies in the range 46.84 to 264.30  $\mu\text{S}/\text{cm}$ , whereas, TDS, DO and alkalinity varies between 40.17-263.70 mg/L, 2.20-5.62 mg/L and 16.00-200.00 mg/L, respectively. Among the nutrients, phosphate and nitrite are showing higher values than the maximum permissible levels in some stations. The phosphate values were found to be between 0.002-1.244 mg/L and nitrite values were 0.003-2.49 mg/L. In the case of sulphate, the values were found within the permissible levels of 3.92-24.00 mg/L. The total hardness was found to be 16.00-92.00 mg/L. Overall studies indicate that most of the parameters are within the standard limit and only phosphate shows higher values. In this context, the removal of phosphate from aqueous phase is highly warranted and successively we have developed novel clay based active adsorbent material, namely, iron pillared montmorillonite, which was efficiently used for phosphate removal from paddy fields of Netravati River basin.

### **KEYWORDS**

Adsorption, phosphate, montmorillonite, river basin, Netravati

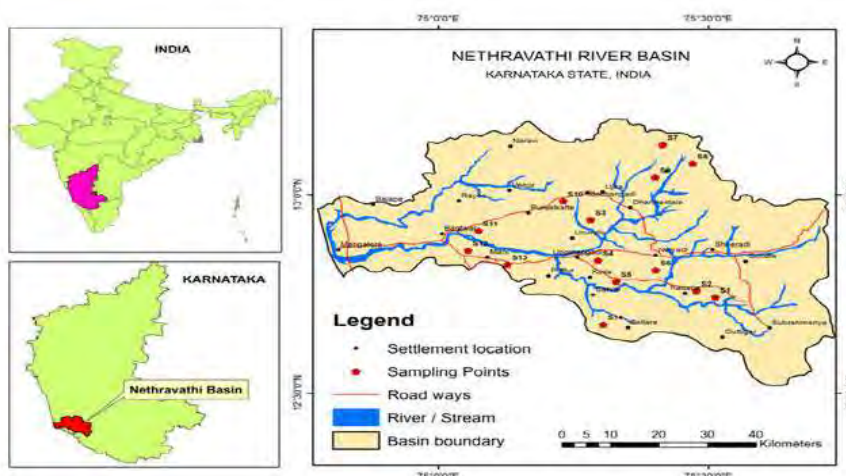
### **INTRODUCTION**

Water is one of the most important commodities, that man has exploited than any other resource for the sustenance of life. Pollution of water bodies is increasing steadily due to rapid population growth, industrial proliferations, increasing living standards and wide spheres of human activities. Some nutrients are necessary for plants to thrive in a healthy aquatic system to provide food, habitat, oxygen etc. However, an increase in amount of these nutrients in water can cause excessive plant growth and lead to serious water quality problems (Levine et al., 1989). Excess of phosphate concentration can lead to eutrophication, leading to explosive growth of algae, depletion of the photic zone, esthetic problems, and reduction of dissolved oxygen in water which terminates the abundance of aquatic plants and animals. Hence Phosphorus removal is important for the control of eutrophication and adsorption is an efficient treatment process (Divya et al., 2016, Mahadevan et al., 2018).

### **Study Area and Methodology adopted**

Karnataka is a state in the southwestern region of India. River Netravati originates from Gangamoola, near Samse in Charamadi Ghats, which is the part of Western Ghats. The fieldwork was conducted in the paddy fields of Netravati river basin and the detailed map is given in Fig. 1. About 14 water samples were collected from different paddy

fields located in the basin and various physico – chemical parameters were analysed using APHA procedure. The removal of phosphate species using iron pillared montmorillonite as adsorbent was carried out and optimized by pH studies.



*Fig.1 Study area*

## **RESULTS AND DISCUSSION**

### **Hydrochemical parameters**

The collected water samples from 14 stations shows a pH range of 4.98 -7.82. The pH below 4.8 and above 9.2 is deleterious for aquatic organisms especially for fish. Conductivity defines the water quality and it indicates the level of dissolved solids in water. Here in the collected samples, conductivity varies from 39.68-397  $\mu\text{S}/\text{cm}$ . In our study TDS values are ranged from 40.17-263.70 mg/L and DO varied between 2.2-5.62 mg/L .Station 10 has very low DO. The collected stations have alkalinity in the range 16.00-200.00 mg/L. Station 3 and 5 exhibits high alkalinity.Hardness is caused by polyvalent ions like  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ , iron, etc dissolved in water. In the present study total hardness ranges between 16.00 and 92.00. Station 14 exhibit highest value for total hardness. Domestic sewage and industrial effluents, besides biological oxidation of reduced species may add sulphate to natural water. In our study area , sulphate concentration varies from 3.92-24.00 mg/L. Nitrite content in sample ranges from 0.00388 to 2.49515 mg/L. Station 14 shows high nitrite content which may be due to overuse of fertilizers. Phosphorus is present in very low concentration in all types of natural waters. The most important anthropogenic sources of phosphate are discharge of domestic sewage, detergents and agricultural runoff. In the present investigation, phosphate content ranges from 0.002 to 1.244 mg/L. Station 13 shows high phosphate concentration which may be due to the increased application of fertilizers to enhance the crop yield. Soil erosion is a major contributor of phosphorus to streams. Phosphate determination may help to judge whether pollution is due to domestic sewage or not. Overload of silicate has influenced composition of other nutrients specially phosphate and nitrite. Enrichment of silicate reduced the nutrient concentration .

### **Effect of pH on phosphate adsorption**

In order to optimize desirable pH range, a series of batch adsorption experiments were carried out over a wide range of pH from 2.0 to 8.0 using various phosphate initial concentrations. For initial concentration of 5, 10, 15, 25,35,50 mg/L, a maximum adsorption of 2.161, 4.563, 6.72, 10.75, 21.26 mg/g, respectively was noticed at pH 3.0.

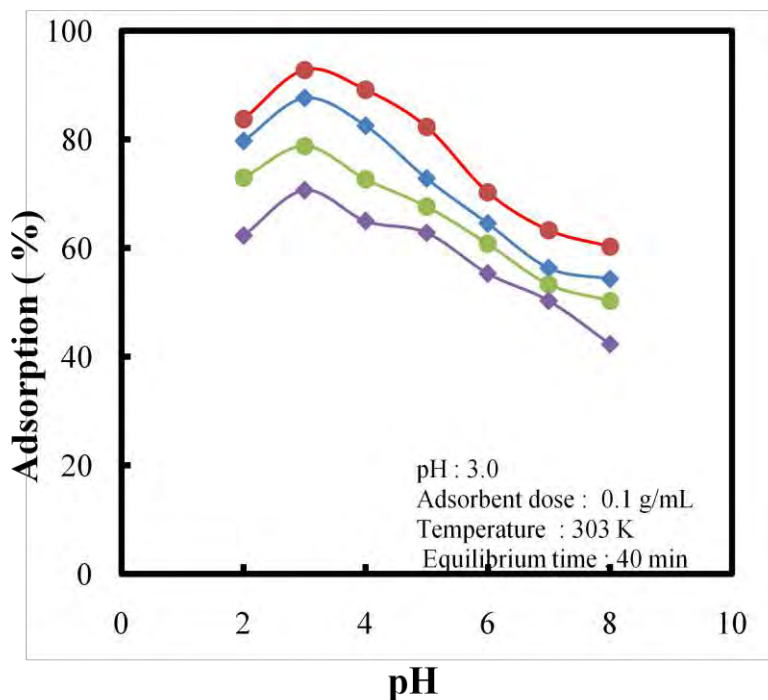


Fig. 3. Phosphate removal pattern with respect to solution pH

## CONCLUSIONS

In the present study, most of the hydrochemical characteristics were found to be within the standard limit prescribed by BIS (2012). The present study indicates two stations exhibiting high values for phosphate (1.244mg/L ,0.997 mg/L)and nitrite(2.261,2.49mg/L). Necessary initiatives, therefore should be taken against paddy field erosion, use of excessive fertilizers and pesticides to improve the overall quality of the water for sustainable management. Moreover, further research and periodic monitoring of water quality in paddy field is of importance for the improvement or maintenance of the river waters. Also the newly developed adsorbent was found to be highly efficient for phosphate removal .

## REFERANCES

Divya, S. R., Sharon, M. S. (2016). Seasonal Pattern and behaviour of water quality Parameters of Achenkovil River . *International journal of fisheries and Aquatic studies* , 4(6), 489-494

Mahadevan, H., Dev, V.V., Krishnan K.A., Abraham, A., Ershana, O.C. (2018) Optimization of retention of phosphate species onto a novel bentonite-alum adsorbent system. *Environmental Technology & Innovation*, 9, 1-15.

# SPECIES DIVERSITY AND LARVAL HABITATS OF MOSQUITOES IN THE NEARBY AREAS OF MSM COLLEGE KAYAMKULAM

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**ABSTRACT:** Mosquito-borne disease, especially Dengue Fever, Chikungunya and Japanese Encephalitis caused serious public health problems in Kerala. *Aedes* mosquitoes act as the major vector of Dengue Fever and Chikungunya in Kerala. The present study investigated the diversity, population density, seasonal prevalence, and larval habitat of mosquito species in the nearby areas of M S M College Kayamkulam for a period of one year from April 2017 to May 2018. The study carried out at the time of dengue reported cases in the area simply state the presence of important dengue and chikungunya vectors. Adult mosquitoes were collected on monthly basis using sweep net and aspirator from natural habitats such as cattle sheds, outdoor bushes, indoor and outdoor dwellings etc. Simultaneously house to house inspections were conducted for larval survey and containers were examined to determine the number and type of containers which may serve as breeding sites. The mosquito larvae collected were reared in the laboratory for the emergence of adults. Mosquitoes were identified using standard taxonomic keys. The study unveiled the presence of 5 genera and 8 species from 932 mosquitoes collected. Among the species identified, *Aedes albopictus* was represented with maximum density (33%) followed by *Armigeres subalbatus* (28%), *Mansonia uniformis* (20%), *Culex gelidus* (6%), *Culex quinquefasciatus* (5.6%), *Mansonia annulifera* (4%), *Culex tritaeniorhynchus* (1.7%) and *Anopheles subpictus* (1.3%). Maximum density were recorded during the monsoon season than the premonsoon season. In the breeding habitats, the larvae of *Ae. albopictus* were more represented compared to other species. It is obvious from the present study that discarded coconut shells and abandoned plastic containers were the better breeding grounds for the perpetuation of mosquitoes and *Ae. albopictus*, the potential vector of Dengue and Chikungunya are the most adapted species in the diverse types of habitats studied.

**Keywords-** *Aedes albopictus*, containers, larval habitats, Per man hour density, species diversity

## INTRODUCTION

Kerala state is highly vulnerable to vector-borne diseases such as Dengue Fever (DF), Chikungunya (CG) and Japanese Encephalitis (JE) because of conducive temperature throughout the year, significant annual rainfall, and presence of many sources for breeding of mosquitoes [1]. Alappuzha is one of the worst affected district, especially with arboviral diseases such as DF and CG. Since agriculture being extensive in this area, and paddy crops which receive water from Back waters and various rivers provide habitat for breeding of mosquitoes [3]. Keeping this view present study aims to understand mosquito ecology in a rural area of Alappuzha district. Kayamkulam is located in Alappuzha district where dengue cases are reporting every year. Rural area near to M S M College Kayamkulam was selected as the study area. Mosquito diversity, larval habitats and seasonal prevalence were studied for a period of one year from April 2017 to May 2018.

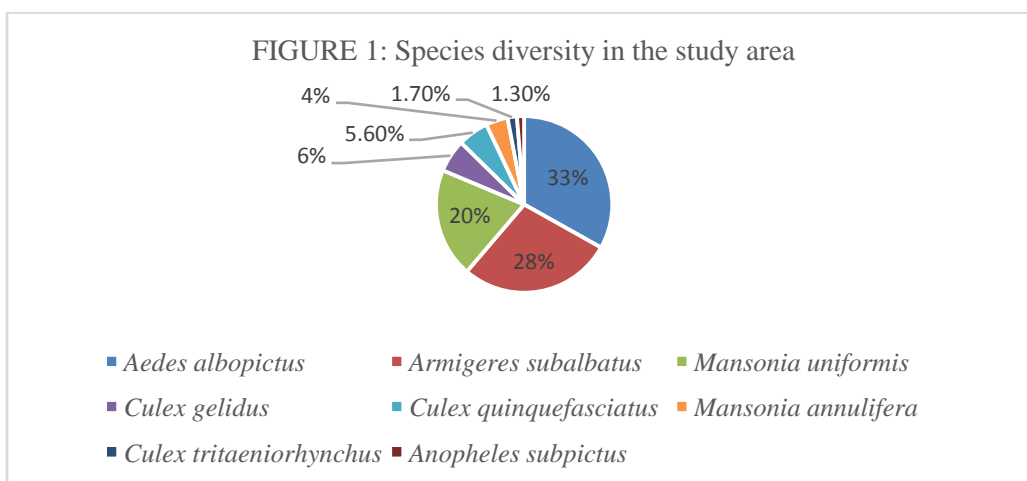
## MATERIALS AND METHODS

Fifty houses and its premises were selected by simple random selection. Adult mosquitoes were collected from in and around human dwellings and animal sheds using sweep net and aspirator on man hour basis and per man hour density (PMN) were estimated for each month. Adult specimens were identified using standard key [2]. Every month, containers inside and outside of selected houses were examined for the presence of mosquitoes larvae. Specimens of immature mosquitoes kept in plastic containers were labelled with date of collection, house identification code, and

container code before being transported to the laboratory. The larvae/ pupae collected from each locality were reared up to the emergence of adults and identified using standard key.

## RESULT AND DISCUSSION

A total of 932 mosquitoes belonging to 5 genera and 8 species were identified in this study. The species diversity in the study area were given in Figure 1. It is obvious from the present study that the genus *Aedes* was dominated over *Ae. Albopictus* with population density (33%). *Armigeressubalbatus* was the second most species (28%) considered as nonvector. *Aedes* and *Armigeres* were mostly obtained from outdoor bushes. The genus *Culex* was represented by 3 species viz *Cx. gelidus*, *Cx. quinquefasciatus* and *Cx. tritaeniorhynchus* and the genus *Mansonia* with two species, *M. uniformis* and *M. annulifera* and they were more in indoor resting collection. *An. subpictus* were obtained from cattle sheds. Out of the 8 species of mosquitoes recorded in the present study 7 were incriminated vectors of different diseases such as malaria, dengue, Japanese encephalitis and filariasis.



Per man hour density of mosquito species collected during different months of the year are given in Figure 2. Maximum density was recorded during the monsoon season (June, July) than the premonsoon season. This could be the probable reason for the high incidence of mosquito-borne disease during the wet season than the dry season. *Ae. albopictus*, the vector of Dengue and Chikungunya were widely distributed in both seasons. Intermittent rainfall during the month of April and May may be the reason for high density of *Aedes albopictus* during the premonsoon season.

From the present study it could be envisaged that 50 houses inspected and 142 containers identified serve as potential breeding sites with 23 positive containers. Discarded coconut shell (48), Plastic bucket (32), Mud pot (12) being the most common breeding site for mosquitoes and the emerged adult were identified as mostly *Ae. albopictus* followed by *Ar. subalbatus*. Larval collection of *Armigeres* were obtained from water holding containers near the cattle sheds. No other species were obtained as emergence.

## CONCLUSION

The present survey provides useful information on the species diversity and prevalence of breeding habitats of mosquito species in the nearby areas of M S M College, Kayamkulam. A total of 932 mosquitoes belonging to 5 genera and 8 species were identified in this study. Maximum density was recorded during the monsoon season than the premonsoon season and *Aedes albopictus*, the vector of dengue and chikungunya was found to be the dominant

species and was obtained throughout the year in the study area. Discarded coconut shell, Plastic bucket, Mud pot and other manmade artificial containers which can store rain water being the most common breeding site for *Aedes albopictus*. In this context, it is imperative to impart necessary and timely awareness to the public in connection with various species of mosquitoes, their habitat, behavior, pathogenicity and implementation of strategies for prevention of perpetuation beyond the permissible limit.

## **REFERENCES**

1. Balasubramanian, R. and Nikhil, T. L. (2013). Mosquito (Diptera: culicidae) fauna in Alappuzha and Kottayam district of the Kerala state, South India. *Journal of entomology and Zoology studies*, 1(6), 134-137.
2. Barraud, P.J. (1934). *The fauna of British India including Ceylon and Burma; Diptera. Volume V. Family Culicidae. Tribes Megarhinini and Culicini* London, Taylor and Francis, 463
3. John, J. T. (2006). Dengue virus diseases in Kerala. *ICMR bulletin*, 36 (4-5), 23.

# PATIO-TEMPORAL VARIATIONS IN ZOOPLANKTON COMMUNITY IN A TROPICAL RIVER IN SOUTHERN KERALA

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## ABSTRACT

Zooplankton constitutes an important component of secondary production in aquatic system and plays a vital role in the energy allocation in different trophic levels. The present work seeks to evaluate the spatio-temporal variations of zooplankton in a tropical river, Achenkovil in Southern Kerala. For this purpose 12 monthly samplings were carried out from four different stations. It was observed that Rhizopods dominated at Station I (Thura), the species with higher densities and frequencies of occurrence were *Centropyxis aculeata*, *Diacyclops* sp and *Euglypha ciliata*. Rotifers as a single group was predominant at Station II (Konni) and Station III (Pandalam), dominant species of this group constitute *Keratella valga*, *K. cochlearis*, *Filinia opoliensis*, *Polyarthra* sp.. At station IV (Payippad), copepods was the dominant group. Prevalent species were *Nauplii* larvae, *Cletocamptus* sp., *Diaptomus* sp. and *Cyclops* sp.. Comparatively reduced number of zooplankton in Achenkovil River exhibited greater perturbation with increasing development in the catchments.

**Keywords** : Achenkovil River, Rotifers, Copepods, cladocerans

## INTRODUCTION

Fresh water is perhaps most vulnerable habitat and most likely to be altered by various anthropogenic activities. The zooplankton constitutes an important component of secondary production in aquatic system and plays a vital role in the energy allocation in different trophic levels. The composition of plankton may be used as a reliable tool for biomonitoring studies to assess the water quality of aquatic bodies. The knowledge of their seasonal qualitative and quantitative fluctuations has been considered essential for proper understanding of the factors influencing biological productivity of fisheries. The zooplankton species also have high sensitivity to environmental impacts which can lead to changes in the composition and diversity of this community (Claudia *et al.*, 2016). Therefore a study was carried out to understand the diversity and seasonal variation of zooplanktons in Achenkovil River, a tropical river in southern Kerala.

## MATERIALS AND METHODS

The River Achenkovil is the ninth largest river in terms of catchment area, and sixth in terms of length among the forty one west flowing rivers of Kerala. The Achenkovil basin lies between latitudes 9° 01' 0" to 9° 18' 30" North latitudes and longitudes 76° 23' to 77° 16' East longitudes.

Monthly plankton samples were collected from the four stations (Station I- Thura, Station II- Konni, Station III- Pandalam and Station IV- Payipad) in the Achenkovil River for a period of one year. The collections were made in the early hours of the day using standard plankton net of 50 cm diameter having mesh size 64 micron. About 200 litres of water was filtered at each station, and the sample was fixed in 4% formalin. Identification of different plankton groups and species was done with the help of standard references (Battish, 1992 and Edmondson, 1959).

## RESULTS AND DISCUSSION

The zooplankton population in the present study comprised rotifers, rhizopods, cladocerans, copepods, nematode worms, insect and molluscan larvae and fish eggs (FIGURE 1). The density of zooplankton was highest during the



pre monsoon period as observed by other workers in various water bodies (Heleni *et al.*, 2000; Abdel Aziz, 2005). The summer highest densities of zooplankton in the river were characterized by small-sized individuals such as rotifers. Rotifers have great ecological relevance in aquatic environments as they filter suspended materials of different sizes (from bacteria to filamentous algae) and use different strategies to obtain food. In the present study, rotifers dominated the zooplankton groups at Stations II and III whereas at Stations I and IV it was next to rhizopods and copepods respectively. Seasonal occurrence and abundance of different species of rotifers showed that *Keratella valga*, *Monostyla bulla* and *Polyarthra sp.* occurred abundantly during the summer season.

The cladoceran population was scanty in comparison to rotifers. The main cladoceran peaks were observed during the pre monsoon (Stations I and IV) and the monsoon (Stations II and III) periods. The zooplankton groups at head water station were dominated by rhizopods. Seasonal occurrence and abundance of different species of rhizopods showed highest density during the pre monsoon period at all stations. The group was mainly represented by *Centropyxis aculeata*, *Centropyxis sp.*, *Diffugia sp.* and *Euglypha ciliata*.

Copepods dominated the zooplankton groups at Station IV. Seasonal analysis showed highest density during the pre monsoon period at all stations. The phytoplanktonic bloom and physical and chemical characteristics of water are stated to be greatly responsible for the abundance of copepod population (Patalas, 1975). The group copepoda was mainly represented by Nauplii larvae, *Cletocamptus sp.*, *Cyclops bicuspidatus*, *Cyclops sp.*, *Diatomus sp.* and *Mesocyclops sp.*

Highest numerical density of *Cletocamptus sp.* during February and March at Station IV could be attributed to the intrusion of saline waters from Kayamkulam Lake. Copepod nauplii, which represent the main prey item for fish larvae were the most abundant component of zooplankton at Station IV. The higher density of copepods at the estuarine side station may be attributed to the contribution of both freshwater and estuarine species.

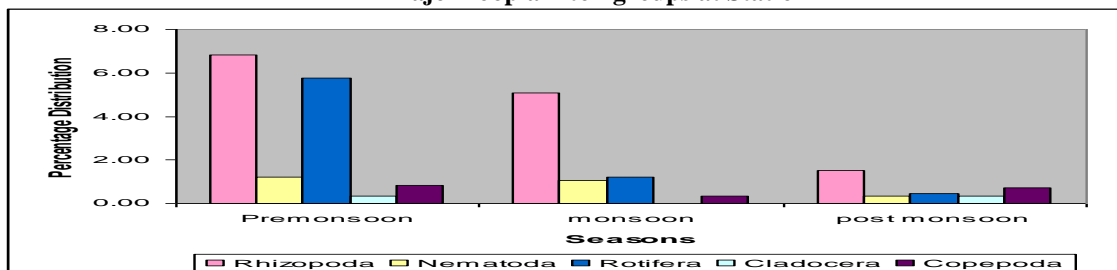
Nematods was observed at all stations among planktonic communities. They were more numerous at Station III whereas at the remaining stations their distribution was scanty. Insect larvae, molluscan larvae and fish eggs occurred only in minute quantities, especially during pre monsoon period. Highest numerical density of molluscan larvae was observed at Station III, where their adults were abundant

In summary, the reduced number of zooplankton in Achenkovil River is apparently due to a complex of environmental factors including flow, water quality, and food and predation pressure. The resulting state of dynamic balance with extremely rapid changes in species composition and abundance owes primarily to the interaction of the zooplankton with water quality, algae, higher plants, zooplanktonic predators, herbivores and planktivorous fish. It is likely that these naturally stressed communities will exhibit greater perturbation with increasing development in the catchments.

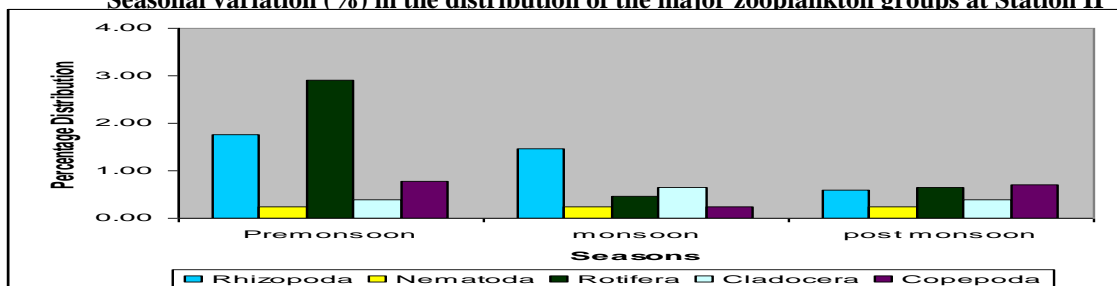
## REFERENCES

- Abdel Aziz, N.E. (2005). Short term variations of Zooplankton community in the West Naubaria Canal, Alexandria, Egypt. *Egyptian Journal of Aquatic research*, 31(1): 119-131.
- Battish, S.K. (1992). *Freshwater zooplankton of India*. Oxford and IBH Publishing Co. , New Delhi.
- Claudia Padovesi, Fonseca, and Renan de Souza Rezende1.( 2016). Factors that drive zooplankton diversity in Neo-Tropical Savannah shallow lakes. *Acta Limnologica Brasiliensia*, 29(15).
- Edmondson, W.T. (1959). *Fresh Water Biology*. John Wiley and Sons, Inc., New York
- Heleni, M.Z., Evangelia, M., Dimitra, C. B. and Spiros, M.( 2000). Zooplankton abundance in the Alidkmon River, Greece. *Belg. J. Zool.*, 130 : 29-33.
- Patalas, K. (1975). The Crustacean plankton communities of fourteen North American great Lakes. *Ver. Intern. Ver. Limnol.*, 19 : 504-511

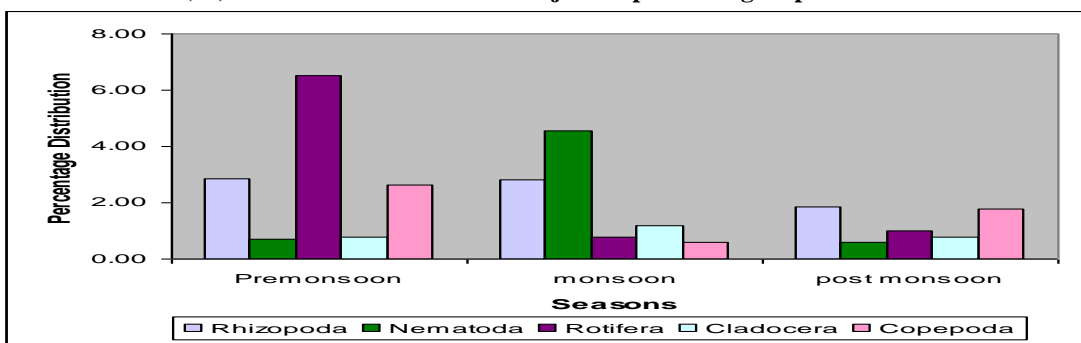
**FIGURE 1.**  
Seasonal variation (%) in the distribution of the major zooplankton groups at Station 1



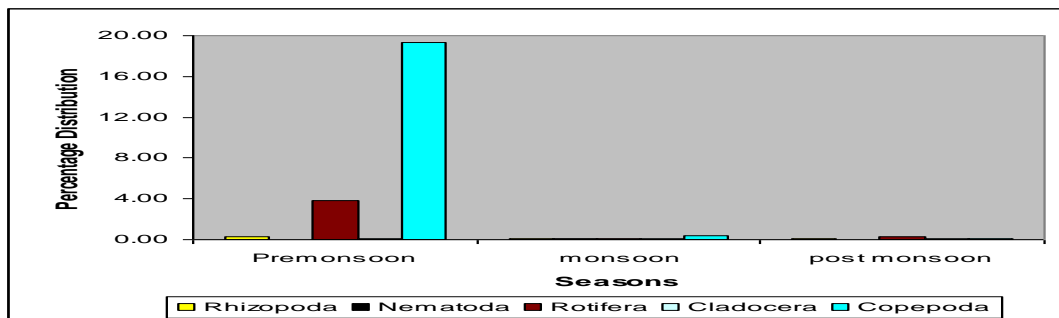
**Seasonal variation (%) in the distribution of the major zooplankton groups at Station II**



**Seasonal variation (%) in the distribution of the major zooplankton groups at Station III**



**Seasonal variation (%) in the distribution of the major zooplankton groups at Station IV**



# **HISTOPATHOLOGICAL CHANGES IN THE GILLS OF *Liza parsia* (MUGILIDAE) COLLECTED FROM KAYAMKULAM ESTUARY, KERALA WITH ERGASILID (COPEPOD) INFECTIONS**

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## **ABSTRACT**

*Liza parsia* is one of the commercially important food fish in Kerala as well as in other parts of India. Parasitic diseases in fishes lower the economic viability of fish. The present study aimed to investigate the histopathological changes in the gills of *Liza parsia* with ergasilids copepod parasites. The histology of the gill of the infected fish exhibits some alterations. The histopathology of the infected fish showed extensive damage of gill filaments, gill lamellae and gill rakers due to the pressure exerted by the ergasilid parasites. Lesions were formed on the gill filaments due to the feeding and attachment of parasites. Tissue reactions included hyperplasia and proliferation of mucus cells of gill epithelium. In addition, hypertrophy of the gill lamellae would adversely affect the respiratory function of the gill due to the reduction in respiratory surface area. Hyper infestation with ergasilids parasites would lead to the mass mortality of fishes and thereby causes production loss and subsequent economic loss.

**Key words:** *Liza parsia*, ergasilids, gill lamellae, Hyperplasia

## **INTRODUCTION**

The parasites can act as severe pathogens causing direct mortality or rendering the fish more vulnerable to predator. The effects of parasites on fish hosts include muscles degeneration, liver dysfunction, interference with nutrition, interference with respiratory system, cardiac disruption, nervous system impairment, castration or mechanical interference with spawning, weight loss and gross distortion of the body (Iyaji and Eyo, 2008). Copepod crustacean parasites receive considerable attention because they are usually conspicuous, externally on the body surface of fins or on the gill filaments, gill rakers, mouth or associated areas. Ergasilids are diversified copepods found mainly on the gills of the host fish. Several species of the genus *Ergasilus* infests mullet. They are small and barely visible to the naked eye, clinging to the gill filaments with their characteristic second antennae. Infections of external epithelia caused by a variety of parasites including monogenea and copepod are also significant, especially when large numbers are present (S.W Feist et al., 2008).

The present study aims to find out the histopathological changes induced by ergasilid copepod infections on the gills of economically important food fish *Liza parsia*.

## **MATERIALS AND METHODS**

The host fish, *Liza parsia* collected from Kayamkulam estuary during monsoon season and were transported to the laboratory for analysis. The gill tissues of the infected fish were excised, washed and fixed in 10% neutral formalin. The fixed gill arch was dehydrated in an alcohol series, cleared in xylene and embedded in paraffin wax, sectioned using microtome at 5 µm and stained with haematoxylin and eosin and observed under a light microscope (Roberts, 2001).

## **RESULTS AND DISCUSSION**

The host fish *Liza parsia* was found to be infested with ergasilids copepod. These parasitic copepods were found to be attached to the gill filament of the host fish with their claw-like secondary antennae. Histology of gill of host fish exhibits histopathological alterations. As a result of the insertions of ergasilids to the gill arches, the gill lamellae

were found to be degenerated. Extensive tissue damage has been found on the gill at the site of attachment of parasites. The destruction and degeneration of primary gill lamellae were noted.

Hyperplasia of the epithelial cells has been observed and lesions were formed on the gills as a result of the feeding and attachment of ergasilid copepod. Hypertrophy of the adjacent epithelia was found as a result of the feeding of parasites. Due to the attachment of ergasilids to the gill filaments, reduction of respiratory surface area was noticed. The reduced respiratory surface area could lead to respiratory disturbances and suffocation in fish. Hyper infestation with ergasilids copepods may lead to the mortality of host fish.

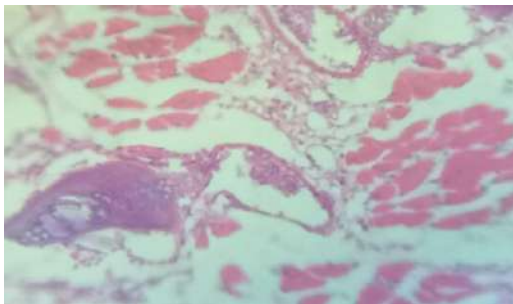


Figure 1: Gill of *Liza parsia* showing histopathological alteration of gill filaments induced by ergasilids

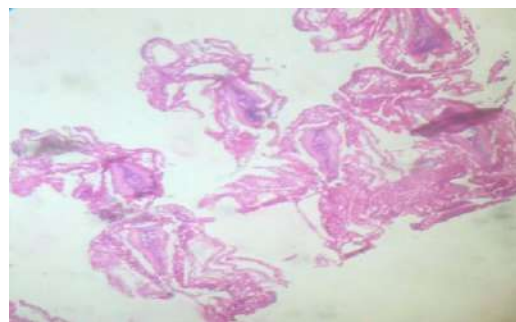


Figure 2: High destruction of gill filaments, gill lamellae, gill rakers and lesions formed by the attachment of *Ergasilus* sp.

*Ergasilus* sp attaches to the host using various appendages modified for grasping and this activity can lead to secondary infection by pathogenic organisms (e.g. bacteria, fungi, and virus) and can cause mass mortality in cultured and wild situations (Vinobaba, 2007). The severity of infection caused by the ergasilids depends on the number of ergasilids on the gills. In the present study, the histology of the gill showed histopathological alterations due to the attachment and feeding of ergasilid parasites. The gill lamellae, gill arches and gill rakers were found to be destroyed and degenerated due to the attachment of parasites with their claw-like second antenna. This report coincides with that of Rameshkumar and Samuthirapandian (2013).

## CONCLUSION

Ergasilid copepods are found infecting the gills of fishes. These copepods are found attached to the gill by their claw-like secondary antennae. The histopathological changes induced by the ergasilid species on the gill of host fish include gill damage, destruction of gill filaments and gill lamellae. Gill arches are eroded due to the attachment of the parasites. Hypertrophy of the surrounding tissue occurred and led to the reduction of respiratory surface area and consequent respiratory disturbances in the host fish. Hyperplasia of the epithelia occurred as a result of infection. Hyperinfestation with ergasilid parasites may lead to the mass mortality of fishes and reduce the market value of fishes.

## REFERENCES

- [1] Feist, SW and Longshaw, M (2008). Histopathology of fish parasite infections-importance for populations. *Journal of fish biology* .73, 2143-2160.
- [2] Iyaji FO & Eyo JE.(2008). Parasites and their freshwater fish host. *Bio-rResearch*.6(1),328-338.
- [3] Rameshkumar, G and Samuthirapandian, R.(2013). Histopathological changes in the skin and gills of some marine fishes due to parasitic isopod infestation. *Journal of Coastal Science and Medicine* .2013(1), 74-80.
- [4] Roberts RJ (2001). *Fish pathology*. Harcourt Publisher Limited. London, UK. pp. 87-93.
- [5] Vinobaba, P.(2007). Histopathological changes induced by ergasilid copepod infections on the gills of food fish from Batticalona lagoon, Sri Lanka. *Journal of Aquatic Science*.12,77-87.

## **FISH DIVERSITY OF AAYIRAMTHENGU REGION OF KAYAMKULAM BACKWATER, KERALA**

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### **ABSTRACT**

The status of fish diversity and seasonal variation in their distribution and abundance were investigated in Aayiramthengu region of Kayamkulam Backwater. In total 19 samples have been analysed which were taken throughout Feb 2016-Jan 2017. The major objective of this study was to find out the diversity of fishes in the Aayiramthengu region of Kayamkulam estuary, Kerala. From the present study 19 fish species were recorded and monthly diversity indices were calculated. The determined diversity indices are Species richness, Shannon index, Simpson's index, Margalef index, Evenness index and Dominance index. The lowest Margalef's index (1.077-2.6) was noticed in the month of May and highest in the month of August. In the case of Evenness (0.654-0.884), highest in the month of October and lowest in June. Dominance index was recorded in the range between 0.126-0.299, lowest value in March and highest value in July. From the present study higher diversity values in monsoon and post monsoon season and lower diversity values showed in premonsoon season.

Key words: Ichthyofauna, Biodiversity, IUCN, Diversity indices.

### **INTRODUCTION**

The backwaters of Kerala have a significant role in the socio-economic and cultural history of the state. Estuaries are the meeting place of fresh water from rivers and salt water from the sea and as such are dynamic environments characterized by large fluctuations in environmental conditions (James et al., 2007). Biodiversity refers to the abundance and the variety within and among fauna and flora as well as the ecosystem and ecological processes to which they belong and is thus usually considered at ecosystem, species and genetic levels. The species diversity of an ecosystem is related to the amount of living and non living organic matter present in it. Fishes are one of the important elements in the economy of many nations as they have been a staple item in the diet of many people (Kurup and Samuel, 1985). Using species assessment as a tool is one way of understanding the threats to biodiversity ecosystem and specially the impacts of changing ecosystem on human well being. However, considering the reason mentioned above present study aimed to describe fin fish assemblages structure at Kayamkulam Backwater.

### **MATERIALS AND METHODS**

Kerala lies towards the South west coast of India, Aayiramthengu is a coastal region located in Kollam District (9° 54' 41.96'' N and 76° 18' 32.36'' E) east of Kayamkulam estuary which opens to the Arabian Sea. Cast net, gill net and drag net were used for fish sampling on monthly basis. After sorting and counting, representative fish fauna were identified upto species level (Day, 1889; Talwar and Jhingaran 1991; Jayaram, 2010). Total numbers for fishes were recorded on monthly data from the Aayiramthengu region. Seasonal species abundance data used as input data for the calculation of biodiversity indices such as Dominance (D), Evenness, Shannon-Weiner (H'), Simpson's Index (S), and Margalef's ('d') indices by using PAST 3.1 software.

### **RESULTS AND DISCUSSION**

The primary aim of the present study was to find out the fish diversity of the Aayiramthengu region of the Kayamkulam Estuary. Distinct variations in distribution and abundance of fish biodiversity in the Aayiramthengu

region were observed during the present study. Abundance of fin fish was tremendously high during the monsoon season and post monsoon due to the reason of heavy rain. Total 39 fish species were encountered during the study period from the study area comprising 19 species of fin fishes belonging to 12 families, 6 orders and 16 genera (Table 1). From the present study shows that the diversity decreased from post monsoon (Oct-Jan) to the premonsoon period (Feb-May) after that increasing the diversity during the monsoon period (Jun-Sep). Distribution and abundance of fish diversity in different estuaries in Kerala has been extensively studied by Mogalekar et al. (2015); Kurup and Samuel (1987); Kurup et al. (1989); Harikrishnan et al. (2011); Bijoy Nandan et al. (2012) and Remya and Amina (2018) reported 125 fin fishes belonging to 13 orders, 87 genera and 57 families from the Kayamkulam Backwater.

Table 1. Piscine taxonomy of fishes collected from Aayiramthengu region of Kayamkulam Estuary

Sl no	Order	Family	Scientific names	IUCN Status
1	Perciformes	Ambassidae	<i>Ambassis ambassis</i>	NE
2	Perciformes	Carangidae	<i>Caranx ignobilis</i>	LC
3	Perciformes	Carangidae	<i>Caranx sexfasciatus</i>	NE
4	Clupeiformes	Clupeidae	<i>Escualosa thoracata</i>	NE
5	Elopiformes	Elopidae	<i>Elops machnata</i>	NE
6	Perciformes	Cichlidae	<i>Eetroplus maculates</i>	NE
7	Perciformes	Cichlidae	<i>Eetroplus suratensis</i>	NE
8	Perciformes	Gerreidae	<i>Gerres oyena</i>	NE
9	Perciformes	Gerreidae	<i>Gerres filamentosus</i>	NE
10	Perciformes	Gobidae	<i>Glossogobius giuris</i>	NE
11	Perciformes	Leiognathidae	<i>Gazza minuta</i>	NE
12	Perciformes	Leiognathidae	<i>Leiognathus brevisrostris</i>	NE
13	Mugiliformes	Mugilidae	<i>Liza parsia</i>	NE
14	Elopiformes	Megalopidae	<i>Megalops cyprinoides</i>	NE
15	Siluriformes	Bagridae	<i>Mystus gulio</i>	NE
16	Mugiliformes	Mugilidae	<i>Mugil cephalus</i>	NE
17	Clupeiformes	Clupeidae	<i>Nematolosa nasus</i>	NE
18	Perciformes	Cichlidae	<i>Oreochromis mossambicus</i>	NE
19	Cypriniformes	Cyprinidae	<i>Puntius filamentosus</i>	NE

NE: Not evaluated, LC: Least Concern

#### Biodiversity indices

Various diversity indices were calculated and presented in Table 2. The Shannon-Weiner index (1.45-2.229) and Simpson's index (0.7-0.87) were minimum in the month of March during the pre-monsoon season and maximum recorded in the month of July during the monsoon season. The lowest Margelef's index (1.077-2.6) was noticed in the month of May during the premonsoon season and highest in the month of August during the monsoon season. In the case of Evenness (0.654-0.884), highest in the month of October during the post monsoon and lowest in June during the monsoon season. Dominance index was recorded in the range between 0.126-0.299, lowest value in March and highest value in July. From the present study higher diversity values in monsoon and post monsoon season and lower diversity values showed in premonsoon season. In a healthy environment, due to rich faunal assemblages, the total phylogenetic diversity are always higher (Ajmal Khan, 2008).

Table 2. Diversity indices of fishes from Aayiramthengu region of Kayamkulam Estuary during Feb 2016-Jan 2017

Months	Shannon Index	Simpson's index	Margelef's index	Evenness	Dominance
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Feb	1.922	0.826	1.656	0.683	0.173
Mar	1.45	0.7	1.144	0.71	0.299
Apr	1.76	0.815	1.199	0.83	0.184
May	1.436	0.735	1.077	0.841	0.264
Jun	1.957	0.844	1.319	0.884	0.155
Jul	2.229	0.8731	2.45	0.774	0.126
Aug	2.07	0.815	2.6	0.66	0.184
Sep	1.921	0.818	1.838	0.682	0.181
Oct	1.773	0.774	1.81	0.654	0.225
Nov	1.775	0.79	1.617	0.655	0.2
Dec	1.992	0.833	2.172	0.732	0.167
Jan	1.896	0.812	1.719	0.739	0.187

## REFERENCES

Ali, A., Raghavan R and Dahanukar, N. (2011). *Puntius denisonii*. In: IUCN Red List of Threatened Species. Version 2011. 1. [www.iucnredlist.org](http://www.iucnredlist.org). Downloaded on 24th June 2011

Ajmal Khan, S. 2008. Statistical Packages for Assessing Biodiversity. Winter School on Advanced Biological Techniques For Fisheries. Professionals. 103-113.

Day, F. 1889. The Fauna of British India, Including, Ceylon and Burma, Fishes. Taylor and Francis. London. 1(2):548

Easa P.S. and Shaji C.P. (1995). Fresh water fish diversity in Kerala part of the Nilagiri biosphere reserve. Research report. Peechi. Kerala Forest Research Institute.

IUCN (2011). IUCN Red list of Threatened Species. version 2011.1. <<http://www.iucnredlist.org>> (Accessed 12.06.2012).

Jayaram K.C. (1999). The fresh water fishes of the Indian Region, Narendra Publishing house. Delhi-551.

Mogalekae H.S, Ansar C.P, Raman N.N, Jayachandran K.V, Dinesh K and Kolhe S (2015). Fish diversity of Vembanad Lake in the Panangad-Kumbalam region of Kochi, Kerala, India. Poll Res. 34(2):345-349(2015)

# PREVALENCE AND DNA BARCODING OF GASTROINTESTINAL HELMINTHES IN *Gallus domesticus* FROM KOLLAM DISTRICT, KERALA.

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## ABSTRACT

The present study deals with the prevalence and DNA barcoding of parasite helminths in gastrointestinal tract of *Gallus domesticus* from Kollam district for a period of six months from Dec 2017 to May 2018. For this study 170 indigenous chickens gastrointestinal tract were collected from various stalls of Kollam. The highest prevalence of parasitic helminths of 85% was noted in the month of December and lowest of 57% in May. Based on the DNA barcoding of the samples the parasitic phylogeny study was analysed. The nucleotide sequence data was analysed by the pair wise alignment tool Blast N, the hits were compared based on the query coverage and percentage of identity. The major helminths parasite found in chickens were *Ascaridia* spp, *Syngamus trachea* spp, *Capillaria* spp.

**Key words:** *Gallus domesticus*, Parasite helminths, Prevalence.

## INTRODUCTION

Poultry industry has involved many of the farmers to get a platform to develop their skills to use modern techniques day by day. As the meat products demands to make variety of delicious dishes and also used for exportation to many countries. The demand of poultry is much more than the expectation. Poultry farming is the process of rearing domestic birds for the production of meat and egg. In India the most people rear chickens, ducks turkey and geese.

According to the 19<sup>th</sup> All India Livestock Census 2012 the total poultry production has increased by 12.39% and total poultry 729.2 million numbers. The percentage of fowls production is that of 95% ducks of 3% and 2% of turkey and others. The poultry production of Kerala as per the 19<sup>th</sup> Live stock Census (2012) is 242.82 lakh which accounts for 3.3% of the total poultry production in the country. Kerala ranks 8<sup>th</sup> among the states in the poultry population in the country.

The poultry disease may affect the whole production of poultry. The major disease includes viral, bacterial and parasitic. Obviously the loss in the form of death of birds reduces the productivity (Ssenyonga 1982). The helminthiasis is common in the free ranging chickens then in the indoor flocks. The diseases cause severe economic losses due to the decreased production and low meat quality (Hange R.etal., 2007).

In India DNA barcoding of helminths fauna of the south west region is unexplored. The present study shows the prevalence of parasite helminths and the identification of helminths parasite to species level based on the DNA barcoding. The study shows the monthly abundance of different species of helminths in the gastrointestinal tract of *Gallus domesticus*. The prevalence of helminths was calculated as per the equation.

Prevalence = ( Number of chicken infected/ number of chicken examined ) x100

## METHODOLOGY

For this study 170 indigenous chickens intestine were collected from different stalls of Kollam district. The intestines will be dissected longitudinally and screened for the presence of helminths parasites (Fowler, 1996). Intestinal contents will also be examined by sedimentation and flotation methods as per the procedure of Bowman



and Lynn (1995). The Helminths will be stored in bottles, fixed in 70 % ethanol and then stored in 10 % formalin before identification. The worms will be identified using dichotomous keys of Yamaguti 1959 & 1961. Morphology and molecular study was performed as described by Chaudhary and Singh (2013). Direct analysis of the trachea, small intestine, large intestine shows the presence of parasites. The worms are collected in a Petri dish. For the identification the worm was transferred in to the sample tube containing 70% ethanol. Rests of the worms were preserved in 10% formalin.

## RESULT AND DISCUSSION

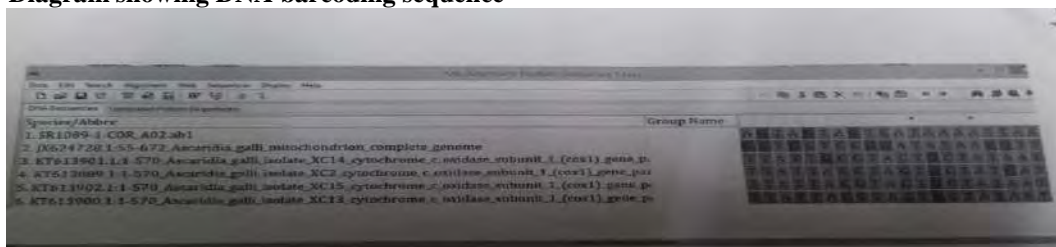
The prevalence and DNA bar coding of parasite helminths in gastrointestinal tract of *Gallus domesticus* from Kollam district during the period from December 2017 to may 2018. The highest prevalence of helminths of 85% was noted in the month December and lowest of 56% in May. (Table 1)

**Table 1: Prevalence number and the percentage of helminths in *Gallus domesticus***

Months	No of chicken examined	No of chicken infected	Abundance of parasite helminths
<b>December</b>	<b>27</b>	<b>23</b>	<b>85%</b>
<b>January</b>	<b>25</b>	<b>15</b>	<b>60%</b>
<b>February</b>	<b>22</b>	<b>15</b>	<b>68%</b>
<b>March</b>	<b>25</b>	<b>16</b>	<b>64%</b>
<b>April</b>	<b>27</b>	<b>18</b>	<b>66%</b>
<b>May</b>	<b>25</b>	<b>14</b>	<b>56%</b>

The major helminths parasite found were ascaridia species, syngamous trachea species, capillaria species. Among these species most abundant was *Ascaridia galli*. The present study focused on the sequence analysis of the parasite and phylogenetic study based on the DNA barcoding. The nucleotide sequence data were aligned and saved the session as .fas file formats and then .mas file format. The sequence were subjected to phylogenetic tree construction using Mega 6 using distance based (Neighbour joining method) and character based approaches(Maximum parsimony).The tree with evolutionary distance .001 and xc13 and xc15 are evolved from the same evolutionary period.

### Diagram showing DNA barcoding sequence



## CONCLUSION

The present study shows that the parasite ascaridia species are most commonly seen in *Gallus domesticus*. The prevalence was highest in the month of December and lowest in May. The sequence of DNA barcoding of the sample submitted for similarity search by BLAST analysis, it was clearly shown that 98% identity was shown with the nucleotide sequence of *Ascaridia gallium*, the most prevalent pathogenic species in *Gallus domesticus* Linnaeus (1758). It causes ascariidiasis therefore controlling measures of parasite helminths in chicken will be done and further studies on the parasites in chicken for controlling helminths parasite and producing quality poultry products.

## REFERENCES

- Bowman, D. D. and Lynn, R.C., (1995): *Georgis Parasitology for Veterinarians*, 6th edn. W.B.Saunderscompany, Sydney.
- Chaudhary A , Singh HS (2013) Description of two new species of the genus *Thaparocleidus* Jain, 1952 (Monogenea, Dactylogyridae) from freshwater fish in India: morphological and molecular phylogenetic evidence. *J.of Helminthology*, Vol 87, pp 160-17.
- Fowler NG, (1996). *How to Carry Out a Field Investigation*. In: Jordan F T W and Pattison M (Editors) *Poultry Diseases*, 4th edition. Saunders, London, England.
- Hange R.R, Raote Y.V, Jayraw A.K. Prevalence of helminth parasites in deshi fowl (*Gallus gallus domesticus*) at Parbhani. *J. Parasit. Dis.* 2007;31(1):61–64.
- Katoch R, Yadav A, Godara R, Khajuria J.K, Borkataki S, Sodhi S.S. Prevalence and impact of gastrointestinal helminths on body weight gain in backyard chickens in subtropical and humid zone of Jammu, India. *J. Parasit. Dis.* 2012;36(1):49–52.
- Kaufmann F, Das G, Sohnrey B, Gauly M. Helminth infection in laying hens kept in organic free range systems in Germany. *Livest. Sci.* 2011;141:182–187.
- Mishra S.C, Mohapatra G.S, Ghosh K.K. Studies on helminthic infection of deshi fowls in Orissa with institution of effective chemotherapeutic measure against *Ascaridia galli* and *Heterakis gallinae*. *Indian J. Poult. Sci.* 1972;7(12):10–13.
- Naphade S.T. A survey on prevalence of helminth infection in desi poultry birds from Marathwada region of Maharashtra. *Int. J. Res. Biosci.* 2014;3(1):13–18.
- Padhi B.C, Mishra S.C, Panda D.N. Epidemiology of helminths in deshi fowls in Orissa. *Indian. J. Poult. Sci.* 1986;22:286–288.
- Soulsby E.J.L. *Helminths, Arthropods and Protozoa of Domesticated Animals*. 7th ed. Tindall, London: The English Language Book Society and Bailliere; 1982.

## WATER QUALITY AND PUBLIC HEALTH RISK

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### ABSTRACT

Surface water and groundwater resources are the main source of water for existence. Water is available in abundance in Thiruvananthapuram, the capital city of Kerala State mainly due to a good water supply system run by the Government. However, the thickly populated areas in the city are facing water scarcity during the summer season which to some extent can be overcome by using the ground water resources available. As per data released by Govt. of India for Census 2011, Thiruvananthapuram city is an Urban Agglomeration coming under category of Million Plus UA/City. Urbanization has made Poojapura, a locality in Thiruvananthapuram city, a highly congested and densely populated area. The present study was aimed at assessing the physicochemical and bacteriological status of the tap and ground water available in this area and about the health status related to this aspect. The water samples were collected from the three selected sites during August-February in three seasons for study. Samples were analyzed for eighteen physico-chemical parameters and bacteriological status using standard procedure and compared with the limits set up by BIS. Tap water values were in the specified tolerance limits. Significant difference in value of conductivity ( $p < 0.001$ ) was seen in different seasons. Ground water samples showed significant seasonal variation in the value of pH ( $p < 0.001$ ), turbidity ( $p < 0.02$ ), conductivity ( $p < 0.004$ ), total hardness ( $p < 0.002$ ), total dissolved salts ( $p < 0.002$ ), calcium hardness ( $p < 0.0001$ ), alkalinity ( $p < 0.002$ ), BOD ( $p < 0.01$ ), COD ( $p < 0.02$ ), chloride ( $p < 0.01$ ), sulphate ( $p < 0.008$ ), sodium ( $p < 0.001$ ), potassium ( $p < 0.003$ ) and carbonate ( $p < 0.002$ ). No trace elements or heavy metals were detected in tap and ground water. Ground water showed the presence of Total coliforms with a significant seasonal variation ( $p < 0.02$ ). Fecal coliforms were not detected. **Ground water sources were not satisfying the drinking water standard.** Health survey result showed people in this area were mostly educated and were aware about the water-borne diseases. This study makes us understand that only through continuous awareness campaign programmes at all levels of the society; we can inculcate civic sense among the public about the responsibility and the need of maintaining the water quality of the fresh water, a gift of nature.

**KEY WORDS :** Urban Agglomeration, physico-chemical parameters, BIS, Conservation

### INTRODUCTION

Climate change has significant impacts on water resources around the world; in addition, expanding human population enhances the competition for water. Pollutants are a threat to this natural resource mainly due to irresponsible anthropogenic activities. Thiruvananthapuram, the capital city of Kerala State referred to by Mahatma Gandhi as the "Evergreen city of India"[5], is characterized by its undulating terrain of low coastal hills [3] with narrow winding lanes and busy commercial alleys and is an Urban Agglomeration city [4]. Urbanisation in Poojapura, a locality in Thiruvananthapuram city is seen to exceed the limits and is highly congested. An understanding of the various factors influencing water quality is very important as human health is largely dependent on the quality of water available for our use. The quality of drinking water from different sources in Thiruvananthapuram city is questionable today. The present study was aimed at assessing the physicochemical and bacteriological status of the tap and ground water available in this area and about the health status.

### METHODOLOGY

Tap and ground water samples were collected from three selected sites in the South west monsoon, North east monsoon and Post monsoon period after a field study for analyzing the eighteen physico-chemical parameters and bacteriological status using standard procedure [1]. A health survey was conducted in thirty residences by direct interview using a questionnaire to understand the existence of any health problems due to water-borne diseases and the awareness about importance of good water quality.

## RESULTS AND DISCUSSION

In Thiruvananthapuram city, clean drinking water is supplied to people through piped system by the Kerala Water Authority even though it faces a number of challenges including rampant water leakages and insufficient network to reach all the residents. Tap water samples from the sites showed the values within the specified tolerance limits. Conductivity value ranged from 48.33 to 55.67  $\mu\text{mol}/\text{cm}$  in the different seasons and was significant ( $p < 0.001$ ). Difference in the values during the different seasons could be attributed to the difference in the site of the natural water source being used for the supply. Ground water conductivity value was within the standard limits and showed significant difference ( $p < 0.004$ ). Total Hardness value were quite within the tolerance limit with a significant variation ( $p < 0.002$ ). Total dissolved salt values showed that the water samples of all the sites of the study area was fresh (TDS  $< 500$  mg/L) which is suitable for human use (**Fig.1**). pH value showed significant difference. BOD and COD value in all sites showed significant seasonal variation. The values clearly point to the poor water quality in the wells which can be due to seasonal changes as well as poor maintenance (**Fig.2**). Dissolved oxygen showed a maximum value of 5.27 mg/L. Alkalinity, carbonate and potassium were within the permissible limits and were significant (**Fig.2,4**). Chloride value was within the desirable limit and showed significant difference. Phosphate, Sulphate and Nitrite value were much below than the limit recommended by the WHO and USEPA (**Fig.3**). Ground water source was available almost everywhere in this area, but the water level was comparatively low. ***It is understood that majority of the wells in this area were not well maintained since they use the water only at times of scarcity and that too only for domestic purposes. Water quality of the ground water sources was not satisfying the prescribed drinking water quality.*** Total coliforms showed significant ( $p < 0.02$ ) seasonal variation. Fecal coliforms were not detected. It is observed that as many as 75 per cent of water systems on reserves face significant threats to the quality and safety of drinking water [2]. The study showed that the residents in this urban area in general were mostly educated and were aware about the health risk due to consumption of contaminated water and were cautious in using good quality of water, but were having an irresponsible attitude of maintaining the quality of ground water.

## CONCLUSION

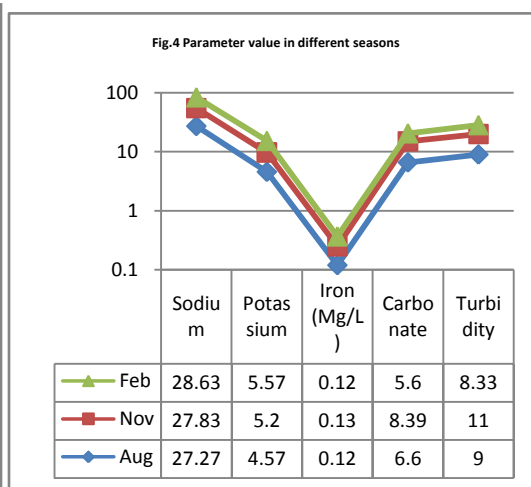
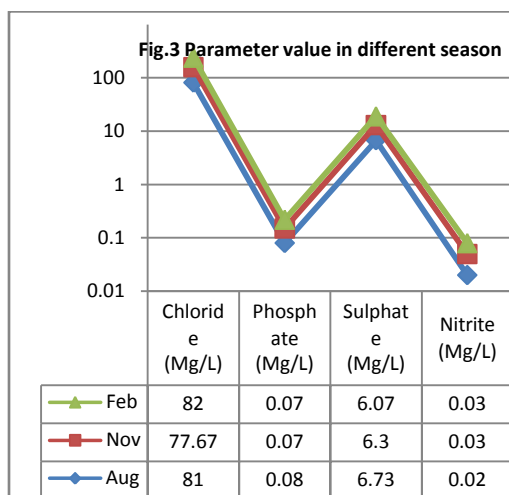
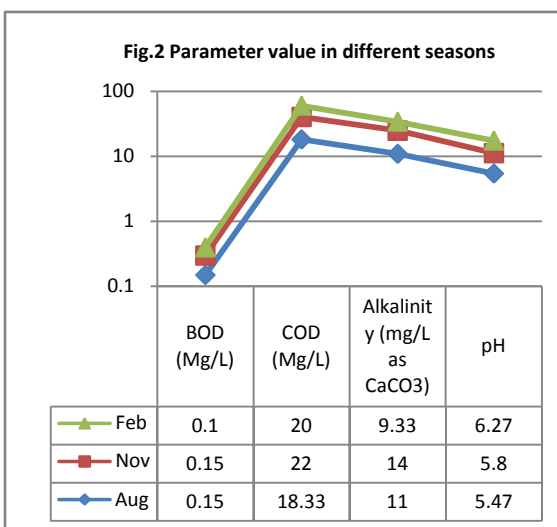
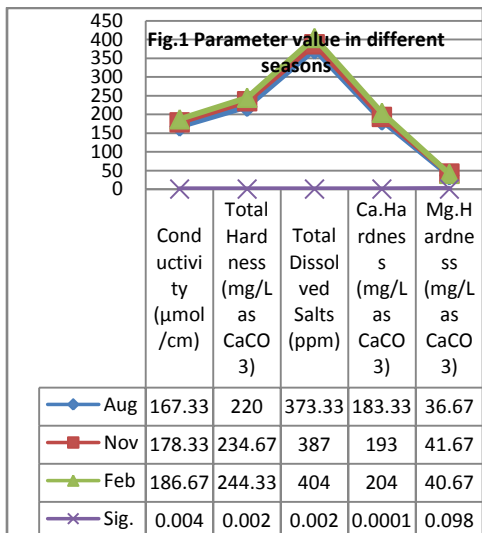
The average availability of water is reducing steadily with the growing population and it is estimated that by 2020, India will become a water-stressed nation. Urbanization causes particular stress on existing water supply system. The study clearly point to the need of regular monitoring and maintenance of the neglected wells in this area with the help of the organizations to make available this good water source to the public not only at times of scarcity but help to minimize the use of piped water for drinking purpose only. Only through continuous awareness campaign programmes at all levels of the society, we can inculcate civic sense among the people about the importance to conserve every drop of water available in the earth.

## ACKNOWLEDGEMENT

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## REFERENCE

1. APHA (2005) Standard methods for Examination of water and waste water. 21<sup>st</sup> edn Pub. (APHA, AWAA, WPCF, Washington DC, USA).
2. Commissioner of Environment and Sustainable Development (2005). "Chapter 5 – Drinking Water in First Nations Communities," in Report to the House of Commons. Ottawa: CESD.
3. Kapoor, Subodh (2002). *The Indian Encyclopedia; biographical, historical, religious, administrative, ethnological, commercial and scientific.* New Delhi: Cosmo Publications.
4. List of Urban Agglomerations of 2011 Census (2017). *Government of Kerala*, May.
5. Thiruvananthapuram India (2010). *Destination 360*, June.



## TOXIC EFFECTS OF COPPER AND ZINC ON CELL DIVISION AND CHROMOSOMAL MORPHOLOGY OF *Allium cepa*

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### ABSTRACT

The present investigation was carried out to determine the cytotoxic and genotoxic effect of heavy metals such as Cu and Zn on onion (*Allium cepa*). *A. cepa* was taken as material and tests were performed as per Fiskesjo and modification proposed by Rank and Neilson. To evaluate the genotoxic potential of the collected effluents, a chromosomal aberration assay was carried out on *A. cepa* root cells exposed at different concentrations of the heavy metals. For the study, onion bulbs were grown in ordinary tap water and its newly emerged roots (1-2 cm long) were exposed to different concentrations of heavy metals (25%, 50%, 75% and 100%) for different periods (6, 12 & 24 hours). Bulbs kept in tap water served as the control. All treatments were done under identical conditions to increase reliability of data and to minimize experimental error. The slides were temporarily sealed and examined under a compound microscope. The percentage found in different types of abnormalities, different stages of cell division, different concentrations of heavy metals and duration of treatment were recorded. Experimental data were analysed statistically using ANOVA and T-Test. Results demonstrated a good correlation between Cu and Zn bio-accumulation and its phytotoxic effect. Although mechanism of action remains to be fully elucidated, several hypotheses suggest that metals can alter the composition, rigidity and fluidity of membranes, inhibiting water and nutrient fluxes, cellular division and thus effecting normal development of its growth in roots and leaves.

**Key words:** Aberrations, *Allium cepa*, Cytotoxicity, Genotoxicity, Heavy metals, Phytotoxic.

### INTRODUCTION

Pollution is a major problem in some countries. Rapid strides in industrialization has made the problem further accentuated. Some of the cities in the world are still having incomplete sewage and therefore, discharge waste water into large lakes, rivers and canals or drains [2]. Most of the industrial water waste contains numerous inorganic as well as organic compounds [3] posing serious threat to the flora and fauna. Monitoring environmental toxicity with the aim of minimizing mutagenic agents from our environment is a prime need of our society [2]. The information on cellular damage induced by heavy metals (Cu and Zn) will certainly bring to light the numerous hazards on which this paper gives an account.

### MATERIALS AND METHODS

CuSO<sub>4</sub> and ZnSO<sub>4</sub> were accurately weighed (0.25mg, 0.5mg, 0.75mg and 1mg) out and prepared in different concentrations (25%, 50%, 75% and 100%). Root growth inhibition test, chromosomal aberration assay and Mitotic Index (MI): For this study, common onion *Allium cepa* was taken as test material and performed as per Fiskesjo [1] and modification proposed by Rank and Neilson [7]. Slides were then temporarily sealed and examined under Phase contrast microscope (Nikon Eclipse E 400) with an oil immersion objective and 100X magnification for cytological studies. The experimental data was analysed statistically using ANOVA and T-Test. Photographs of selected cytological abnormalities were taken and MI was also calculated [5]. Statistical Analysis: ANOVA (Analysis of Variance) and T-test was performed to test the significant difference between two heavy metals inducing chromosomal aberrations and whether there is significant difference between different concentrations and different durations of treatment. Least significant differences were calculated at a level of 5 %.

### RESULTS

The cytological effects of heavy metals (Cu and Zn) on somatic cells of *A. cepa* were determined based on (a) Induction of chromosomal abnormalities and (b) Mitotic Indices. All chromosomal aberrations induced at tested concentrations were statistically tested. The control materials of *A. cepa* showed normal divisions with 16 chromosomes observed at the metaphase division. The root meristems of the treated plants revealed aberrations such as vacuolated nucleus, stickiness, bridges, laggards, polyploidy, clumping, non-congression metaphase and were noticed with changing orientation of spindle *etc.*, (plate I & figs 1-5). The most important and frequently occurring abnormality observed in all treated materials was the vacuolated nucleus and chromosome stickiness at its metaphase, anaphase, and telophase stages. Clumping of various magnitudes was also frequently observed (plate II & fig 6). Chromosome bridges (produced in telophase stage were of two kinds - mono-bridges and bi-bridges) was another characteristic feature noticed at the anaphase stage of the treated material. Twenty-four hour treatments consistently showed high frequency of cells with chromosome stickiness at almost all concentrations (plate IV & figs 18, 19 & 21). Highest frequency of anaphase cells with sticky bridges were observed in 75% and 100% concentrations of treatment. In a few of the treated cells, chromosomes have been found to lag at anaphase (plate IV & fig 23). Laggards were observed to be very few in the treatment using low concentrations (25% and 50%). Highest frequency of lagging chromosomes was observed during 24 hrs of treatment with vacuolated nucleus, bridges, stickiness, micronucleus at interphase, and spindle disturbances. Of all these aberrations, chromosomes were found with spindle disturbances (plate III & figs 14 & 15) and with change in orientation of spindle (plate III, fig 14). Bridges and stickiness were found during the treatment of 50%, 75% and 100% metal concentrations with a few exceptions. Polyploidy cells and micronucleus were observed during treatment of 25% and 75% (plate III & figs 16 & 17). The percentage value of all these aberrations increased rapidly with enhancement in metal concentration and prolongation of treatment period. More vacuolated nucleus was present in all treatment durations of 6 hrs, 12 hrs and 24 hrs respectively (plate III & fig 12). Mitotic Index: Mitotic index value is an indicator of the percentage of cells under division of the total number of cells observed. In the present study, it was observed that both heavy metals have a mitoinhibitory effect on the *Allium* test system. It is also remarkable to note that heavy metal concentration and duration of treatment were complementary to each other in inhibiting the MI. When comparing the two heavy metals, it was found that Cu caused a highly significant gradual reduction in the MI value at concentrations tested at all time intervals (figs 1&2). But at the same concentrations and different durations, an unexpected gradual increase in the mitotic index value was obtained. In the case of Zn, a gradual reduction in the MI with respect to concentration and duration was seen, except in 25% where it showed gradual increase with respect to duration (figs 4&5).

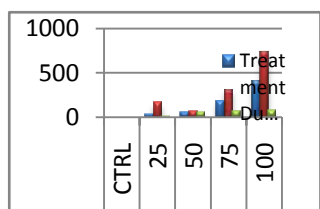


Fig 1: Aberrations induced by Cu

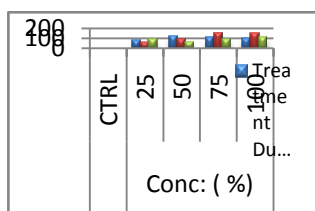


Fig 2: Aberrations induced by Zn

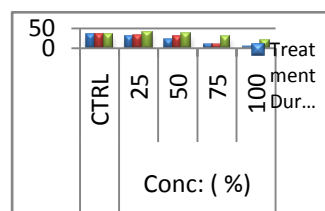


Fig 3: Mitotic Index induced by Cu

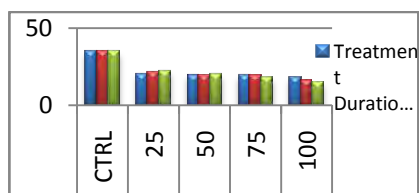


Fig 4: Mitotic Index induced by Zn

## DISCUSSION

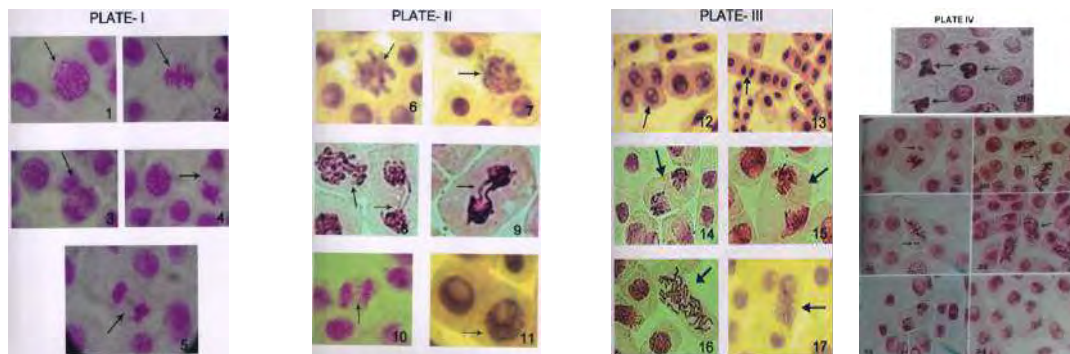
A spectrum of cytological abnormalities such as chromosome stickiness, clumping, bridges, laggards, non-congression metaphase, dissolution of chromosome matrix, polyploidy and various types of spindle abnormalities were induced, following treatment with different concentrations of the effluents. Such chromosomal irregularities can affect the vigour, fertility, yield, or competitive ability of exposed plants. They are indicators of the clastogenic effects of their inducers [8]. The suppressing and mito-inhibitory effects of heavy metals on *Allium* test system investigated during the present study agreed with findings of Shanthamurthy and Rangaswamy [7] and Kumar [3]. In treatment with Cu and Zn, high frequencies of non-specific stickiness were observed in *A. cepa*. In the present study, it was found that when higher the degree of pollution, more is the decline of mitotic index. The degree of decline is also directly proportional to the duration of treatment in case of heavy metal Cu.

## CONCLUSION

The present investigation indicates that Zn & Cu exhibited a toxic effect on the root as well as the somatic cells of *A. cepa*. This is evident in the significant micro and macroscopic, morphological, and cytological changes, representing direct or indirect risk to aquatic flora and fauna, growing in the site of release of effluents, loaded with heavy metals. Therefore, it is recommended that effluents need to be treated for removing or minimizing the effects of heavy metal concentrations. As follow up to the study, chemical analysis of genotoxic compounds also should be carried out together to understand the genotoxicity of heavy metals.

## REFERENCES

- [1] Fiskesjo, G. (1985). The *Allium* test. In: waste water monitoring, *Hereditas*, vol. **102**, no. 1, p. 99-112.
- [2] Grover, R., S.S. Marwaha and Kennedy, J.F. (1999). Studies on the use of an anaerobic baffled reactor for the continuous anaerobic digestion of pulp and paper mill black liquors. *Process Biochem.*, 34: 653-657.
- [3] Kumar A (2000) Carbonaceous sugar mill effluent retards growth and yield of *Hordeum vulgare* 1B65. *Adv Plant Sci* **13**:93- 96.
- [4] Rank, J. and Nielsen, MH. (1993). A modified *Allium* test as a tool in the screening of the genotoxicity of complex mixtures. *Hereditas*, vol. 118, no. 1, p. 49-53.
- [5] Rank, J. and Nielsen, MH (1994). Screening of toxicity and genotoxicity in wastewater using the *Allium* test. *Hereditas*, vol. 121, no. 3, p. 249-254.
- [6] Nielsen, M.H and Rank, J. (1998) Genotoxicity testing of wastewater sludge using the *Allium cepa*-anaphase- telophase chromosome aberration assays. *Mutation Res.* **418**: 113-119.
- [7] Shanthamurthy KB, Rangaswamy V. (1979). Cytological Effects of Paper Mills Effluents on Somatic Cells of *Allium cepa*. *Cytologia* **44**, 921 -926.
- [8] Somashekar, S. K., Gurudev, M. R and Ramiah, S. (1985). Somatic cell abnormalities induced by dye manufacturing industry waste water. - *Cytologia* **50**: 129-134.





# SIGNAL TRANSDUCERS AND ACTIVATORS OF TRANSCRIPTION AS A MEDIATOR OF VEGF AND MMP-2 IN BREAST CANCER

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## ABSTRACT

Worldwide, breast cancer is the most frequently diagnosed cancer in women, accounting for 23% of all cancers. In this particular study, we study the role of STAT3 in regulation of angiogenesis and metastasis in breast cancer. Elevated mRNA and protein expression for Vascular Endothelial Growth Factor (VEGF) and Matrix Metalloproteinases 2 (MMP-2) were demonstrated in breast tumor samples compared with normal breast tissues. Mann-Whitney U test showed that at mRNA level, the positive expression of VEGF and MMP-2 significantly contributed to increased lymph node metastasis in breast cancer patients. Inhibiting STAT3 with STAT3 inhibitor AG490 in breast cancer cells, we found a robust reduction in VEGF and MMP-2 as revealed by immunohistochemistry analysis. These significant findings may potentially add to discovering new bench markers for diagnosis or therapeutic targets for treating malignant breast cancer associated with aberrant STAT3 signalling.

**Keywords** – Breast cancer, lymph node metastasis, MMP-2, STAT3, VEGF

## INTRODUCTION:

In India, breast cancer is the most common cancer in women and the molecular causes for its progress and development have been extensively investigated. Though significant progress has been achieved in delineating the molecular mechanism of breast tumorigenesis, specific signal transduction pathway involved has not been fully characterized. The STAT family have been recognized as critical integrators of cytokines, hormones and growth factor receptor signalling [1]. About 20% of breast cancer is triple-negative. Therefore, targeted therapy may be a new avenue for the treatment of triple-negative breast cancers. In this particular study, we study the role of STAT3 in regulation of angiogenesis and metastasis in breast cancer using VEGF and MMP-2 markers.

## MATERIALS AND METHODS:

### Patients:

Breast tumor samples and adjacent normal breast tissues were collected from 100 breast cancer patients who were previously untreated and undergoing primary surgery for breast cancer at Regional Cancer Centre, Thiruvananthapuram, India. Of the 100 breast tumor and adjacent normal breast samples collected, 92 tumor samples and 20 normal samples were subjected to mRNA analysis while 55 tumor samples and 10 normal samples were used for protein analysis.

### Immunohistochemistry (IHC):

IHC analysis was carried out using standard procedures using primary antibodies specific for STAT3 (1:800; Cell Signaling Technology), MMP-2 (1:200, Santa Cruz Biotechnology) and VEGF (1:200, Santa Cruz Biotechnology). The percentage of positive cells was estimated from 0 to 100%. Intensity of staining was judged on an arbitrary scale of 0 to 3+.

### Reverse Transcriptase - Polymerase Chain Reaction (RT-PCR):

The mRNA expression of STAT3, MMP-2 and VEGF were observed in breast cancer tissues and in normal breast samples using RT-PCR.

#### **MTT ASSAY**

Cell proliferation or cytotoxicity were determined by 3-(4,5-dimethylthiazole-2-yl)-2,5-diphenyltetrazolium bromide (MTT) assay. Cell survival was expressed as percentage over the untreated control. The IC<sub>50</sub> dose for AG490 was determined from dose-response curve.

#### **IMMUNOCYTOCHEMISTRY**

Immunocytochemistry was performed using primary antibodies for STAT3 (1:200; Cell Signaling Technology), VEGF (1:200, Santa Cruz Biotechnology) and MMP-2 (1:200, Santa Cruz Biotechnology).

#### **STATISTICAL ANALYSIS:**

Statistical analysis was carried out using SPSS software 17.0 (SPSS Inc. Chicago, USA). To estimate the correlation between STAT3 and prognostic markers, Spearman's rho correlation test (two-tailed) was used. The positive and negative expression of angiogenic and metastatic markers were compared with the lymph node status of cancer patients using Mann-Whitney tests. All the quantitative data were represented as mean  $\pm$  SEM and the significant differences were estimated using Student's t test. The significance for all the tests was set at  $P < 0.05$ .

#### **RESULTS:**

##### **Expression of VEGF and MMP-2 at the mRNA level in breast tumor tissues and normal breast samples**

The mRNA expression levels of VEGF and MMP-2 were investigated in 92 breast tumor samples and 20 normal breast samples using RT-PCR. 59% of the tumors were positive for VEGF while only 20% of normal samples expressed VEGF. In the case of MMP-2 transcript expression, 57% of tumor samples expressed MMP-2 whereas only 25% of normal samples showed positivity for it. Elevated frequency of mRNA expression for VEGF and MMP-2 were demonstrated in tumor samples compared with normal samples.

##### **Protein level expression of VEGF and MMP-2 in breast tumor samples and normal breast tissues**

Immunohistochemical analysis of 55 breast tumor samples and 10 normal breast tissues revealed a high frequency of expression of VEGF and MMP-2 in tumor samples relative to normal samples. 85% of the tumor samples showed VEGF positivity whereas only 20% of their normal counterparts demonstrated VEGF expression. MMP-2 expression was recognized in 82% and 71% of the tumor samples respectively. Majority of the normal samples were negative for VEGF and MMP-2 protein expression.

##### **Correlation between VEGF and MMP-2 with STAT3 and activated STAT3 in normal breast tissues and breast tumor samples**

In order to understand the prognostic importance of STAT3 in breast cancer angiogenesis and metastasis, we correlated VEGF and MMP-2 with STAT3 using Spearman rank test. No significant associations were found between STAT3 and VEGF and MMP-2 in normal breast tissues at the mRNA level. In tumor samples, mRNA expression of STAT3 significantly correlated with MMP-2 while VEGF strongly associated with MMP-2. In turn, VEGF demonstrated robust associations with MMP-2 at the protein level in tumor tissues.

##### **Influence of mRNA expression of VEGF and MMP-2 on the lymph node status of breast cancer patients.**

Positive expression of VEGF at the mRNA level was found to significantly contribute to increased metastases of lymph nodes in breast cancer patients. MMP-2 mRNA positivity significantly enhanced lymph node metastasis of breast cancer patients.

#### **Effect of STAT3 inhibition on breast cancer cell angiogenesis and metastasis**

At the mRNA level, the expression of VEGF and MMP-2 were analyzed in STAT3 inhibited breast cancer cells. MCF-7 cells were treated with indicated concentrations of AG490 for 6, 12 and 24 h. VEGF expression was downregulated dramatically in MCF-7 cells treated with 200  $\mu$ M AG490 for 12 h relative to AG490 untreated cells (control). Further, a slight inhibition of VEGF was found in 24 h AG490 treated cells. MMP-2 on the other hand, did not show any discernible bands in control as well as treated groups. At the protein level, *aprofound decrease in VEGF and MMP-2 were found when MCF-7 cells were treated with 200  $\mu$ M AG490 for 12 h.*

#### **DISCUSSION:**

Well established tumors undergo neovascularization or angiogenesis. The vascular endothelial growth factor (VEGF) is a potent inducer of angiogenesis. The tumor invasion and metastasis are critical steps in determining the aggressive phenotypes of human cancers and are the major causes of cancer deaths (Yao *et al.*, 2013). MMP-2 is an endopeptidase that favour tumor invasion and metastasis by remodeling the tissues (Kim *et al.*, 2006). Statistical analysis of correlation between STAT3 and VEGF and MMP-2 revealed significant associations between STAT3 and MMP-2 at the mRNA level in tumor samples. STAT3 significantly associated with lymph node metastasis while similar association was observed in VEGF and MMP-2 expression. Our study revealed a drastic reduction of VEGF and MMP-2 protein expression in AG490 treated MCF-7 cells. This reveals the importance of STAT3 as a marker of prognosis in breast cancer.

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#### **REFERENCES:**

1. Xiong, A., Yang Z., Shen, Y., Zhou, J, Shen, Q. (2014). Transcription factor STAT3 as a novel molecular target for cancer prevention. *Cancers*, **6**(2), 826-857.
2. Yao. G., He, P., Chen, L., Hu, X., Gu, F., Ye, C. (2013) MT1-MMP in breast cancer: induction of VEGF-C correlates with metastasis and poor prognosis. *Cancer Cell International*, **13**(1), 98-106.
3. Kim, J. H., Park, C. I., Park, B. W., Lee, H. D., Jung, W. H. (2006) Expression of MT-1 MMP, MMP2, MMP9 and TIMP2 mRNAs in ductal carcinoma *in situ* and invasive ductal carcinoma of the breast. *Yonsei Medical Journal*, **47**, 333-342.

# NEW RECORD OF FREE-LIVING MARINE NEMATODE (NEMATODA: COMESOMATIDAE) FROM SOUTH WEST COAST OF INDIA

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## ABSTRACT

The present paper provides the systematics of a free living marine nematode collected from the Arabian Sea (9°39'19"N and 76°17'23"E), the northwestern extension of Tropical Indian Ocean, South West Coast of India. Seasonal samplings were designed for a period of two years from 2012-2017. Marine nematodes were collected as per standard procedures and identified using standard keys. Among the collected nematodes, Comesomatidae was the most abundant and *SabatieriaPraedatrix* (De Man, 1907) which is described in this paper happens to be the first record in the South west coast of India. This species is characterized by having an annulated cuticle with transverse rows of punctuations; amphids immediately posterior to the cephalic setae, buccal cavity cup-shaped without teeth and tail conico-cylindrical with more or less a swollen tip. In marine ecosystems the described species has prime importance as they serve as indicators of organic load.

**Key words:** *Chromadoria*, *Comesomatidae*, *Marine nematodes*, *Meiobenthos*, *SabatieriaPraedatrix*.

## INTRODUCTION

Free-living marine nematodes are the most abundant metazoans in the benthic environment. They accounts for about 60-90% of meiofauna in marine sediments [14]. The Phylum Nematoda consists of small multicellular vermiform metazoans- the nematodes or round worms. Of this, Comesomatids are among the most abundant nematodes in continental margin sediments [8].

Information of marine benthic nematodes along south west coast of India is insufficient, even though significant contribution on nematode assemblages along the Western continental shelf were carried out by several authors [16, 17, 1, 7, 14, and 12]. So the present paper aims on the systematic account of a Chromadorid nematode collected from the continental shelf of South west coast of India.

## MATERIALS AND METHOD

The present study was carried out in the Arabian Sea (9°39'19"N & 76°17'23"E) in Kerala during 2012-2017 (Figure 1). Samples were collected seasonally (pre-monsoon, monsoon and post monsoon) for the year 2012-2017.

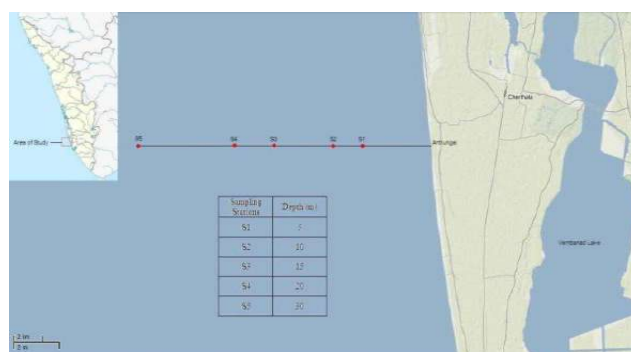


Figure 1. Study area and sampling sites

#### Analysis of Nematode fauna

Samples were collected using a Van Veen grab (0.1 m<sup>2</sup> mouth area) and subsampled using a corer of 2.5 cm diameter and 6 cm length from the grab. The collected samples were sieved using 0.5mm and 63µm sieves and the nematode fauna were fixed in 70% alcohol for identification. Microscopic slides were prepared by formalin-ethanol glycerol method [18]. Identification of nematodes was carried out using a high power compound microscope equipped with 100X oil immersion lens (Olympus CX21i) [11].

## RESULTS

Systematic Position		
Phylum	:	Nematoda [13]
Class	:	Adenophorea [10]
Order	:	Chromadoria [3]
Family	:	Comesomatidae [6]
Genus	:	<i>Sabatieria</i>
Species	:	<i>Sabatieria praedatrix</i> [4]
Synonym	:	<i>Sabatieria dubia</i> [5]
	:	<i>Sabatieria cobbi</i> [9]
	:	<i>Sabatieria rugosa</i> [15]

Occurrence: Male specimens were collected from 20m depth.

#### Description

Male: L = 1.12 mm; a = 35.4; b = 7.59; c = 10.28; Scale: 30µ

Body length is 1.12 mm. Maximum diameter is 31.5µm. Cuticle annulated and ornamented with transverse rows of dots, fewer rows of larger dots laterally which may appear longitudinally elongated. Six short and four longer cephalic setae. Buccal cavity cup-shaped without teeth. Amphids 2.5 turns 7µm wide. Tail conical in anterior two thirds cylindrical in posterior third. Spicule 17µm and arcuate, with a short central projection at the proximal end, distally pointing structure. Apophysis of Gubernaculum straight.

## REMARKS

The present material agrees well with the description of *Sabatieria praedatrix* [4] in the nature of cuticle, disposition of amphids, spicular structures and tail shape. Exception is only for the smaller body size (1.8mm in the type specimen) mainly due to geographical distribution. So they are referred as *Sabatieria praedatrix* [4]. This is the first record of the species from South west coast of India.

Habitat: Sandy and sandy silt sediments.

Distribution: South West England (Intertidal mud), Netherland, Baltic Sea, Norway, Skagerrak, Kattegatt, Baeltand, Singarayakonda and Chennai. (South east coast), Arabian Sea (South west coast)



Figure 2. *Sabatieriapraedatrix*  
(a) Entire male, (b) Male head and (c) Male tail

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## REFERENCES

1. Ansari, Z. A., Parulekar A. H. and Jagtap, T. G. (1980). Distribution of sub-littoral meiobenthos off Goa coast, India, *Hydrobiologia*, **74** (3), 209–214.
2. Chitwood, B. G. (1933). Some marine nematodes of the super family Enoploidea. *Trans. Amer. Micr. Soc.*, **55**, 208-213.
3. De Man, J. G. (1907). Sur quelques especes nouvelles ou peu connues des Nematodes libres habitant les cotes de Zelande. *Mem. Soc. Zool. France*, **20**, 33-90.
4. Ditlevsen, H. (1918). Marine free-living nematodes from the Auckland and Campbell Islands. *Vid. Medd. Danak. Naturrv. Foren.*, **73**, 1-30.
5. Filipjev, I. N. (1918). Svobodnozhivuchichjanorskija Nematodiokrestnostej Sebast-opoija. *Trav. Lab. Zool. and Stat. Boil. Sebastopol. Acad. Sci. ussr.* **2**(4), 1-350.
6. Harkantra, S.N., Nair, A., Ansari, Z.A. and Parulekar, A.H. (1980). Benthos of the shelf region along the west coast of India, *Indian J. Mar. Sci.*, **9**, 106–110.
7. Jensen, P. (1978). Revision of Microaimidae, erection of Molgolaimidae fam. n., and remarks on the systematic position of *Paramicroaimus* (Nematoda, Desmodorida). *Zool. Scr.*, **7**, 159-173.
8. Kreis, H. (1929). Freilebende marine Nematoden von der Nordwestkuste Frankreichs (Treburden cotes du Nord). *Capita Zool*, **2** (7), 1-98.
9. Linstow, V. (1905). Die Nematoden. *Fauna arctica, Jena*.
10. Platt, H. M., Warwick, R. M. (1988). *Free living marine nematodes, Part II, British Chromodorids, Pictorial key to world genera and notes for the identification of British species, in: Synopses of the British Fauna (New series)*, volume **38**, edited by D.M. Kermack & R.S.K. Barnes, (Brill/ Backhuys, Leiden), 502.
11. Priyalakshmi, G. (2008). Studies on the taxonomy of Interstitial fauna of some prominent beaches of Kerala, Ph.D Thesis, Cochin University of Science and Technology, 1-284.
12. Rudolphi, K. A. (2012). Enterozoorumsivevermiumintestinaliumhistorianaturalis. Wikipedia.
13. Sajjan, S., Joydas, T. V. and Damodaran, R. (2010). Meiofauna of the Western Continental Shelf of India, Arabian sea, *Estuarine Coastal and Shelf Science*, **86**, 665-674.
14. Stekhoven, J. H. (1935). Additional notes to my monographs on the free-living marine Nemas of the Belgian coast I. and II. *Mem. Mus. r. Hist. nat. Belg.*, **72**, 1-36.
15. Timm, R. W. (1961). The marine nematodes of the Bay of Bengal. *Proc. Pakist. Acad. Sci.*, **1**, 1-88.
16. Timm, R. W. (1967a). New marine nematodes of the family Linhomoeidae from East Pakistan, *Proc. Pakist. Acad. Sci.* **4**, 15-22.
17. Vincx, M. (1996). Meiofauna in marine and brackish water sediments, in: *Methods for Examination of Organismal Diversity in Soils and Sediments*, edited by Hall, G.S., (CAB International) 187–195.

# CARBON SEQUESTRATION BY MARINE NEMATODES IN THE BOTTOM SEDIMENTS OF ARABIAN SEA, THE NORTH-WESTERN EXTENSION OF TROPICAL INDIAN OCEAN ALONG THE WEST COAST OF INDIA

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## ABSTRACT

Marine environments as carbon sinks play a major role in maintaining a balanced global carbon cycle. The amount of carbon in coastal environments and the amount that is sequestered in sediments vary spatially and temporally. Marine organisms especially nematodes are important both in cycling carbon and for redistributing it vertically in the water column and laterally across ocean basins. The present paper highlights the importance of marine nematodes in the sequestration of carbon in Arabian Sea, the north-western extension of the Tropical Indian Ocean, Kerala, India during the year 2013-2014. Five stations (I, II, III, IV and V) representing depths of 5m, 10m, 15m, 20m and 30m respectively from the shoreline along one transect were selected for seasonal sampling. The field surveys were carried out as part of a major research project funded by Kerala State Council for Science, Technology and Environment (KSCSTE), Govt. of Kerala. Meiobenthic nematodes were collected and identified using standard keys and carbon sequestration was calculated as per standard methods. The carbon content of nematode assemblages belonging to twelve families revealed that, organic load indicators of the family Comesomatidae had high percentage of carbon content - of 8.59  $\mu\text{g}$ - at station V during post monsoon, whereas 2.87  $\mu\text{g}$  at station I during monsoon. The family Axonolaimidae recorded maximum carbon content of 3.08  $\mu\text{g}$  at station I during pre monsoon. Considering the total carbon sequestered by the nematodes along the coast, highest contribution of 11.04  $\mu\text{g}$  was recorded at station II and lowest contribution of 0.28  $\mu\text{g}$  was indicated at station III. Meiobenthic nematodes which act as biological pumps assimilate detrital carbon and subsequently mineralize organic carbon to carbon dioxide. So by protecting coastal ecosystems as well as its bio resources, we can safeguard the critical benefits these systems provide to maintain human wellbeing, global biodiversity, and climate mitigation.

**Key words:** Arabian Sea, Carbon sequestration, Climate change, Marine systems, Meiobenthic nematodes.

## INTRODUCTION

Oceans contain approximately 90% of the global carbon budget and present greatest opportunities for the storage of anthropogenically derived carbon dioxide. Being the largest carbon pool on Earth, they play an important role in regulating global climate changes [7]. As carbon sequestration is the long-term storage of carbon, relationship between increased levels of carbon dioxide in the atmosphere and rising global temperatures, attracts the attention of researchers and policy makers. The biological response to increasing temperature, ocean stratification, nutrient availability and ocean acidification, is frequently taxa- and ecosystem-specific and the results of synergistic effects are challenging to predict. The sequestration flux depends upon the factors such as input rates of nutrients allochthonous to the ocean, the export flux at the base of the euphotic zone, the deviation of carbon fixation and remineralization and the flux attenuation in the upper 1000 m [5]. The present paper focuses on the amount of carbon content sequestered by nematodes in the Arabian sea.

## MATERIALS AND METHOD

The present study was conducted seasonally (pre-monsoon, monsoon and post monsoon) in Arabian Sea ( $9^{\circ}39'19''\text{N}$  &  $76^{\circ}17'23''\text{E}$ ), Kerala, India during 2013-2014 (Figure 1). Samples were collected using a Van Veengrab (0.1 m<sup>2</sup> mouth area) and subsampled using a corer of 2.5 cm diameter and 6 cm length. The collected samples were sieved using 0.5mm and 63µm sieves and the nematode fauna were fixed in 70% alcohol for identification using standard keys and carbon sequestration was assessed [3].



Figure 1. Study area and Sampling stations

## RESULTS AND DISCUSSIONS

The faunal composition consisted of twelve families of nematodes viz., Oxystominidae, Oncholaimidae, Comesomatidae, Selachinematidae, Desmodoridae, Microlaimidae, Chromadoridae, Ceramonematidae, Desmoscolecidae, Sphaerolaimidae, Linhomoeidae and Axonolaimidae (Table 1, Figures 2-4). Nematodes are involved in biological carbon pump and they probably play a significant role in regulating the direction and magnitude of detrital carbon flow [1]. Of the twelve families, Comesomatidae contributed to high percentage of carbon content - of 8.59 µg - at station V during post monsoon and 2.87 µg at station I during monsoon. The family Comesomatidae is characterized by the presence of many organic load indicators. The Axonolaimidae family recorded maximum carbon content of 3.08 µg at station I during pre monsoon. Changes in community composition should profoundly affect the efficiency of the biological pump which induces regional differences in the accumulation and preservation of organic carbon in the sediments [6]. Biological pump (BP) and microbial carbon pump (MCP) are the two most important biologically driven carbon sequestration mechanisms known to date [4]. As a community grazer, nematodes feed on bacteria, affecting microbial carbon pump too. Considering the total carbon sequestered by the nematodes along the coast, highest contribution of 11.04 µg was recorded at station II and lowest contribution of 0.28 µg was indicated at station III. It is estimated that, each year roughly 0.16 Pg C are actually preserved in marine sediments [2].

Table 1. Occurrence and distribution of nematode families at five different stations



Family	Station I	Station II	Station III	Station IV	Station V
Oxy stominidae	+	+	+	+	+
Oncholaimidae	+	+	+	+	+
Comesomatidae	+	+	+	+	+
Selachinematidae	+	-	-	+	-
Desmodoridae	+	+	+	+	+
Microlaimidae	+	+	+	+	+
Chromadoridae	+	+	+	+	+
Ceramone matidae	+	+	-	+	+
Desmoscolecidae	+	+	-	+	+
Sphaerolaimidae	-	+	-	-	-
Linhomoeidae	+	+	+	+	+
Axonolaimidae	+	+	-	+	+

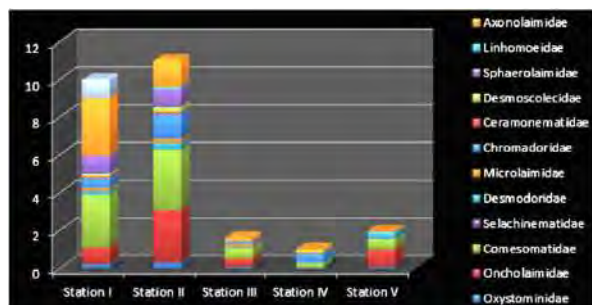


Figure 2. Seasonal average variations in the carbon content of nematode families during pre monsoon.

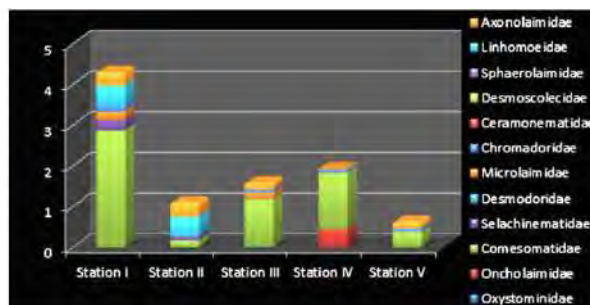


Figure 3. Seasonal average variations in the carbon content of nematode families during monsoon.

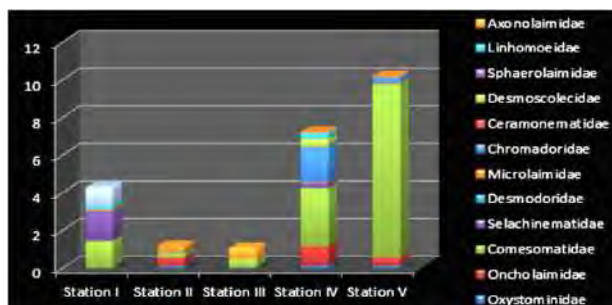


Figure 4. Seasonal average variations in the carbon content of nematode families during post monsoon.

## CONCLUSION

The present study supports the fact that nematodes play a crucial role in carbon sequestration in marine environments. High carbon sequestration capacity and storage rates of marine sediments strongly suggest that

conservation of these key coastal/ marine systems may be a very cost-effective tool in mitigating climate change, potentially one of the very few low cost options for removing carbon dioxide already present in the atmosphere. So regular bio-monitoring is recommended.

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## **REFERENCES**

1. Findlay, S. and Tenore, R. K. (1982). Effect of a Free-Living Marine Nematode (*Diplolaimellachitwoodi*) on Detrital Carbon Mineralization, *Marine Ecology - Progress Series*, **8**, 161-166.
2. Hedges, J. I. and Keil, R. G. (1995). Sedimentary organic matter preservation: an assessment and speculative synthesis. *Mar. Chem.* **49**, 81–115.
3. Jensen, P. (1984). Measuring carbon content in nematodes. *Helgolander Meeresunters*, **38**, 83-86.
4. Jiao, N., Herndl, G.J., Hansell, D.A., Benner, R., Kattner, G., Wilhelm, S.W., Kirchman, D.L., Weinbauer, M.G., Luo, T., Chen, F. and Azam, F. (2010). Microbial production of recalcitrant dissolved organic matter: long-term carbon storage in the global ocean. *Nat Rev Microbiol*, **8**, 593–599.
5. Passow, U. and Carlson A.C. (2012). The biological pump in a high carbon dioxide world, *Marine Ecology Progress Series*, **470**, 249–271.
6. Rocha, C. L. (2003). *The Biological Pump*, Treatise on Geochemistry, University of Cambridge, 6, 83–111
7. Zhang, Y.Y., Zhang, J., Liang, Y., Mei, L., H., Gang, L., Xiao, C., Peng, Z., Zeng, J., Hui, Z. D., Yong, L.X., and Hua, L.J. (2017). Carbon sequestration processes and mechanisms in coastal mariculture environments in China, *Science China*, **60**(12), 2097–2107

# PLANT-EXTRACT-ASSISTED GREEN SYNTHESIS OF GOLD NANOPARTICLES USING *CURCUMA LONGA* EXTRACT

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**ABSTRACT:** This article reports the environmentally benign synthesis of gold nanoparticles (GNPs) using aqueous extract of *Curcuma longa* as the stabilizing and reducing agent. The effect of the phytochemicals present in *C. longa*, including saponins, phenolic compounds, phytosterols, and quinones, on formation of stable gold nanoparticles was investigated by Fourier-transform infrared spectroscopy. The characteristics of the nanoparticles formed suggest application of gold nanoparticles as chemical sensors in the future. Given the simple and eco-friendly approach for synthesis, these nanoparticles could easily be commercialized for large-scale production.

**Keywords:** green synthesis, phytochemicals, nanoparticles.

## INTRODUCTION

In recent years, the development of efficient green chemistry methods for synthesis of metal nanoparticles has become a major area of research in materials science. Because they show unique properties, different from those of bulk metals due to their unique size and shape dependent characteristics. (Hubenthal,2010). Many processes are followed for the synthesis of nanoparticles(Yu, 2007). The physical and chemical methods are not usually eco-friendly and have several drawbacks such as high cost, use of toxic chemicals, involvement of expensive instrument, requirement of high energy, pressure, etc. As a consequence, biologically mediated synthesis processes of nanoparticles are gaining importance since these involve single step and simple and nontoxic, biocompatible and eco-friendly (Nune, *etal*; 2009 )

In our approach to green synthesis, we selected turmeric rhizomes to produce gold nanoparticles. The plant *Curcuma longa* L. (Belong to Zingiberaceae family.) This rhizome has been used for many medical applications ((Khanna, 1999) and also used as an anti-oxidant and anti-microbial...

In this paper we focus on the green synthesis of GNPs using aqueous extract of *Curcuma longa*, which is known to contain curcumin. The growth of GNPs was confirmed by colour transformation. The GNPs have also been characterized using ultra-violet (UV)–visible spectrophotometer and Fourier-transform infrared spectroscopy (FTIR). The size and shape of the nanoparticles have been analyzed using Transmission electron microscopy.

## MATERIALS & METHODS

### Preparation of *Curcuma longa* aqueous extract

The rhizome, of *Curcuma longa* was washed thoroughly with tap water to remove debris. About 1 g of *C. longa* was mixed with 10 mL of distilled water and crushed in a mortar pestle. The aqueous extract of *C. longa* was filtered with Whatman No. 4 filter paper. The filtered extract was centrifuged at 1000 r/min for 10 min. The supernatant was collected and was kept at room temperature.

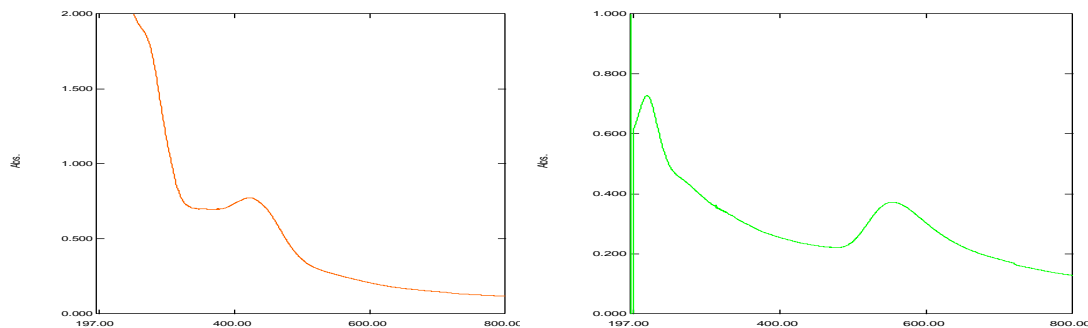
**Green synthesis of GNPs:**Preparation of gold nanoparticle was done according to the method described by Sree lekshmi *et al*; 2013 with slight modifications. Biogenic gold nanoparticle was synthesized using Tetra Chloro auric acid solution ( $\text{HAuCl}_4 \cdot 3\text{H}_2\text{O}$ ) and *C. longa* extract. In a conical flask, 10 ml of *C. longa* extract was added to 10  $\mu\text{l}$  of aqueous solution of 0.3M Chloroauric acid solution ( $\text{HAuCl}_4 \cdot 3\text{H}_2\text{O}$ ) at room temperature under static conditions. The reduction of Au NPs was clearly observed within the next 5-30 min. The solution has been modified from pale yellow to pink colour, which indicates the formation of biogenic (Au/*C. longa*) NPs.

**Characterization of Au- NPs.** The reduction of Au-NPs was confirmed by using UV-vis spectroscopy in the range of 500 to 600nm (Shimadzu, UV-1601 UV-VIS Spectrometer). Transmission electron microscopy (TECNAI, G2 F20) was used to investigate the size and morphology of the Au-NPs using SC1000 Orius CCD camera. The stability of Au-NPs was measured using Particulate Systems Nano- Plus Zeta/Nano Particle Analyser, Japan. The bioreduction compounds that are responsible for the reaction were determined using Fourier Transform Infrared spectroscopy. The spectrum was obtained by Thermo Scientific Nicolet 6700 system with 16 scans per sample at the range of 550– 4000  $\text{cm}^{-1}$

## RESULT &DISCUSSION

### UV-vis Analysis of GNPs

By using CL extract, we fabricated GNPs at room temperature, and the formations of GNPs were observed by visual color change and conformed by UV-visible spectroscopy. The absorption spectrum of the C.L aqueous extract has shown in Fig. 1(a) exhibits a characteristic band at 410nm. The disappearance of the UV-Vis absorption band at 410 nm and appearance of a new band at 540 nm could be attributed to the formation of AuNPs. The UV-Vis time scan of the prepared solution of AuNPs at the room temperature shown in Fig. 1(b). The disappearance of the band at 410nm indicated that the precursor metal ions (chloroauric acid) are reduced to small metal ions. (Mahitha, *etal*; 2013).



**Figure 1: UV-vis absorbance bands for (a) *Curcuma longa* extract and (b) Au-NPs forms using *Curcuma longa* extract**

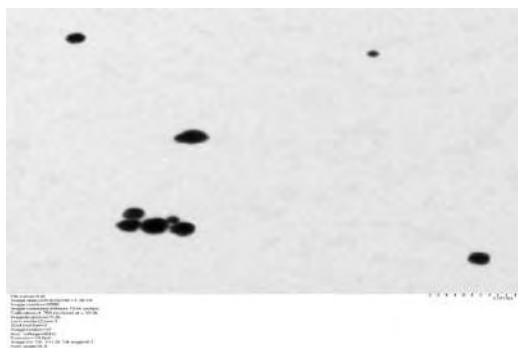
### Fourier transform infra red spectroscopy

FTIR measurements were used to investigate reduction, stabilizing and capping of gold nanoparticles. The FTIR spectrum of extract of C.L observed peaks at 3290.93, 2923.56, 2853.17, 2364.3, 2354.66, 2327.66, 1719.23, 1457.92, 1018.23 and 666.285. The band 3290.93 was ascribed to  $-\text{NH}_2$  group and it was shifted to 3355.53 in gold nanoparticles. The bands 2923.56 and 2364.3 were due to the presence of aromatic C-H stretch and it shifted to 2924.52 and 2361.41 in gold nanoparticles. Another C-H stretch band 2853.17 was not shifted in gold nanoparticles. The bands 2354.66 and 1719.23 were due to C-O bond and it was shifted to 2326.7 and 1382.71 and led to the formation of the N-O stretching. The gold nanoparticles band 1039.44 was responsible for C-O-C stretching. The C.L extract band 666.285 was shifted to 667.25 and it was responsible for C-H stretch.

### TEM Analysis

The morphology and size of the synthesized AuNPs were investigated by TEM analysis.. Figure 3a represents the particles resulting from the reduction of HAuCl<sub>4</sub> with turmeric extract. It has been shown that the particles are lying in reasonably good dispersion. It is clearly observed that all the AuNPs could be distinguished clearly from other NPs without any aggregation. The Au-NPs formed was well dispersed with spherical structures and a bi-medial distribution between two main populations of nanoparticles near 15 and 25 nm.

**Figure 3: (a) TEM image of biosynthesized nanoparticles**



#### **Zeta potential study**

The stability of Au-NPs was performed using zeta potential. A zeta potential was used to determine the surface potential of synthesized AuNPs solutions and their stability. The zeta potential was measured as an insinuation of potential stability of colloid. It should be noted that the particles with zeta potential values more positive than +30 mV or more negative than -30 mV are considered to be stable. The zeta potential results of Au-NPs formed using the extract is -20.82mV .High absolute zeta potential value indicates a high electric charge on the surface of the NPs. It describes strong repellent forces among the particles, preventing aggregation and stabilizing NPs in the buffer solution.

#### **CONCLUSION**

*Curcuma longa* plant rhizome was successfully used for the biosynthesis of gold nanoparticles in this article we have presented a new method.. The study results support the environmental friendliness and promising potential of nanoparticle tailoring by bio-inspired or biological route. In future, it would be significant to select such plant extract to understand the clear mechanism of biosynthesis and to technologically to engineer the nanoparticles in order to achieve the better control over size and shape and absolute dispersivity to utilize the potential activity of herbal plants in nanoscience for biomedical applications.

#### **Acknowledgements**

Ms .Dhanyaraj .D expresses heartfelt gratitude to Kerala University for funding this project successfully.

#### **REFERENCES**

- Abhijith, K.,S, Thakur, M.,S. (2012).Application of green synthesis of gold nanoparticle for sensitive detection of aflaxiin B1 based on metal enhanced fluorescence.Analytical metods ,4(12):4250-4256
- Hubenthal, F. (2010). Nobel metal nanoparticles: synthesis and optical properties. In: Andrews D L, Scholes G D, Wiederrecht G P, eds. Comprehensive Nanoscience and Technology. Boston: Elsevier, 375-433.

Mahitha, B.,D,Raju, T., Madhavi, C.,H, Mahalakshmi, N.,J, Sushma (2013).Evaluation of antibacterial efficacy of phyto fabricated gold nanoparticles using *Bacopa monniera* plant extract. *Indian Journal of Advances in Chemical Science*, 1(2): 94-98.

Nune, S., K, Chanda ,N, Shukla, R. (2009).Green nanotechnology from tea: phytochemicals in tea as building blocks for production of biocompatible gold nanoparticles. *Journal of Materials Chemistry*, 19 (19): 2912–292.

Shankar, S .,S, Rai, A, Ahmad ,A.(2004).Rapid synthesis of Au, Ag, and bimetallic Au core–Ag shell nanoparticles using Neem (*Azadirachta indica*) leaf broth. *Journal of Colloid and Interface Science*, 275(2): 496–502I.

Sreelakshmi, C.,H, Nidhi Goel, Datta K., K, Anthony Addlagatta,Ramesh Ummanni, B., V.(2013). Green Synthesis of Curcumin Capped GoldNanoparticles and Evaluation of Their Cytotoxicity. *Nanoscience andNanotechnology Letters* ,Vol. 5: 1–8.

Yu DG (2007). Formation of colloidal silver nanoparticles stabilized by Na<sup>+</sup>poly( $\gamma$ -glutamic acid)-silver nitrate complex via chemical reduction process. *Colloids and Surfaces B: Biointerfaces*, 59 (2): 171–178.

# DETERMINATION OF LETHAL CONCENTRATION (LC 50) OF CHANNA STRIATA

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## ABSTRACT

The present study was conducted to evaluate the acute toxicity of *Channa striata* by static bioassays. *Channa striata* is a native fresh water carnivorous air breathing fish species. The average length and weight of fish used in the present investigation were 18-20 cm and 40-45g, respectively. The fishes were fed daily with minced fish and chicken liver. Only healthy and active animals of more or less similar size were randomly selected for the experiment. The physico-chemical parameters such as pH, Temperature, Dissolved Oxygen of test water were measured daily. The ten fishes were exposed to lead chloride with different concentrations of 40, 60, 80, 90 and 100 mg/L. All the exposed fishes were daily observed and dead fishes were removed immediately. The mortality was recorded on daily basis. The LC<sub>50</sub> value at 96 hr was found to be 89.77 ppm to *C. striata*. The data obtained were statistically evaluated by using Finney's probit analysis method. It was found that there was positive relationship between the mortality and concentration level.

**Key Words:** *Channa striata*, LC<sub>50</sub>, Mortality, PH, Temperature.

## INTRODUCTION

Pollution of the biosphere with heavy metals has become a serious anxiety in the developing world. The discharge of these metals in the environment has significantly increased as a result of anthropogenic activities mainly linked to burning of fossil fuels, mining and smelting of metalliferous ores, municipal wastes, fertilizers, pesticides, and urban sewage. Mining is by far the major contributor to metal pollution. Mine drainage water, effluent from the tailing ponds and drainage water from soil loads continue to extrude unwanted metals into the aquatic environment [5]. The heavy metals are poisonous due to their bioaccumulation. Metals also become increasingly concentrated at higher trophic levels, possibly due to food-chain magnification [9].

Acute toxicity caused by different toxicant on freshwater fish can be evaluated by quantitative parameters like survival and mortality of test animals and sensitivity of fish species against metal's toxicity. *Channa striata* is commonly called chevron snakehead, striped murrel or striated murrel is one of the most economically important species inhabiting fresh water as well as brackish water [2]. It is also a well-known food fish widely used for medicinal and pharmaceutical purpose. The main objective of the present study was to determine the LC<sub>50</sub> of freshwater murrel *Channa striata* exposed to sub-lethal concentrations of heavy metal Lead chloride over a period of 96 hours.

## MATERIALS AND METHODS

Freshwater murrel *Channa striata* (SL 18±2 cm, 43±2g) were collected from fresh water habitat and kept in large glass aquaria bearing tap water for 20 days in the laboratory for acclimatized in normal photoperiod and temperature and starved for 24 hours prior to experimentation. Fishes were fed daily with minced fish and chicken liver, and water was renewed every day. Lead chloride was used for the toxicity studies. The test solutions were prepared by using distilled water (having Dissolved Oxygen=6.0mg/l; pH=7.1 and room temperature 28±2°C). 96-hour acute toxicity test were performed by using various concentration of PbCl<sub>2</sub>.H<sub>2</sub>O (40mg/l, 60mg/l, 80mg/l and 100mg/l). The data obtained were statistically evaluated by using Finney's probit analysis method.

## RESULTS AND DISCUSSION

The evaluation of toxic impact of lead chloride on the fresh water fish *Channa striata* was selected for the toxicological study. Acute toxicity of lead chloride on *C. striata* is presented Table. 2. Median lethal concentration

of lead chloride for 24 hours is 41.967 ppm upper confidence limit is 61.43 ppm and lower confidence limit is 23.958 ppm. For 48 hour LC50 of lead chloride is 64.580 ppm, upper confidence limit is 79.194 ppm and lower confidence limit is 33.14 ppm. LC50 for 72 hours is 80.268 ppm, the upper and lower 95% confidence limits were found to be 96.330 ppm and 68.324 ppm respectively. Studies to evaluate the toxicity of lead chloride to *Channa striata* exposed for 96 h showed mortality at 89.77 ppm. Whereas upper confidence limit is 110.442 ppm and lower confidence limit is 74.432 ppm. Similar works also reported in *Channa striata* [8], *Tinca tinca* [6], *Clarias batrachus* [7], *Channa punctatus* [1].

The mortality rate increased with increase in the concentration of lead chloride (Table.1). The percent mortality after changing to probit mortality was plotted against log concentration of lead chloride using probit method [4]. In this a straight line was obtained and the LC50 value obtained from the graph was 89.77 ppm. Mortality in control group was virtually absent and found to be suitable for LC50 upper and lower confidence limits and fitted for regression equation for 96 h exposed period (Fig.1). The susceptibility of *Channa striata* to the toxic effect of lead chloride is directly proportional to the concentration and duration of the dose. If the dose increases the rate of mortality will also increase. This data clearly indicates that lead chloride is also toxic to *Channa striata*.

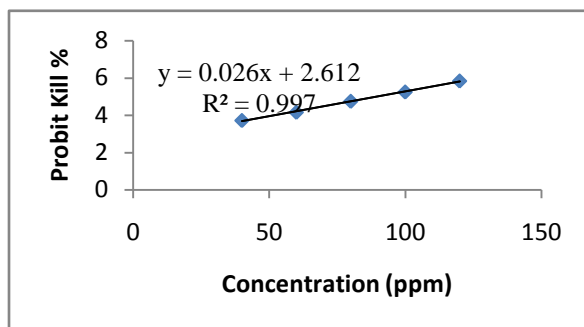
**Table 1:** LC<sub>50</sub> value of *Channa striata* exposed to different concentrations of PbCl<sub>2</sub> for 96 hours.

Hour.	Concentration of PbCl <sub>2</sub> (ppm)	Log Concentration	No. of Fishes Exposed	No. of Fishes Respond	Probit Kill %	Percent Kill %
24	40	1.60206	10	1	3.72	10
48	60	1.778151	10	2	4.16	20
72	80	1.90309	10	4	4.75	40
96	100	2	10	5	5.25	50

**Table 2:** Table showing LC<sub>50</sub> value, upper and lower confidence limits for PbCl<sub>2</sub> at different time intervals for the *Channa striata*

Parameters	24 hour	48 hour	72 hour	96 hour
LC <sub>50</sub> (ppm)	41.967 ppm	64.580 ppm	80.268 ppm	89.770 ppm
Upper confidence limit	61.43 ppm	79.194 ppm	96.330 ppm	110.442 ppm
lower confidence limit	23.958 ppm	33.14 ppm	68.324 ppm	74.432 ppm

**Fig 1:** Graph of Concentration of PbCl<sub>2</sub> vs Probit kill





## CONCLUSION

On the basis of above results and discussion, it can be concluded that the lead may had a higher assimilation and toxicity in aquatic organisms. The heavy metal discharged into aquatic environment caused chronic stress conditions that have harmful influence on aquatic life.

## ACKNOWLEDGMENT

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## REFERENCES

- Azmat, H., Javed, M. and Jabeen G. (2012) Acute toxicity of Aluminium to the fish (C. catla, L. rohita & C. mrigala). Pakistan Vet. J., 31: 30–34.
- Bloch ME. (1793). Naturgeschichte der ausländischen fische. 7, Berlin, Germany, Morino and Co. 7,1-xiv+1-44, pls. 325-360.
- Devi and Banerjee T. K (2007). Toxicopathological impact of sub-lethal concentration of lead nitrate on the aerial respiratory organs of 'murrel' *channa striata* (Bloch, pisces). Iran. J. Environ. Health. Sci. Eng., 2007, Vol. 4, No. 4, pp. 249-256.
- Finney DT. Probit Analysis, 3rd edit. Cambridge University Press. London, 1971.
- Kousar, S. and Javed, M. (2012). Evaluation of acute toxicity of copper to four fresh water fish species. Int. J. Agric. Biol., 14: 801–804.
- Lalshah and Ahmet (2003). Effect of heavy metal accumulation on the 96-hour LC50 values in *Tinca tinca*. World journal of Zoology. 78:257-259.
- Rani AMJ and Sivaraj A. (2010). Adverse effects of chromium on amino acid levels in freshwater fish *Clarias batrachus* (Linn.). Toxicological & Environmental Chemistry, 92(10): 1879-1888.
- Senthil, Murugan, S., Karuppasamy, R. Poongodi, K. and Puvaneswari S. (2008) Bioaccumulation pattern of Zinc in freshwater fish *Channa punctatus* (Bloch.) after chronic exposure. Turkish Journal of Fisheries and Aquatic Sciences., 8: 55-59
- Wyn B, Sweetman JN, Leavitt PR (2007). Historical metal concentrations in lacustrine food webs revealed using fossil ephippia from Daphnia. Ecol. Appl. 17(3):754-764.

## STUDIES ON THE SEASONAL VARIATION IN THE DIET COMPOSITION OF *OXYURICHTHYS TENTACULARIS* (VALENCIENNES, 1837)

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**ABSTRACT** - Knowledge on the food, feeding habits and trophic inter-relationships of fishes is essential to understand the life history of fish including growth, breeding and migration. Members of the Gobiidae are small benthic fishes inhabiting a wide range of habitats in temperate and tropical regions. The *Oxyurichthys tentacularis*, a member of family Gobiidae, is one of the important food fish of Ashtamudi Lake. Studies on Indian gobioid fishes are very few. Given the lack of biological or ecological data on this species the objective of this work was to study the food and feeding habits of the same. Monthwise gut content analysis revealed that the percentage occurrence of detritus (53.62) was found highest in the month of August. Similarly the diatoms was found to be highest (30.94) in June, crustaceans in July (29.23), filamentous algae in August (16.30), molluscs in April (16.11), foraminiferans in January (7.71), blue green algae in November (4.36), fish scales and eggs and polychaete worms in December (1.93) and March (1.80) respectively. The average values on the diet composition of *o.tentacularis* showed that detritus (38.57%) was found to be the most preferred food item, which was followed by diatoms (22.00%), crustaceans (14.90%), molluscs (8.46%), filamentous algae (6.36%), foraminiferans (4.52%), blue green algae (2.42%), ciliophora (1.16%), fish scale and eggs (0.89%) and polychaete worms (0.72%). Detritus and crustaceans are consistently present in the stomach throughout the year. The presence of bivalves, eggs and scales and mollusc shell in the diet, appear to be incidental. It has even been noticed that the same species may consume a variety of food from different localities which means that, some of the gobioid species have no food specificity. From the available details on the feeding habits of other species of gobioids it is clear that they may have a range from near herbivorous to purely carnivorous, feeding on a wide variety of ingestible organisms from its habitat. The presence of sand grains, and detritus in the diet was a sign of the benthic behaviour of the fish.

**Keywords:** Ashtamudi Lake, Bottom feeder, Carnivorous, Gut content analysis, *Oxyurichthys tentacularis*.

### INTRODUCTION

Knowledge on the food, feeding habits and trophic inter-relationships of fishes is essential to understand the life history of fish including growth, breeding and migration. Gut content analysis provides important information about fish feeding patterns and quantitative assessment of food habits which is an important aspect of fisheries management. Usually, growth of a fish is influenced by the quality and quantity of food materials available and consumed. Thus, any fluctuation in quality and quantity of food materials will have an effect on growth rate of the fish.

Food and feeding habits of different types of shell and fin fish species were carried out by [4], [6], [9] and many others. The *Oxyurichthys tentacularis* (local name Koozhali), a member of family Gobiidae is commercially one of the most demanded fish of Ashtamudi Lake. Knowledge on food and feeding behaviour of this species occurring in Ashtamudi Lake is scanty. Hence, an attempt was made here to study the food and feeding behaviour of *Oxyurichthys tentacularis* inhabiting the Ashtamudi lake of Kerala.

### MATERIALS AND METHODS

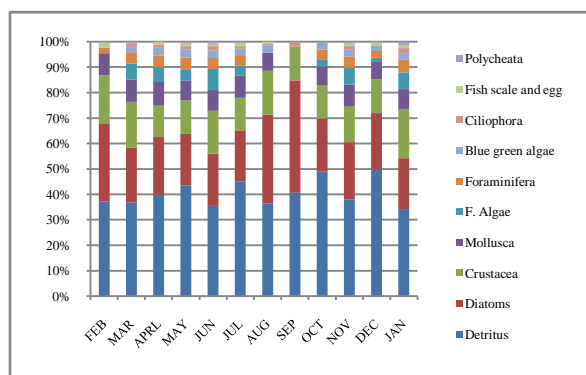
The specimens of *O. tentacularis* were collected from Ashtamudi lake (8° 53'- 9° 02' N; 76° 31'- 76° 41' E) using a modified gill net, locally known as "koozhalivala", cast net and dip net with the help of local fishermen, from February 2016 to January 2017. A total of 360 guts (length range of fish 9cm to 17cm were examined following the procedures suggested by [10].The guts along with contents were removed and preserved in 5% formalin and

subsequently analyzed both quantitatively and qualitatively. The total length and fullness of the guts were recorded. The gut was exposed and the stomach contents were analyzed using the frequency of occurrence and point methods. For the frequency of occurrence, the number of stomachs containing food was quantified and expressed as a percentage of all non-empty stomachs. The methods of [1], [5], [10] were deployed for the study. Quantitative analysis was carried out by using both occurrence and point volumetric methods [1], [2], [3], [5]. The percentage occurrence of stomach under the different conditions of feeding was also calculated for the whole period of study.

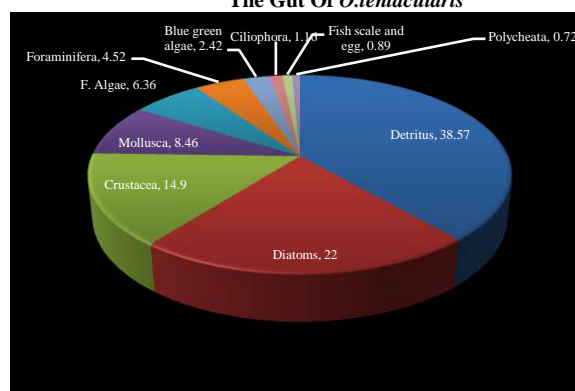
## RESULT AND DISCUSSION

The percentage composition of food items in the gut of *O.tentacularis* as observed in different months has been summarized in the **FIGURE 1** and **2**. Gut contents were identified up to group level and grouped in to 10 broad categories i.e. detritus, diatoms, crustacea, molluscs, filamentous algae, foraminifera, blue green algae, ciliophora, fish scale and eggs and polychaeta. It was seen that there were considerable variations in the percentage of different food items during different months of the year. Detritus was the highest percentage occurrence (January (53.62) and that of lowest (13.58) in September. It is the major food item constituting about 38% of the total gut contents. The presence of sand grains, and detritus in the diet was a sign of the benthic behaviour of the fish [8]. After a sharp decrease in February; the percentage is seen increasing till May. Again in June an increase is seen followed by a decrease during the months of August and September. Diatom percentage varies from 31 (June) to 14.75 (September). Diatoms are the second preferred food item whose highest percentage was recorded during the months of January and June (31) and the lowest in September (14.75). After a decrease in February it shows an increasing trend till June and again a decrease followed by a peak value in November. Crustacea also shows a somewhat similar trend with peak values recorded during the month of January (29.68) and lowest value during September (4.46). Molluscs were completely absent in the gut content during September, followed by a fluctuating trend in the values during the other months. The highest percentage of it was recorded during January and March (12). Complete absence of filamentous algae was noticed in the diet during the months of February, August and September, with its peak value in January (12.56). Between a peak and drop during the months of January and February, absence of it is recorded during August and September. Highest percentage of blue green algae was recorded during June. A somewhat similar trend was followed by ciliophora and polychaetes with complete absence or the lowest values recorded during the end of monsoon period.

**FIGURE 1.**Monthwise Percentage Composition Of Gut Contents



**FIGURE 2.**Percentage Composition Of Various Food Items In The Gut Of *O.tentacularis*



## CONCLUSION

The present study showed a mixed diet composition such as detritus, crustaceans, filamentous algae, blue green algae, diatoms, polychaete worms, foraminiferans, ciliophora, fish scales and eggs, thus revealing that the fish is predominantly a carnivore. From the present study it can be inferred that *O.tentacularis* consume a variety of food

from different localities which means that, this gobioid species have no food specificity The presence of sand grains, and detritus in the diet was a sign of the benthic behaviour of the fish.

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## REFERENCES

- Hynes, H. B. N., (1950). The food of freshwater Sticklebacks *Gasterosteus aculeatus* and *Pygosteus pungitius*, with a review of methods used in studies of the food of fishes. *J. Anim. Ecol.* 19: 36- 58.
- Hyslop, E. J., (1980). Stomach contents analysis - A review of methods and their application. *J. Fish. Biol.* 17: 411-429.
- Lima-Junior, S.E., and Goitein, R., (2001). A new method for the analysis of fish stomach contents. *Acta Scientiarum, Maringá*, 23: 421-424.
- Manon, M.R., and M.D. Hossain., (2011). Food and feeding habit of *Cyprinus carpio* var. *specularis*. *J. Sci. Foundation* 9: 163-181.
- Philip, K.P. (1994). Studies on the biology and fishery of the fishes of the Family Priacanthidae (Pisces: Perciformes) of Indian waters. Ph.D. Thesis, Cochin University of Science and Technology, Kochi, p.169.
- Pillay, T.V.R., (1952). A critique of the methods of study of food of fishes. *J.zool.Soc. India.* 4: 185-200.
- Rakesh verma., (2013). Feeding biology of *Labeo dyocheilus*: a vulnerable fish species of India. *International Journal of Research in Fisheries and Aquaculture*, 3(3): 85-88.
- Serajuddin, M. & Rustam Ali. (2005). Food and feeding habits of striped spiny eel, *Macrognathus pancalus* (Hamilton). *Indian J. Fish.*, 52(1): 81-86.
- Sherly Williams E. (1993). Studies on the biology of certain intertidal organisms. PhD Thesis, University of Kerala.
- Windell, J. T. & Bowen, S. H. (1978). Methods for study of fish diets based on analysis of stomach contents. In *Methods for the Assessment of Fish Production in Fresh Waters*, 3rd edn, (T. Bagnel, ed.), pp. 219-226. Oxford: Blackwell Scientific Publications.

# EFFECT OF GOLD NANOPARTICLES ON GILL HISTOLOGY OF *OREOCHROMIS MOSSAMBICUS*

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## ABSTRACT

Nanotechnology involves the application of materials at the nanoscale to new products or processes. The 1-100 nm scale is of interest for biological interfaces because objects less than 12 nm in diameter may cross the blood-brain barrier [5] and objects of 30 nm or less can be endocytosed by cells [3]. Currently large gaps exist in our knowledge and understanding of the toxicity and exposure of nanomaterials for aquatic organisms. Ecotoxicological studies with gold nanoparticles are rather limited with only a few reports of aquatic organisms. Hence, in the present study, an attempt was made to assess whether there is any toxic effects on synthetic and biologically synthesised gold nanoparticle supplementation on fish *Oreochromis mossambicus*. Gold nanoparticles were prepared using HAuCl<sub>4</sub>·3H<sub>2</sub>O (Sigma-Aldrich). Synthetic gold nanoparticles were prepared by sodium borohydride reduction method and for the green synthesis, aqueous fruit extract of *Emblia officianalis* were used. Synthesis of gold nanoparticles were confirmed from the UV-Vis study of surface plasmon resonance property of the colloidal solution. Juveniles of *Oreochromis mossambicus* in the range 7±0.35 cm and 5±0.62 gm were collected and stocked at 20 fish/1000L and fishes were maintained at laboratory conditions. Experimental diet was prepared by incorporating 10 ml of biogenic and synthetic gold nano solution per 100 gms of basal feed. Non-treated control diets and *Emblia officianalis* extract incorporated diets too were prepared. The experimental schedule was for six weeks and the fishes were fed at 2% of body weight twice daily. The biological effect was assessed in terms of histopathological studies at gill. The histopathological data revealed significant variations between treated and untreated groups. The details have been documented and discussed in the light of available literature.

**Key words:** *Emblia officianalis*, Gold nanoparticle, Nanotechnology.

## INTRODUCTION

The recent development and implantation of new technologies have led to new era, the nano-revolution which unfolds role of plant in green synthesis of nanoparticles which seem to have drawn quite an unequivocal attention with a view of synthesizing stable nanoparticles. The possibilities of employing plants in the deliberate synthesis of nanoparticles have burgeoning interest as an important source towards reliable and environmentally benign method of metallic nanoparticles synthesis and its characterisation. In the present study, the plant selected for biogenesis of gold solution is *Emblia officianalis*. The objective of the study is to determine the effects of biogenic gold nanoparticle in the aquatic candidate *Oreochromis mossambicus* with emphasis on histopathological data of gill.

## 2. MATERIALS AND METHODS

**2.1 GOLD NANOPARTICLE SYNTHESIS:** Synthesis of gold nanoparticle was done with sodium borohydride reduction. Biogenic gold nanoparticles was prepared by using 1 ml aqueous extract of *Emblia officianalis*. [1]. The characterization is done by measuring the UV visible spectrum of the particles in a aqueous solution, using a UV visible spectroscopy

**2.2 EXPERIMENTAL DESIGN:** Juveniles of *Oreochromis mossambicus* in the range 7±0.35 cm and 5±0.62 gm were collected from ADAK, Varkala, quarantined and stocked at 20 fish/1000L tanks and maintained at laboratory

conditions. Basal feed was prepared as outlined by Hardy *et al.* (1978)[2]. Experimental diets were prepared by incorporating 0.3 M of 10  $\mu$ l of biogenic gold nanoparticle and same concentration of synthetic gold nanoparticle per 100gms of basal feed. Non-treated control diets too were prepared. The experimental schedule was for 30 days and the fishes were fed at 2% of body weight twice daily.

**2.3. SCANNING ELECTRON MICROSCOPY:** SEM images provide good three-dimensional views of base, middle and tip regions of the gill filaments. It allows the study of the damage of surface ultrastructures of the gill. The gill arch was dissected, washed in 1% phosphate buffer and fixed in 3% glutaraldehyde. Then gill tissue was dehydrated in ascending concentrations of ethanol starting from 30% through absolute, critical point dried in Hitachi HCP 2 model, and mounted on stubs and coated with gold in Ion sputter E1010 and is viewed under FEI Quanta 200 Scanning Electron Microscope.

### 3. RESULT AND DISCUSSION

UV-Vis spectral analysis was done by using UV-Vis spectrophotometer (Dynamica HALO DB -20) at the range of 200-800 nm and observed the absorption peaks at 530-550 nm regions for both the biogenic and synthetic gold nanoparticles which are identical to the characteristic UV-visible spectrum of metallic gold (Fig. 1 and 2)

Fig:1

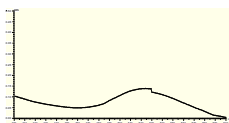
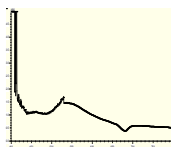


Fig:2



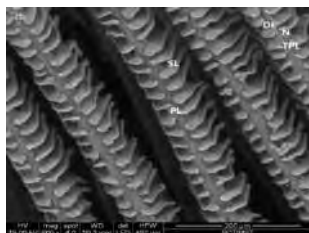
[fig: 1 uv vis spectrum of green synthesized gnp, fig:2. uv vis spectrum of chemically synthesized gnps]

The scanning electron microscopy revealed significant synthetic gold nanoparticle exposure induce alterations in gills. The structural details in the observations of gill of *Oreochromis mossambicus* in the control group, exhibited a normal architecture. (Plate 1-11). No specific damage or pathological abnormalities could be observed in the gills of fishes with biogenic nanoparticle exposure. (Plate 1-11). The slides exhibited a better cytostructural profile. Hence in this study, cytotoxicity by biogenic gold is ruled out and it is confirmed that aqueous fruit extract of *Embllica officianalis* extract along with gold nanoparticles produce better biological response

#### PLATE – I

#### SCANNING ELECTRON MICROGRAPHS OF THE MIDDLE PORTION OF THE GILL OF

#### *OREOCHROMIS MOSSAMBICUS*

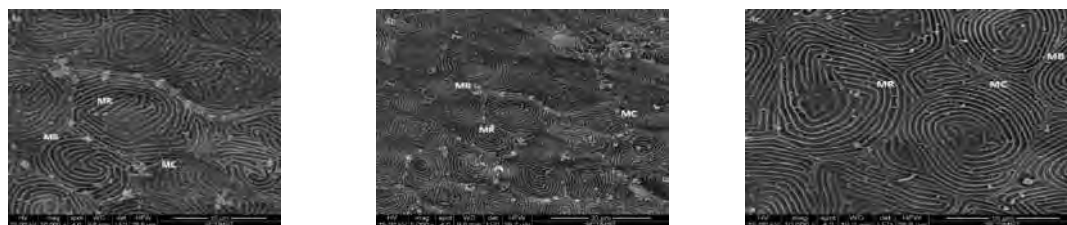


(Figure 1a : Gill Filament of the Fish fed with normal diet. Figure 1b : Gill Filament of the Fish fed with synthetic GNP incorporated diet. Figure 1c : Gill Filament of the Fish fed with Green Synthesized GNP incorporated diet. PL

– Primary Lamellae, SL – Secondary Lamellae, DL – Balloon Like dilation, N- Necrosis, TPL – Thickening of Primary Lamellae.)

## PLATE – II

### SCANNING ELECTRON MICROGRAPHS OF THE SURFACE EPITHELIUM OF THE GILL OF *OREOCHROMIS MOSSAMBICUS*



**(Figure 2a :** Surface epithelium of the Gill Fish fed with normal diet.**Figure 2b :** Surface epithelium of the Gill Fish fed with synthetic GNP incorporated diet.**Figure 2c :** Surface epithelium of the Gill Fish fed with Green Synthesized GNP incorporated diet. MR – Micro Ridge, MB – Micro Bridge, MC – Mucous Cells).

The changes observed in the gill of fishes exposed to synthetic gold nanoparticles were severe (Plate:I -11). The secondary lamellae are thin and are fused together. The shape was altered. Hypertrophy of epithelial cells, necrosis were severe, oedema, separation of respiratory epithelium, lamellar telangiectesis and vacuolization were observed. The micro ridged epithelial cells become perforated and numerous mucous gland openings became visible. (Plate.4, Fig:4b). Mucous secretion is also high. The damage and structural changes were more pronounced when compared with the control and biogenic gold nanoparticle incorporated feed fed group.

The results from the present study suggest that the histopathological lesions observed in fishes are due to exposure to synthetic gold nanoparticle incorporated in the diet. The improvised physiological response in biogenic fed *Oreochromis mossambicus* highlights the advantage of biogenic synthesized gold nanoparticles over synthetic gold nanoparticles.

## CONCLUSION

Despite increasing application of gold nanoparticles in industry and consumer products, there is still little known about their potential toxicity, particularly to organisms in aquatic environments. To investigate effects of gold nanoparticles in fish, tilapia *Oreochromis mossambicus* were supplemented with diet containing gold nanoparticles. Green synthesised gold nanoparticles showed little gill damage and showed better profile than the groups treated with plant extracts alone. Thus, it shows that biogenic gold nanoparticles can be looked upon as an environmentally benign replacement to the toxic chemical methods for synthesis of nanostructures and as promising candidates for biomedical applications.

## REFERENCE

1. Ahammed Riswan and Chand. 2009. *Journal of Ecophysiology and Occupational health*, 9: p153
2. Berntssen M. H. G., Julshamn, K. and Lundebye, A. K. (2010). Chemical contaminants in aquafeeds and Atlantic salmon (*Salmo salar*) following the use of traditional- versus alternative feed ingredients. *Chemosphere* .78:637–64
3. Connor, E.E.; Mwamuka, J.; Gole, A.; Murphy, C.J. and Wyatt, M.D. (2005). Gold nanoparticles are taken up by human cells but do not cause acute cytotoxicity. *Small* 1:325–327.
4. Hardy, R., (1978) Fish feed formulation in fish feed technology lecture -9 oct-dec; pp233-238
5. Sonavane, G., Tomoda, K., Makino, K. (2008). Biodistribution of colloidal gold nanoparticles after intravenous administration: effect of particle size. *Colloids Surf B*. 66:274–280. doi: 10.1016/j.colsurfb.2008.07.004.

## STUDIES ON THE ANTENNAL LOBES OF THE STINGLESS BEE *TETRAGONA IRIDIPENNIS* (SMITH)

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### ABSTRACT

*Stingless bee (Tetragona iridipennis) belongs to the family Apidae. Stingless bees are commonly known as Dammer bee. Since sensory perception in this insects being relatively less known this studies were undertaken to explore the sensory structure profile of the insect. The antennal lobe and glomeruli are the structures for olfactory reception. However there is no data available about the structure of antennal lobe of stingless bee the antennal lobe anatomy was investigated through standard histochemical protocols like hematoxylin and eosin staining. Light microscopy studies were carried to understand the detailed structure on the antennal lobes. Photographs of the antennal lobes were also taken. Macro and micro glomeruli were found in both left and right antennal lobes. Number of glomeruli reveals that Tetragona irridipennis has relatively less olfactory receptors.*

**Keywords:** antennal lobe (AL), glomeruli, histochemical, olfactory, Tetragona irridipennis

### INTRODUCTION

*Tetragona* is the largest genus of stingless bees which belongs to the Family Apidae, subfamily Meliponinae. Our understanding on insect olfaction has emerged from the studies on 'model insects like *Drosophila*, *Tribolium*, *Apis*, *Spodoptera* etc. However, comparative studies on other less known insects are very much essential for a comprehensive understanding, and therefore studies on *Tetragona sp.* and other insects can be useful in providing us insights about insect olfaction. The sensory profiles and sensory sophistication of stingless bees especially *Tetragona irridipennis* have not been probed yet. The present studies aims to make a study on sensory profile of *Tetragona irridipennis* and the brain centres concerned with sensory sensory reception - specifically the antennal lobe of the brain. The antennal lobe is often considered as the first sensory processing area of olfactory sensory information. The antennal lobe glomeruli their pattern of distribution, total number of glomeruli are all good indicators of an insect's olfactory sensory acuity. It has been proven that as the number of the glomeruli increase so does the olfactory sensitivity of an insect. The results of the studies can be helpful in understanding the sensory sophistications of a social insect with a range of contrasting behavioral repertoires.

Numerous studies have shown that the honeybee olfactory system is highly capable of perceiving, discriminating, and learning odours (for review see Menzel and Muller, 1996). The morphologic substrates (e.g., antennal lobe [al], mushroom body [mb]) involved in odour processing are well described (Mobbs, 1982; Rybak and Menzel, 1993; Menzel et al., 1994; Galizia et al., 1999). However, the development of this system is presently poorly described for the honeybee. In contrast to this, an enormous effort has been made to study the postembryonic development of the olfactory pathway in the moth *Manduca sexta* (for reviews see Oland and Tolbert, 1996; Hildebrand et al., 1997). The olfactory pathway of insects, including that of the honeybee, consists of the antenna as the receptive organ, the antennal (olfactory) lobe as the first-order olfactory neuropil, and centers of higher order processing such as the lateral protocerebrum and the mb, a prominent neuropil in the dorsal protocerebrum. In adult bees, the peripheral al neuropil is divided into spherical subcompartments, the olfactory glomeruli. Synapses between receptor neuron terminals and central neuron processes are located within these glomeruli. Individual glomeruli can be identified by their position within the al (Flanagan and Mercer, 1989; Galizia et al., 1999). Furthermore, optical recordings of odour evoked activity within single glomeruli or within specific groups of several glomeruli indicate that glomeruli represent functional as well as morphological units (Joerges et al., 1997; Galizia et al., 1998; Faber et al., 1999).

### MATERIALS AND METHODS

*Tetragona irridipennis* were collected from the wall crevices of buildings nearby. Bees collected were narcotized and sacrificed. After removing the mouth parts and cuticle the heads were then kept in 4% paraformaldehyde for 24 hours (fixation brings about sudden death of the cells in such a manner that their morphological organization & chemical composition are preserved in a life like condition). Fixative and water from the tissue were removed and replaced them with dehydrating fluid alcohol. To minimize tissue distortion from diffusion currents specimens were dehydrated in a graded ethanol series from water through 10%, 20%,



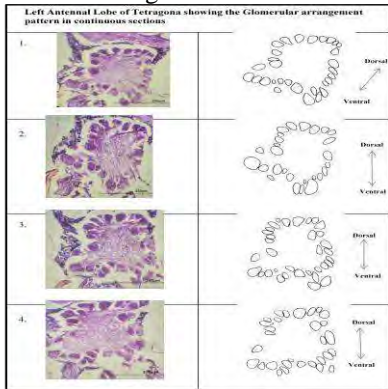
50%, 90%, 100% ethanol. After dehydration clearing was done using xylene for the removal of alcohol from the tissue in order to make the tissue more clear and transparent, so that minute details can be observed under microscope. Before embedding was done the xylene was completely removed and the tissue was then embedded in paraffin wax and blocks were made. The blocks made were sectioned under rotary microtome. The thickness of tissue were 5µm. Ribbon of tissue section obtained were placed on slides coated with egg albumen.

H & E Staining Procedure: Sections were immersed in the filtered Harris Hematoxylin for 1 minute and rinsed with tap water. Tap water was exchanged till the water was clear. Sections were immersed in EOSIN stain for 1-2 minutes and rinsed with tap water. Tap water was exchanged till the water was clear. Sections were dehydrated in ascending alcohol solutions (50%, 70%, 80%, 95% x2, and 100% x2). And was cleared with xylene (2X). Coverslip was mounted on the labeled glass slide. H&E staining results nuclei and other basophilic structures stained as blue. Cytoplasm and acidophilic structures as light to dark red.

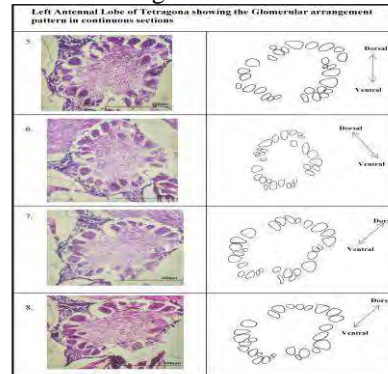
**RESULTS AND DISCUSSION**

The antennal lobe of *Tetragona* is unique in many ways. The glomerulus is arranged in an elliptical manner on the periphery of the antennal lobe. Gradations in the size of the glomerulus were seen (diagram 1,2,3,4). The pattern of the glomerular arrangement were arranged in clusters. Glomeruli with an average diameter of 40 microns and 12 microns respectively were observed from different locii of the antennal lobe (table 1). We could identify ~ 70 glomeruli from right and left antennal lobes (table 2).

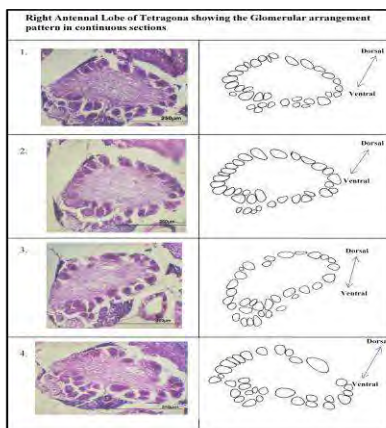
**Diagram 1**



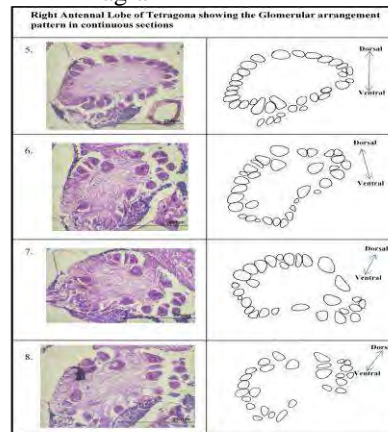
**Diagram 2**



**Diagram 3**



**Diagram 4**



**Morphometry of Antennal Lobe and Glomeruli (Table 1)**

Serial No.	~Diameter of Left Antennal Lobe( $\mu\text{m}$ )	~Average Diameter of Glomeruli Of Left A.L( $\mu\text{m}$ )	~Diameter of Right Antennal Lobe( $\mu\text{m}$ )	~ Average Diameter of Glomeruli Of Right A.L( $\mu\text{m}$ )
1	252	30	236	28
2	248	32	240	28
3	260	30	268	30
4	236	30	280	25
5	236	32	280	27

(Table 2)

Serial No.	~No. of Glomeruli in left Antennal lobe	Serial No.	~No. of Glomeruli in right Antennal lobe
1	30	1	33
2	27	2	33
3	34	3	33
4	30	4	32
5	29	5	35
6	29	6	33
7	28	7	29
8	27	8	27
~70 glomeruli are found in both the left and right antennal lobes			

## CONCLUSION

The antennal lobe of *Tetragona* is similar in its morphological features to that of other hymenopterans. The antennal lobe houses in number of glomeruli, which are considered to be specific for odour blends. Hence, more the number of glomeruli an insect possess slightly seems to be a reliable indicator of that insects chemosensory acuity (olfactory sharpness).~70 glomeruli were identified from both the antennal lobes and unique pattern of glomerular distribution were revealed in the present studies. Antennal lobe of *Tetragona* has glomeruli distributed on its periphery. This is in contrast to antennal lobe glomeruli seen in other insects, where the glomeruli are distributed more or less uniformly throughout the antennal lobe. Significance of this pattern of the glomerular arrangement needs to be further probed.Total number of glomeruli is taken as an index of the insect's olfactory sensitivity. With a number of ~70 glomeruli *Tetragona* probably relies less on olfactory sensory inputs. It is likely that *Tetragona* depends more on visual sensory inputs in addition to mechanosensory receptors.

Being a social insect ~70 glomeruli is relatively less when in comparison to other social insects like ants which has glomeruli in the range of 300-400.However *Tetragona* is likely to depend on other sensory receptors. This aspect of *Tetragona* needs to be ascertained. Social insects needs a superior communication system to maintain its social fabric. Therefore the question of the fundamental properties of other sensory system is needed to be analyzed with reference to the ecology of the *Tetragona iridipennis*.

## REFERENCES

- [1] Berg, B. G., Galizia, C.G., Brandt, R., Mustaparta, H. 2002. Digital atlases of the antennal lobe in two species of tobacco budworm moths, the Oriental *Helicoverpa assulta* (male) and the American *Heliothis virescens* (male and female).
- [2] Faber, T., Joerges, J., Menzel, R. 1999. Associative learning modifies neural representations of odors in the insect brain. *Nat Neurosci* 2:74 –78.

- [3] Flanagan, D., Mercer, A. R. 1989. An atlas and 3-D reconstruction of the antennal lobes in the worker honey bee, *Apis mellifera* L. (Hymenoptera: apidae). *Int J Insect Morphol Embryol*. 18:145–159.
- [4] Galizia, C. G., McIlwrath, S. L., Menzel, R. 1999. A digital three-dimensional atlas of the honeybee antennal lobe based on optical sections acquired by confocal microscopy. *Cell Tissue Res* 295:383–394
- [5] Galizia, C. G., Nagler, K., Holdobler, B., Menzel, R. 1998. Odour coding is bilaterally symmetrical in the antennal lobes of honeybees (*Apis mellifera*). *Eur J Neurosci* 10:2964 –2974.
- [6] Gascuel, J., and Masson, C. 1991. A quantitative ultrastructural study of the honeybee antennal lobe. *Tissue Cell*. 23:341–55.
- [7] Hildebrand JG, Rosler W, Tolbert LP. 1997. Postembryonic development of the olfactory system in the moth *Manduca sexta*: Primary-afferent control of glomerular development. *Cell Dev Biol* 8:163–170
- [8] Joerges J, Kuttner A, Galizia CG, Menzel R. 1997. Representations of odours and odour mixtures visualized in the honeybee brain. *Nature* 387:285–288.
- [9] Menzel R, Muller U. 1996. Learning and memory in honeybees: from Behavior to neural substrates. *Annu Rev Neurosci* 19:379 – 404..
- [10] Menzel R, Durst C, Erber J, Eichmuller S, Hammer M, Hildebrandt H, Mauelshagen J, Muller U, Rosenboom H, Rybak J, Schafer S, Scheidler A. 1994. The mushroom bodies in the honeybee: from molecules to behaviour. In: Schildberger K, Elsner N, editors. *Fortschritte der zoologie* 39. Neural basis of behavioral adaptations. Stuttgart: Fischer. pp81–102.
- [11] Mobbs PG. 1982. The brain of the honeybee *Apis mellifera*. I. The connections and spatial organization of the mushroom bodies.
- [12] Oland LA, Tolbert LP. 1996. Multiple factors shape development of olfactory glomeruli: insights from an insect model system. *J Neurobiol* 30:92–109.

## BRACHYURAN MANGROVE CRAB DIVERSITY OF PUTHUVYPE MANGROVE BELT, COCHIN, KERALA

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### ABSTRACT

Brachyuran mangrove crab diversity of Kerala is understudied with meager reports and the present study has been undertaken to assess the Brachyuran crabs of Puthuvype mangrove belt of Cochin backwaters during 2015-16. Puthuvype (9°59'05.7"N - 76 13 54.2"E) is a coastal area notified under CRZ (Coastal Regulation Zone) of Ernakulam District of Kerala state and has good mangrove spread consisting about 32 mangrove floral species. A yearlong survey revealed a total of 12 brachyuran true mangrove crabs along this region coming under 4 families (Portunidae, Grapsidae, Sesarmidae and Ocypodidae). Portunidae with 4 species, Grapsidae and Sesarmidae with 3 species each and Ocypodidae with 2 species. *Parasesarma plicatum* and *Astruca annulipes* showed maximum whereas *Pseudosesarma glabrum* and *Metopograpsus latifrons* registered minimum abundance. Puthuvype mangrove ecosystem is under severe threat due to developmental and industrialization process, there by the existence of mangrove species, both flora and fauna are also under serious threat and warrants immediate conservation.

**Keywords:** Brachyuran crabs, Crab diversity, Crab abundance, Mangroves, Mangrove crabs, Puthuvype

### INTRODUCTION

Mangroves of west coast of India especially along coastal line of Kerala are less complex compared to the dense complex networks of mangrove ecosystems along the east coast of the country (Naskar and Mandal, 1999). The species diversity of mangrove vegetation in Kerala was also reported to be high and diverse but studies on mangrove fauna were few, other than that of fish and shell fishes. Reports on crab diversity of mangrove ecosystems of Kerala were meagre and practically no authentic reports are available for brachyuran mangrove crabs. Kerala has good mangrove patches throughout the state, which are on destruction process due to developmental activities and about 32 mangrove floral species and associates were reported (Sahadevan *et al.*, 2016) especially from Cochin backwater system.

Cochin backwaters are characterized by wide salinity gradient and varying habitat types like low lying swamps, tidal creeks and the mangrove patches, which support diverse flora and fauna, including the brachyuran crabs (Devi, 2015). The distribution of crabs is influenced by habitat characteristics such as vegetation, substratum, food, salinity and the presence of other animals (Aspey, 1978; Icely and Jones, 1978; Rabalais and Cameron, 1985; Ewa-Oboho, 1993; Thurman, 1998; Caesar *et al.*, 2005, Pandya and Vachharajani, 2010). Crabs are the conspicuous members of the mangrove ecosystems (Verwey, 1930; Macnae, 1968) and are ecologically significant in many ways. Devi (2015) reported that a total of 23 brachyuran crabs were identified from the Cochin backwaters and estuaries. The major mangrove patch of Cochin is distributed along Puthuvype region and the mangroves in Puthuvype are mainly located towards the north of the development site. The mangrove cover of the area could be categorized into three, viz. moderately dense, interspersed with settlements and under degradation due to developmental activities. The brachyuran crabs of this mangrove belt are not reported yet. This is the first time to attempt a scientifically study on the diversity of brachyuran mangrove crabs of the puthuvype mangrove belt.

## MATERIALS AND METHODS

### Collection Site

Puthuvype (Fig.1) is an upcoming major Industrial area under Coastal Regulation Zone (CRZ) region in Kochi, Kerala. This island is situated on the western side of Ernakulam District with Kodungallur Strait on the North, Cochin backwaters and Cochin Port on the South to which, River Periyar debouches and Kochi city on the East and Arabian Sea on the West. The ecology of Puthuvype of Vypeen Island is unique, endowed with large canals extending over 50 km and a network of small canals emerging from there (Chatturvedi, 2005).



Fig. 1. Location map of Puthuvype, Ernakulam district, Kerala

### Sampling and Identification

Crab samples were collected monthly from the mangroves region during 2015-16. Specimens were mostly hand-picked or collected using stick and twine. Special trap 'ring-type crab trap' was also used. Each sampling effort lasted about 20 min. 6-7 specimens of abundant species and 1-3 of rare species were collected. Unmutilated extra specimens caught and berried females were released back to the site after documentation. Also, help was sought from the resident people for collecting crab specimens at their leisure; they were instructed to keep the specimens collected by them in bottles containing 5% formalin provided to them.

Photographs of representative fresh specimens were taken at the collection site itself. Required number of specimens were preserved in 5% formalin and kept in polythene bottles depending on the size of the specimen. The bottles were appropriately labeled (names of crab and collection site and date of collection) and properly sealed with insulation tape to prevent leakage of formalin. Specimens were brought to laboratory for further identification using standard keys. Identification and classification were done using standard keys and publications (Pillai, 1951; Sakai, 1976; Sethuramalingam and Ajmal Khan, 1991; Dev Roy and Das, 2000; Dev Roy, 2008). The classification was made as that of Ng *et al.* (2008) and validity of the names of the brachyuran crabs were cross-checked with information from World Register of Marine Species (WoRMS, 2018; <http://www.marinespecies.org>)

## RESULTS AND DISCUSSION

The Puthuvype area houses 12 species of true mangroves crabs coming under 4 families (Portunidae, Grapsidae, Sesarmidae and Ocypodidae). Portunidae with 4 species, Grapsidae and Sesarmidae with 3 species each and Ocypodidae with 2 species. *Parasesarma plicatum* and *Astruca annulipes* showed maximum whereas *Pseudosesarma glabrum* and *Metopograpsus latifrons* registered minimum abundance. The mangrove crabs

identified are given in table 1 and figure 2. Since there were no former studies about mangrove crabs of Puthuvype area, this is the first report of true mangrove crabs from Puthuvype mangrove belt. Sahadevan *et al.*, (2017) reported crabs belonging to four families and 32 species of mangrove associates belonging to 18 families from mangrove patches of Ernakulam district.

The brachyuran crabs identified in the present study were all known to science and there were no new species or records from the area. The study can be regarded as baseline study for brachyuran crabs of the area. Puthuvype mangrove ecosystem is under severe threat due to developmental and industrialization process, there by the existence of mangrove species, both flora and fauna are also under serious threat and warrants immediate conservation.



**Figure 2.** (1) *Scylla olivacea* (2) *Scylla Serrata* (3) *Scylla tranquebarica* (4) *Thalamita crenata* (5) *Metapograpsus latifrons* (6) *Metapograpsus messor* (7) *Metapograpsus thukuhar* (8) *Neosarmatium malabaricum* (9) *Parasesarma plicatum* (10) *Pseudosesarma glabrum* (11) *Austruca annulipes* (12) *Austruca perplexa*

Table 1. Diversity and abundance of brachyuran crabs from Puthuvype, Cochin

Family	Scientific Name	Abundance
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Portunidae	<i>Scylla olivacea</i>	20
	<i>Scylla tranquebarica</i>	29
	<i>Scylla serrata</i>	11
	<i>Thalamita crenata</i>	30
Graspidae	<i>Metopograpsus latifrons</i>	8
	<i>Metopograpsus messor</i>	16
	<i>Metopograpsus thukuhar</i>	23
Sesarmidae	<i>Neosarmatium malabaricum</i>	21
	<i>Parasesarma plicatum</i>	211
	<i>Pseudosesarma glabrum</i>	6
Ocypodidae	<i>Uca annulipes</i>	201
	<i>Uca perplexa</i>	111

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## REFERENCE

- Aspey, W. P. (1978). Fiddler crab behavioral ecology: burrow density in *Uca pugnax* (Smith) and *Uca pugilator* (Bosc) (Decapoda Brachyura). *Crustaceana*, **34**: 235-244.
- Caésar, I.I., Armendáriz, L.C. and Becerra, T.V. (2005). Bioecology of the fiddler crab *Uca uruguayensis* and the burrowing crab *Chasmagnathus granulatus* (Decapoda, Brachyura) in the Refugio de Vida Silvestre Bahía Samborombón, Argentina. *Hydrobiologia*, **545**: 237-248.
- Chatturvedi, J.C. (2005). Political Governance. Public policy and administration. Isha Books, Delhi. 3:321.
- Dev Roy, M.K. and Das, A.K. (2000). Taxonomy, ecobiology and distribution pattern of the Brachyuran Crabs of mangrove ecosystem in Andaman Islands. *Rec. Zool. Surv. India, Occ. Paper No. 185*: 1-211, pls. 1-21, text figs. 1-5.
- Dev Roy, M.K. (2008). An annotated checklist of mangrove and coral reef inhabiting brachyuran crabs of India. *Rec. Zool. Surv. India, Occ. Paper No. 289*: 1-212
- Devi, P.L. (2015). Brachyuran crabs of Cochin backwaters- Diversity, habitat ecology and systematics, with special emphasis to genus *Scylla*. Ph.D thesis, Faculty of science Cochin University of Science and Technology, India, 325pp.
- Ewa-Oboho, I.O. (1993). Substratum preference of the tropical estuarine crabs, *Uca tangeri* Eydoux (Ocypodidae) and *Ocypode cursor* Linne (Ocypodidae). *Hydrobiologia*, **271**: 119-127.
- Icely, J.D. and Jones, D.A. (1978). Factors affecting the distribution of the genus *Uca* (Crustacea: Ocypodidae) on East African shore. *Estuarine Coastal Marine Science*, **6**: 315-325.
- Macnae, W. (1968). A general accounts of the fauna and flora of mangrove swamps and forests in the Indo-west Pacific region. *Adv. Mar. Biol.*, **6**:73-270.
- Naskar, K. and Mandal, R. (1999). *Ecology and Biodiversity of Indian Mangroves*. Part-I: Global Status. Daya Publishing House, Delhi, 361.

- Ng, P.K.L., D. Guinot, & P.J.F. Davie (2008). Systema Brachyurorum: Part I. An annotated checklist of extant brachyuran crabs of the world. *Raffles Bulletin of Zoology. Supplement* 17:1–296.
- Pandya, P.J. and Vachharajani, K.D. (2010). Spatial distribution and substratum preference of the brachyuran crab, *Macrophthalmus depressus* (Decapoda: Ocypodidae) along the lower estuarine mudflat of Mahi River, Gujarat, India. *Crustaceana*, **83(9)**: 1056- 1067.
- Pillai, N.K. (1951). Decapoda (Brachyura) from Travancore. *Bulletin of the Central Research Institute, University of Travancore, Trivandrum* 2, series C (1):1–4.
- Rabalais, N.N. and Cameron, J. N. (1985). Physiological and morphological adaptations of adults *Uca* subcylindrica to semi-arid environments. *Biol. Bull.*, **168**: 135-146.
- Sahadevan, P. (2016) Diversity of Fishes, Crustaceans and Molluscs of Puthuvypeen of Ernakulam District, Kerala, South India. *Int. J. Fish. Aquat. Stud.*, **4(6)**:101-107.
- Sahadevan, P., Dinesan, C. and Suma, C.C. (2017). On mangroves and mangrove associates of Puthuvypin of Ernakulam district of Kerala (South India). *International Journal of Multidisciplinary Research and Development*, **4** (3): 134-139.
- Sakai, T. (1976). *Crabs of Japan and Adjacent Seas*, Volume 1: Kodansha Ltd.
- Sethuramalingam, S. & S. Ajmal Khan (1991). Brachyuran crabs of Parangipettai Coast. Centre of Advanced study in Marine Biology, Annamalai University. 92pp
- Thurman, C.L. (1998) Osmoregulation by six species of fiddler crabs (*Uca*) from the Mississippi delta area in the northern Gulf of Mexico. *J. Exp. Mar. Biol. Ecol.*, **291**: 233-252.
- Vewey, J. (1930). Eingeesii ber die Biologie Ost-Indischer Mangrovekrabben. *Truebia*, **12**: 16
- WoRMS (2018). Accessed at: <http://www.marinespecies.org/aphia.php?p=taxdetails&id=1061900> on 2018-06-24; *Austruca annulipes* (H. Milne Edwards, 1837).



# IN VITRO ANTIMICROBIAL ACTIVITY AND PHYTOCHEMICAL SCREENING OF LEAF EXTRACTS OF *CALOTROPIS GIGANTEA* L. AGAINST SELECTED PATHOGENIC MICROORGANISMS.

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**ABSTRACT** The leaves of *Calotropis gigantea* were screened for its antimicrobial and phytochemical activities. The solvents used for the leaf extraction were n-hexane, ethyl acetate and methanol. The results of well diffusion method revealed that, different concentrations of methanolic and ethyl acetate extracts showed better zone of inhibition in *Escherichia coli* whereas, *Staphylococcus aureus*, *Klebsiella pneumoniae* and *Vibrio cholerae* showed better zone of inhibition in both methanolic and hexane extracts. The zone of inhibition showed by *Bacillus cereus* is lesser as compared to others in all extracts. Phytochemical screening of leaves revealed the presence of alkaloids, cardiac glycosides, saponins, flavonoids, reducing sugars and terpenoids in most prominent amount while tannins and steroids in lesser amount. The results therefore established a good support for the use of *C. gigantea* in traditional medicine.

**Keywords:** *Calotropis gigantea*, Bioactive compounds, Well diffusion method, Antimicrobial activity.

## INTRODUCTION

Medicinal plants are endowed with various bioactive compounds, being used as therapeutic substitutes for the treatment of many diseases throughout the world<sup>[1]</sup>. Usually, bioactive plant compounds are produced as secondary metabolites eliciting pharmacological effects in both animals and humans such as immunosuppression, anti-infectives, and metabolic diseases. The search for new pharmacologically active agents from natural resources such as plants, animals and microbes led to discovery of many clinically useful drugs<sup>[2]</sup>. *Calotropis gigantea*, commonly known as Giant milkweed is a traditional medicinal plant belonging to the family Asclepiadaceae which includes latex bearing plants. The plant is growing widely throughout the tropical and subtropical regions of Asia and Africa. The Asclepiadaceae is a large family comprising of 175-180 genera and 2200 species distributed mainly in the tropical and subtropical region of the world, represented in India by 23 genera and 41 species<sup>[3]</sup>. Studies proved that, the extracts of the plant parts are having anti-helminthic, analgesic, antisyphilitic, antipyretic, cytotoxic and antimicrobial effects in vertebrates<sup>[4]</sup>.

Locally, the plant is used to cure several illnesses such as toothache, ear-ache, sprain, anxiety, pain, epilepsy, diarrhoea and mental disorders. *C.gigantea* also exhibited anticandida activity, cytotoxic activity, and wound healing activity<sup>[5]</sup>. Leaves, roots, stem, flowers and latex of *C.gigantea* are used in ayurveda for the treatment of various ailments<sup>[6]</sup>.

## MATERIALS AND METHODS

**COLLECTION AND PROCESSING OF PLANT MATERIALS:** The healthy and mature leaves of *C. gigantea* for the proposed study were collected from the nearby areas of Trivandrum district. The collected leaves were washed and shade dried. The shade dried leaves were ground to powder using an electric blender and were sieved with a mesh of size 0.5mm. The powdered samples obtained were stored in clean air-tight containers for further analysis.

**EXTRACTION OF PLANT MATERIALS:** Methanol, ethyl acetate and hexane extracts of plant leaves were prepared using Soxhlet apparatus. The residues obtained were weighed and stored at 4°C for further investigations.

**PHYTOCHEMICAL SCREENING:** Phytochemical analysis of all crude extracts were carried out by standard methods<sup>[7]</sup>.

**ANTIBACTERIAL ACTIVITY :** The crude extracts were screened for antibacterial activity using agar well diffusion method<sup>[8][9]</sup>. Test organisms used were *Escherichia coli*, *Bacillus cereus*, *Staphylococcus aureus*, *Klebsiella pneumoniae* and *Vibrio cholerae*. The cultures were plated on Muller Hinton agar. Wells were made with well cutter (diameter 6 mm) to which different extracts were added. Tetracycline is used as positive control and DMSO as negative. The activity of the extract was determined by measuring the diameters of zone of inhibition.

### STATISTICAL ANALYSIS

Results of the experiments are expressed as Mean  $\pm$  S.D. All experiments were done in triplicates.

### RESULTS AND DISCUSSION

The phytochemical analysis of leaf extracts revealed the presence of alkaloids, cardiac glycosides, saponins, flavonoids, reducing sugars and terpenoids in most prominent amount while tannins and steroids in lesser amount. Anthraquinones was absent in solvent extracts. These were documented in Table 1.

**TABLE1 : Phytochemical analysis of bioactive compounds in different extracts of *Calotropis gigantea* leaves.**

Phytochemicals	Extracts		
	Methanol	Ethyl acetate	Hexane
Alkaloids	+	+	+
Cardiac glycosides	+	+	-
Saponins	-	+	+
Tannins	+	-	-
Flavonoids	+	+	-
Terpenoids	+	+	+
Reducing sugars	+	+	+
Anthraquinone	-	-	-
Steroids	+	-	-
Phenol	+	+	+

In vitro antimicrobial sensitivity assay of methanolic, ethyl acetate and hexane extracts of *C.gigantea* leaves were evaluated using five pathogenic microbial strains namely, *Escherichiacoli*, *Bacillus cereus*, *Staphylococcus aureus*, *Klebsiella pneumoniae* and *Vibrio cholerae*. Agar well diffusion is used for the study and minimum inhibitory zone (mm) were analysed.

The results revealed that, different concentrations of methanolic and ethyl acetate extracts of *C.gigantea* leaves showed better zone of inhibition in *Escherichia coli* than hexane extract. The reason for minimal antibacterial activity in hexane extract may be due to a low concentration of antibacterial compounds in these extract. Compared to other strains, *Staphylococcus aureus*, *Klebsiella pneumoniae* and *Vibrio cholerae* showed better zone of inhibition in both methanolic and hexane extracts than ethyl acetate. This may be due to the presence of high amount of bioactive compounds in it. The zone of inhibition showed by *Bacillus cereus* is lesser as compared to others in all extracts. These were depicted in tables 2.

**TABLE 2: Antimicrobial activity of Methanol, Ethyl acetate and Hexane extracts of *Calotropis gigantea* leaves on selected microbes.**

Extracts	Conc. (ug/ml)	Zone of Inhibition (mm)				
		<i>E. coli</i>	<i>B. cereus</i>	<i>S. aureus</i>	<i>K.pneumoniae</i>	<i>V. cholerae</i>
Methanol	500	8 $\pm$ 0.2	7 $\pm$ 0.0	9 $\pm$ 0.0	9 $\pm$ 0.5	8 $\pm$ 0.1
	750	10 $\pm$ 0.5	8 $\pm$ 1	11 $\pm$ 0.1	12 $\pm$ 0.5	10 $\pm$ 0.2

	1000	13 ± 0.4	9 ± 0.5	14 ± 0.0	15 ± 0.0	11 ± 0.1
	PC	20 ± 0.0	22 ± 0.1	17 ± 0.5	16 ± 0.5	21 ± 0.0
	NC	-	-	-	-	-
<b>Ethyl acetate</b>	500	9 ± 0.0	8 ± 0.5	9 ± 0.1	7 ± 0.0	9 ± 0.5
	750	12 ± 0.2	9 ± 0.0	10 ± 0.0	8 ± 0.4	10 ± 0.5
	1000	13 ± 0.2	10 ± 0.2	11 ± 0.5	9 ± 0.1	11 ± 0.0
	PC	24 ± 0.1	22 ± 0.0	18 ± 0.1	16 ± 0.1	24 ± 0.0
	NC	-	-	-	-	-
<b>Hexane</b>	500	7 ± 0.1	12 ± 1	9 ± 0.2	13 ± 0.5	10 ± 0.2
	750	8 ± 0.5	15 ± 0.5	10 ± 0.0	14 ± 0.5	13 ± 0.0
	1000	9 ± 0.0	11 ± 0.0	12 ± 0.1	16 ± 0.0	15 ± 0.5
	PC	20 ± 0.5	16 ± 0.0	17 ± 0.0	23 ± 0.1	22 ± 0.5
	NC	-	-	-	-	-

## CONCLUSION

Plants have been used for the prevention and treatment of many diseases from time immemorial. The present study reveals the presence of phytochemical and antimicrobial substances in *Calotropis gigantea* leaves and further studies are required to find out the active components of medicinal properties in this valuable plant.

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## REFERENCE

- Himani RAINA, Garima SONI, Nupur JAUHARI, Neelam SHARMA, Navneeta BHARADVAJA. Phytochemical importance of medicinal plants as potential sources of anticancer agents. *Turk J Bot.* 2014; 38: 1027-1035
- M. Butler. *J Nat Prod*, 2003; 67(12), 2141-2153.
- Shirsat, M. K., Mahatama, O. P., Pal, U. S., Bais, S. K. and Dwivedi, J. GC-MS analysis of *Calotropis gigantea* Linn whole plant chloroform extract. *J. of Pharmaceutical and Biosciences*, 2013; 1: 26-29.
- Gaurav Kumar, Loganathan Karthik and Kokati Venkat Bhaskara Rao. Antimicrobial Activity of Latex of *Calotropis Gigantea* Against Pathogenic Microorganisms - An In Vitro Study. *Pharmacologyonline*. 2010; 3: 155-163.
- Suresh P, Suresh E, Kalavathy S. Review on a potential herb *Calotropis gigantea*. *Sch Acad J Pharm* 2013; 2(2):135-143.
- S Sarkar, R. Chakravrti, A Ghosh. *Calotropis gigantea* Linn. - A Complete Basket Of Indian Traditional Medicine. *Int. J. Phrm. Res. Sci.*, 2014, 02 (1), 7-17.
- Chandrabhan Seniya, Sumint Singh Trivedia, Santosh Kumar Verma. Antibacterial efficacy and Phytochemical analysis of organic solvent extracts of *Calotropis gigantean*. *J. Chem. Pharm. Res.*, 2011; 3(6):330-336.
- Murray PR, Baron EJ, Pfaller MA, Tenover FC, Tenover HR. *Manual of Clinical Microbiology*, 6th Ed. ASM Press, Washington DC, 1995; 15-18. 18.
- Olurinola PF. *A laboratory manual of pharmaceutical microbiology*, Idu, Abuja, Nigeria, 1996; 69-105.

# MACROFAUNAL DIVERSITY ALONG AYIRAMTHENGU MANGROVES

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## ABSTRACT

An investigation on quantitative distribution and monthly dynamics of the macrofaunal composition, diversity and abundance was carried out along the five stations of Ayiramthengu mangroves (9.1200° N, 76.4816° E) at Kollam, Kerala. Station I (tides, waves, and high influx of salt water in the mangrove area), Station II (open area with less salt water intrusion), Station III (with very less salt water influx and a retting zone), Station IV (area of less mangroves) & Station V (area of luxuriant mangrove growth and entangled respiratory roots). Random sampling was carried out during the early hours, from the month of March to April 2018. The collected samples were fixed, placed in polythene vials after sorting, and identified to the nearest taxa possible using standard keys. Hydrological parameters such as water temperature, pH, dissolved oxygen, salinity, and nutrients were also determined. Statistical analyses were conducted using SPSS Vs 24. During the study, six groups of macro fauna were representing 36 taxa. Crustaceans (43.1%) were most dominant group, followed by Gastropods (29%), Bivalves (10%), Polychaetes (8.26%) and Cnidarians (5%). Macrofaunal diversity varied from station to station. Diversity indices such as Shannon ( $H=3.320$ ), Simpson ( $\text{Lambda}'=0.956$ ) and Margalef's richness index ( $R=5.663$ ) were higher at Station I compared to other stations. This may be due to the mixing of sea water and fresh water of the area, providing high level of nutrients, both in water column and sediment, making it most productive than other stations. The study thus, provides valuable information on the present macrofaunal diversity along the Ayiramthengumangroves, Kollam and serve as a baseline data to carry out detailed benthic diversity studies.

**Keywords:** Composition, Diversity indices, Macrobenthos, Mangroves

## INTRODUCTION

Mangrove forests are one of the most productive and bio-diverse wetlands on earth. Healthy mangrove forests are key to a healthy marine ecology. A mangrove is a shrub or small tree that grows in coastal [saline](#) or [brackish waters](#). Areas where mangrove occurs include [estuaries](#) and marine shorelines. They serve as custodians of their juvenile stock and form a most valuable biomass [7]. Stress on wetlands has increased rapidly due to the growing population, technological development, urbanization, and economic growth. Additional pressures on wetlands from natural causes like subsidence, drought, hurricanes, erosion etc., and human threats coming from over-exploitation, encroachment, reclamation of vast wetland areas for agriculture, commercial and residential development have altered the rate and nature of wetland functions, particularly in the last few decades. Even though mangroves have such important values, they were treated as unwanted plants used mainly as a source of timber and charcoal, which caused depletion during the last two decades. Limited benthic studies have been conducted in the tropics compared to higher latitudes and the theory relating to its community structure is based largely on studies from temperate regions [10]. Olomukoro [8] studied the effects of heavy metals and macroinvertebrate communities in Ekpan Creek of Nigeria. Ingole *et.al.*, [3] carried out a comparative study of macrobenthic and meiobenthos of Kakinada backwaters and correlated its temporal and spatial diversity with sediment grain size and depth. Ramkumar *et.al.*, [6] studied the benthic macroinvertebrate communities of three different stations in Tuticorin coastal waters and assessed the impact of pollution on its distribution. Macroinvertebrate diversity of Veli and Kadinamkulam lake was studied by Latha and Thanga [4]. NGK Pillai *et.al.*, [9] worked on the species composition, distribution, and taxonomic description of polychaetes fauna in sea grass beds of the Minicoy lagoon, Lakshadweep, India. Brackish-waters represent ideal study cases for assessing different directional factors controlling community structure and dynamics,

which are exposed to severe environmental conditions (hypoxia, high temperature, low pH and highly toxic products) which can evolve tolerance, making communities highly resilient and fit for recovering after severe episodic events [5]. Finally, brackish-water biotopes are ideal models also for studies on ecological directional changes.

In the present work, an effort was made to assess the dynamics of benthic diversity and assemblages of five environmentally disturbed stations along the Ayiramthengu Mangrove situated in Kollam district of Kerala, south west India. An attempt was also made to correlate the distribution of benthic communities between stations. Therefore, the study will provide valuable information not only on benthic diversity along the mangroves of Ayiramthengu, but also on its present ecological status.

## MATERIALS AND METHODS

Study Area: Ayiramthengu (906<sup>0</sup>-908' N: 76028' to76029'E) is situated about 6Km west of Oachira town, on the banks of Kayamkulam estuary. The mangrove here covers 20 acres of area. Five sampling stations were selected representing differing stressors that are likely to affect macrobenthic diversity, abundance, and its richness. Station I represented a high influx of salt water in the mangrove area, Station II represents an open area with less salt water intrusion, Station III represents a very less salt water influx and a retting zone, Station IV represents a less mangrove area without any disturbances and Station V represent an area of luxuriant mangrove growth showing entangled respiratory roots. Sampling Protocol: Random sampling was carried out from March to April 2018 during the early hours, based on the procedure of Annurohimet.al.,[1]. The collected samples were fixed and placed in polythene vials after sorting, with identification to the nearest taxa possible using standard keys and taxonomic references. Fine sorting was also performed under a dissection microscope. The statistical analyses were conducted using SPSS Vs 24. Computation of Univariate analysis of species diversity indices (Shannon diversity index (H'), Margalef's Richness index (d), Pielou's evenness index (J') and Simpsons dominance index ( $\lambda'$ ) was also done to know the community structure of macrofauna from the study stations.

## RESULTS

Benthic fauna found at the study stations represented six groups viz, Gastropods, Bivalves, Polychaetes, Isopods, Crustaceans, and Echinoderms, all totaling to 37 taxa. Crustaceans (42%) were the most dominant, followed by Gastropods (29%), Bivalves (10%), Polychaetes (8.26%), Echinoderms (5%) and Isopods (1.1%). At Station I, the numerically abundant species was *Bursa spinosea* and *Crassostrea* sp (8.5%), whereas the least abundant taxa were *Coronata borealis* (0.2%) and *Tibia curta* (0.62%). At Station II, the numerically abundant species was *Balanus glandula* (15.07%) and the least abundant was *Capitella capitata* (2.15%) and *Turritella communis* (1.43%). At Station III, the numerically abundant was *Balanus glandula* (20.28%) and *Modiolus* sp (17.39%), whereas the least abundant were *Armadillidium* sp (1.44%), *Marphysa macintoshi* and *Paragrapsus gairardii* (2.17%). At Station IV and V, only three species were recorded. Among them, the numerically abundant was *Cerithidea flaviatilis* (54% at Station IV and 57.97% at Station V) and *Uca annulipes* (31% at Station IV and 30.4% at Station V), whereas the least abundant taxa were *Rhizostom octopus* (13% at Station IV and 11.6% at Station V). Shannon-Wiener index showed a higher value at Station I (H=3.320) and lower value at Station V (H=0.928). Simpson Index was greater at Station I (Lambda'=0.956) and lesser at Station V (Lambda'=0.558). Margalef's index showed a higher value at Station I (R=5.663) and lower value at Station IV (R=0.434) and Pielou's evenness values were greater at Station IV (J=0.889) and lower at Station II (J=0.735). Temperature of the water was found maximum at Station III during April (30°C) and minimum during April (26.80°C) at Station V. DO was recorded maximum at Station V during April (5.80 mg/l) and minimum at Station III during March (2 mg/l). pH value showed a higher concentration at Station I during April (8) and minimum at Station III during March (7.10). The salinity was higher at Station I during April (6.40%) and minimum at Station IV during April (4.48%). Nitrate-nitrogen was higher at Station I (2.31 µg/l) and minimum at Station V (0.67 µg/l) during April. Nitrite-nitrogen recorded maximum (2.25 µg/l) at Station I and minimum (0.24 µg/l) at Station IV during March. Phosphate phosphorous was recorded higher at Station II (2.20 µg/l) and low (0.21 µg/l) at Station V during March respectively. Silicate concentration was high (1.72 µg/l) at Station II and low (0.40 µg/l) at Station IV during March respectively.

## **DISCUSSION**

Diversity indices such as Shannon ( $H=3.320$ ), Simpson ( $\lambda=0.956$ ) and Margalef's richness index ( $R=5.663$ ) were high at Station I compared to other stations. The comparison between stations evidenced a completely different situation. The increased number of species accounted in Station I under the marine influence areas depends on both abiotic and biotic determinants such as sea water exchange, larval recruitment, and adaptive strategy of each species[2]. This may be due to the mixing of sea water and fresh water of the area providing a high level of nutrients, both in water column and sediment, making it most productive than other stations. The study thus, provides valuable information on the present macrofaunal diversity along the Ayiramthengu mangroves, Kollam and serves as a baseline data to carry out detailed benthic diversity studies.

## **REFERENCES**

- [1] Annurohim, Sujasmitho, BK., , Aminatul Badriyah Ikrom<sup>2</sup>, NengahDwianita Kuswytasari<sup>1</sup>, Maya Shovitri<sup>1</sup>, Enny Zulaika<sup>1</sup>, Nur Hidayatul Alami<sup>1</sup>, Triono Bagus Saputro<sup>1</sup>, Wirdhatul Muslihatin<sup>1</sup>, Dini Ermavitalini<sup>1</sup>, Taslim Ersan (2014). Benthic Macrofauna in Mangrove Zonation at Poteran Island, Madura, Indonesia. *J. Appl. Environ. Biol. Sci.*, 5(5)90-95.
- [2] Cardone F, Corriero G, Fianchini A, Gravina MF, Nonnis Marzano C 2014. Biodiversity of transitional waters: species composition and comparative analysis of hard bottom communities from south-eastern Italian coast. *Journal of the Marine Biological Association of the United Kingdom* 94(1): 25-34.
- [3] Ingole B, Sivadas S, Nanajkar M, Sautya S. 2009. A Comparative Study of Macro Benthic Community from Harbours along the Central West Coast of India. *Env. Monit.*, 154: 135-146.
- [4] Latha, C and VSG. Thanga. (2010). Macroinvertebrate diversity of Veli and Kadinamkulam lakes, South Kerala, India. *Journal of environmental biology / Academy of Environmental Biology, India*. 31. 543-7.
- [5] Lardicci C, Abbiati M, Crema R, Morri C, Bianchi CN, Castelli A 1993. The Distribution of Polychaetes Along Environmental Gradients: An Example from the Orbetello Lagoon, Italy. *PSZNI Marine Ecology* 14 (1): 35–52.
- [6] Ramkumar R, Edward JKP, Jaikumar M. 2010. Macrobenthic community structure on Tuticorin coastal waters, Gulf of Mannar, southeast coast of India. *World J. Fish. Mar. Sci.*, 2(1): 70-77.
- [7] Odum, E.P. (1971) *Fundamental of Ecology*. 3rd Edition, W.B. Saunders, Philadelphia.
- [8] Olomukoro JO.1996. Macrobenthic fauna of Warri River in Delta State. Nigeria. Ph.D. thesis, University of Benin, Nigeria.
- [9] N. G. K. Pillai, P. P. and Koya, Said, K. P. (2011) Status report on the tuna fishery in India, with reference to long tail tuna, *Thunnus tonggol*. Technical Report. CMFRI.; Kochi.
- [10] Snelgrove VR, Blackburn TH, Hutchings PA, Alongi DM, Grassle GF, Hummel H, King G, Koike I, Lamshead PJD, Ramsing NB, Solis-Weiss V. (1997). The importance of marine sediment biodiversity in ecosystem processes. *Ambio* 26: 578–583.

## **A SURVEY ON THE HUMAN FOOD HABITS AND ITS INPUT ON HEALTH AT KARAVARAM PANCHAYAT, THIRUVANANTHAPURAM DISTRICT, KERALA**

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### **ABSTRACT**

*The prevalence of obesity and underweight has increased in recent years due to changes in eating habits all over the world. On the other hand eating behavior and dietary factors are as a risk factor in several important diseases such as cancer, coronary heart diseases or obesity. Therefore, we assessed the food habits of people in relation to their age groups and food preference. The study was conducted during the period of January 2017 to June 2017 in the Fifth ward of Karavaram Panchayat, Thiruvananthapuram district, Kerala. A self administered questionnaire was used to collect information on socio-demographic indicators, food habits and preferences. In the present study it was clear that people were affected with lifestyle diseases like diabetes, high cholesterol, etc., in the site. The age group of 50 and above was more prone to the diseases. The results of this study could be used as an important baseline for future monitoring of the dietary pattern, nutritional status of a population in a given area.*

**KEYWORDS:** *Food Habits, Preferences, Dietary Pattern*

### **INTRODUCTION**

Healthy eating is defined as eating practices and behaviors that are consistent with improving, maintaining and or enhancing health (Raine, 2005). Meal pattern and food intake are markers for nutrient intakes and diet quality (Kerver *et al.*, 2006). Nutrient intake has an influence on health and development of several chronic diseases. The preference for eating habits or foods in humans is established by the influences from socioeconomic level of household, religion, tradition, regional characteristics, educational level of parents, public media, and long-term education at home, school, and the society. Urbanization and globalization has seriously affected one's eating habits and enforced many people to consume fancy and high calorie fast foods, popularly known as Junk foods (Solomons and Gross, 1995).

### **MATERIALS AND METHODS**

The study was conducted during the period of January 2017 to June 2017 in the Fifth ward of Karavaram Panchayat, Thiruvananthapuram district, Kerala. Site covers an area of 1.25 sq. km. It is a typical rural area having low population density. Here, generally the land is plain. The elevated land slopes play host to groves of rubber in addition to other crops such as tapioca. Majority of people belong to the Hindu community. Most of the people are engaged in Agriculture. Total families of about 191 are present. People who work at daily wages are also present. Predominant landmarks are absent. A simple baseline survey was conducted to gather information on food and related diseases. To predict the characteristics of the entire population, all households were taken for investigation and observation. Age, sex, education, level of income and average family size of the study respondents were considered independent variables in the study. Age is categorized into 5 groups. Data was collected on average consumption of foods and nutrients by various socioeconomic and demographic groups. Assessment of habitual dietary intake of each person in a family is also taken into consideration. Economic status was stratified into three classes as upper class, middle class and lower class. Data were collected by questionnaire. The questionnaire included several questions on frequently consumed food, eating out, and perceived associated health risk, and other basic things.

## RESULTS

Subjective information is presented in TABLE 1. According to the study, it was clear that the age group of 15 – 30 showed obesity (1.64%) and thyroid (3.28%) (TABLE 2) .In site , among the fast food consuming people, 87.5% of people had diabetes and the percentage of other lifestyle diseases were also high (TABLE 3).

**Table 1: Profile of the participants (Baseline)**

Demographic characters		Site
Sex	Male	45.68
	Female	54.32
Age Group	0-15	23.05
	15-30	25.51
	30-40	17.28
	40-50	15.64
	50 Above	18.52
Literacy Rate	Literate	62.14
	Illiterate	37.86
Economic Conditions (According to income)	Upper Class	-
	Middle Class	53.57
	Lower Class	46.43

**Table 2: Diet related diseases in site**

Age categories	Diabetes (%)	Cancer (%)	High B.P (%)	High Cholesterol level (%)	Obesity (%)
1-15	-	-	-	-	-
15-30	-	-	-	-	1.64
30-40	4.76	-	6.83	9.63	-
40-50	9.36	-	26.35	25.36	-
50 above	23.64	-	35.29	32.73	3.64

**Table 3: Food Preferences and related diseases in site**

Diseases	Fast food (%)	Homely food (%)
Diabetes	87.5	12.5
Cancer	-	-
Stroke	85.23	15.1
High B.P	77.78	22.22
Osteoarthritis	75	25
High Cholesterol level	72.73	27.27



Obesity	80	20
Thyroid(other diseases)	70	30

## DISCUSSION

The principles of healthy eating are the basis on which everyone can build a diet according to their taste preferences, motivation, awareness and living conditions. Nearly 80% of the respondents were unaware of this principle. The kinds and amount of food eaten are affected by the money that can be spent for food India is facing an “epidemic” of diet related non-communicable diseases, along with prevalent under nutrition resulting substantial socioeconomic burden. A decreasing intake of coarse cereals, pulses, fruits and vegetables, an increasing intake of meat products and salt coupled with declining levels of physical activity due to rapid urbanization have resulted in escalating levels of obesity, atherogenic dyslipidemia, subclinical inflammation, metabolic syndrome, type 2 diabetes mellitus, and coronary heart disease.

## CONCLUSION

Balanced meal through healthy and rational eating habits is very important in the growth, development and health improvement in humans, and this is not accomplished by appetite or food preference but can be accomplished by the practice of proper dietary habits on the basis of proper nutrition knowledge. The way of eating is determined by the age, the sex, the physical and/or mental work that is fulfilled by each individual and it can differ in order to ensure normal growth, employability and creating prerequisites for good health and life. A balanced intake of proteins, carbohydrates, fats, vitamins and minerals with or without cooked food and distribution of meals during the day is a premise for maximizing the health and the quality of life. The survey found that a few people have a little awareness of the useful and harmful food products. The current study suggests that there is much room for improvement in the diet of the population.

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## REFERENCES

- Kerver, J.M., Yang, E.J., Obayashi, S., Bianchi, L. and Song, W.O. (2006). Meal and snack patterns are associated with dietary intake of energy and nutrients in US adults. *Journal of the American Dietetic Association* **106**(1) 46-53.
- Raine, K. (2005). Determinants of healthy eating in Canada: an overview and synthesis. *Canadian Journal of Public Health* **96** S20-S26.
- Solomons, N.W. and Gross, R. (1995). Urban nutrition in developing countries. *Nutr Rev* **53**:90-95.

## PRODUCTIONS OF INDUSTRIAL ENZYMES FROM RED FLOUR BEETLE, *TRIBOLIUM CASTANEUM* (HERBST) AND THEIR POTENTIAL APPLICATION AS A DESTAINER

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### ABSTRACT

*Tribolium castaneum* is a major secondary storage pest that feeds on a wide variety of foods such as nuts, grains, pulses. The damage caused by this pest has resulted in economic losses to the food industry. But this pest can also be exploited for industrial purposes. Many insects including beetle family have been reported to have their indigenously produced enzymes. In the present work, *Tribolium castaneum* crude samples were isolated to screen the cellulase and amylase production. The enzyme production was established by substrate-agar plate assay and confirmed by endoglucanase and amylase assay. In addition, the partially purified cellulase and amylase showed its destaining ability against blood stained clothes.

**Keywords:** Amylase, Cellulase, Destaining, Enzymes, *T. castaneum*

### INTRODUCTION

The red flour beetle, *Tribolium castaneum* (Herbst) (Coleoptera:Tenebrionidae) is a worldwide stored product pest commonly found in indoor foodstorage facilities [3]. It attacks stored food products such as flour, cereals, beans, spices, , nuts, seeds, etc. [8,9]. Infestations cause significant loss due to the consumption of grains. Their presence also results in elevated temperature and moisture conditions which lead to an accelerated growth of molds including toxigenic species [4]. They infest stored products with their larva layers and excrements and consequently lower the quality of stored products greatly. Adult insects and larvae also feed upon broken grains [1]. Besides consumption and contamination of products (through faeces, shed skin, body parts, secretions, dead insects), these beetles can cause infested products to give off a displeasing odour and taste. Though pests are found to be troublesome, they can also be exploited for commercial purposes. One such application of the red flour beetle is the production of industrially important enzymes such as amylases and cellulases. A number of researches have been done to obtain enzymes economically from yeast, bacteria, plants and animals. Amylase is an enzyme which reduces the carbohydrate sources to oligosaccharides, which are essential for all the living organisms to release energy. Amylase is highly used in industries for wide number of process like fermentation, drug production and in food industries. Cellulases are the enzymes that can hydrolyze beta-1,4 linkages in cellulose chains, as a result of which they release oligosaccharides, cellobiose and glucose. They are enzymes that are synthesized by quite a large number of microorganisms including fungi and bacteria during their growth. Cellulolytic enzymes have the potential to convert cellulosic biomass into useful products [6]. Cellulose is mainly produced by terrestrial plants and marine algae and used as a food source by many organisms [7]. Pests like *Tribolium castaneum* (red flour beetle) obtain food and energy by degrading plant cellulose into its constituent residues by the cellulolytic enzyme, cellulases [6]. While living on a starch-rich diet, these insects depend on the enzymatic activity of amylase, or more precisely,  $\alpha$ -amylase present in them for survival. This present study was thus mainly carried out, to isolate and screen the amylolytic and cellulolytic activities in *Tribolium castaneum* and to know about the industrial applications of these enzymes.

### MATERIALS AND METHODS

#### COLLECTION OF INSECT SAMPLE

*T. castaneum* (red flour beetle) samples were collected from nearby cashew factory and reared in the laboratory at optimum conditions.

#### PREPARATION OF CRUDE ENZYME SAMPLE

Crude enzyme sample was prepared by homogenizing 10g of insect sample in 40 ml 0.1 M Phosphate buffer of pH 7.0. Homogenate was kept overnight in freezer and centrifuged at 10,000 rpm to discard pellet. 10 ml of supernatant was added to 40 ml of icecold acetone and kept overnight at 4°C to get proteins in precipitate form. The mixture was centrifuged at 10,000 rpm for 15 min. The pellets were air dried and dissolved in 10 ml of 0.1 M phosphate buffer and 10 ml of Tris-HCl buffer of pH 6.0 and 8.0 respectively. This crude protein sample was stored at 4°C and used as the enzyme source [6].

#### SCREENING OF ENZYMES

50µL of the enzyme sample was loaded on to the wells punched in starch agar plates and CMC Agar plates respectively plates and incubated for 24h at 37°C. After incubation, the starch agar plate plates were spread with iodine solution (0.3% iodine and 1% KI). Similarly, the CMC Agar plates were stained with 0.1% congo red dye for 15 min followed by de-staining with 0.5 M sodium chloride solution. Enzyme positive samples were identified and recorded based on the clear zone formation around the sample well.

#### PRODUCTION AND PARTIAL PURIFICATION OF THE ENZYMES

1mL of the crude enzyme sample were added to Starch Broth and CMC Broth respectively and incubated for 7 days for maximum amylase and cellulase production. After incubation the media were centrifuged at 5000 rpm for 10 min. So, as to partially purify the enzymes, ammonium sulfate precipitation was done on the collected supernatant.

#### ENZYME ASSAY

Alpha amylase activity and Endoglucanase activity was checked by DNS method of Miller [5]. The absorbance of both the reaction mixture was measured at 540nm using the Shimadzu UV-VIS-NIR Spectrophotometer.

#### APPLICATION OF THE ENZYME

Application of the partially purified enzymes as a detergent additive was studied on white cotton cloth pieces stained with human blood. The stained cloth pieces were taken in separate flasks. The following sets were prepared.

- ❖ Stained cloth (human blood) + distilled water (100 ml)
- ❖ Stained cloth (human blood) + distilled water (100 ml) + 1 ml detergent (5 mg/ml)
- ❖ Stained cloth (human blood) + distilled water (100ml) + 1 ml detergent (5 mg/ml) + 1 ml enzyme solution (Amylase)
- ❖ Stained cloth (human blood) + distilled water (100ml) + 1 ml detergent (5 mg/ml) + 1 ml enzyme solution (Cellulase)

The above flasks were incubated at 50°C for 15 min. Thereafter the cloth pieces were taken out, rinsed with water and dried for visual examination.

## RESULTS AND DISCUSSION

The present work was carried out to extract industrially important enzymes such as Amylase and Cellulase from the Red Flour Beetle, *Tribolium castaneum*.

#### SCREENING OF ENZYMES

Substrate plate agar assay was adopted for the screening of amylase and cellulase using the Star Agar Media and CMC Agar media respectively. Clear zones was found near the sample well after staining both the plates with iodine solution and Congo Red solution respectively (FIGURE.2). The formation of clear zone around the sample wells clearly indicates the utilization of the substrate (starch and CMC) by the enzyme sample loaded on to the wells.

**FIGURE.2 Image showing the Clear Zone Around the Sample Wells in CMC Agar Plate and Starch Agar Plate**



#### ENZYME ASSAY

The concentration of the partially purified Amylase and Cellulase were quantified using the DNS Assays. The concentration of the amylase enzyme was found to be 1790.432  $\mu\text{g/mL}$  while that of cellulase was found to be 1883.237  $\mu\text{g/mL}$ .

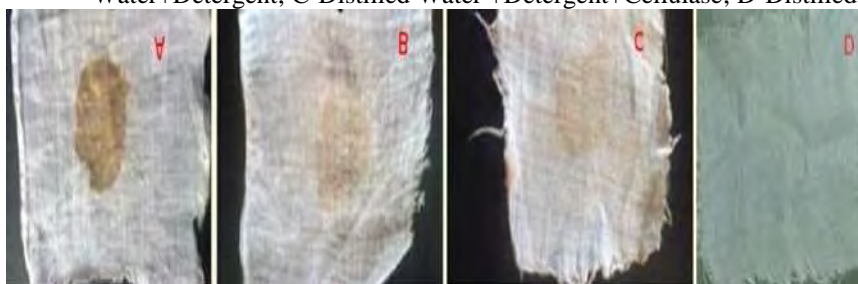
TABLE.1 Concentration of the Partially Purified Enzymes

Sl.No	Enzyme	Absorbance at 540nm	Concentration ( $\mu\text{g/mL}$ )
1	Amylase	0.222	1790.432
2	Cellulase	0.246	1883.237

#### APPLICATION OF THE ENZYMES AS A DESTAINER

To ascertain the application of amylase and cellulase as wash detergent additives, the experiment was carried out which included the soaking of blood stained white cloth pieces in different solutions for 15 min. It was found that among the different conditions of washing tested; the mixture of enzymes and detergents showed faintness of the blood. The complete removal of stain was seen in the detergent solution supplemented with amylase enzyme whereas the stains were not completely removed from cloth dipped in cellulase and detergent mixture (Figure.3). This suggested that the amylase enzyme may be useful to detergent industry. Our results are in accordance with reports of Hmidet, *et al.*, 2009 [2] who have worked on enzyme preparation containing amylase and protease produced by *Bacillus licheniformis*. Wash performance analysis revealed that this crude enzyme could effectively remove a variety of stains, such as blood, chocolate and barbecue sauce.

FIGURE.3 Effect of Different Solutions on the Blood Stained Cloth; A- Distilled Water; B-Distilled Water+Detergent; C-Distilled Water +Detergent+Cellulase; D-Distilled Water+Detergent+Amylase



#### CONCLUSION

Stored food products are subjected to the attack of wide variety of pests that feed on various conditions. One such pest is the red flour beetle, *Tribolium castaneum* which attacks food products such as grains, nuts, pulses etc. The infestation leads to the reduced quality and marketability of such food products. Though, these pests are found to be troublesome, there are ways by which such pests can be exploited for commercial purposes. In the present study, the production of commercially important enzymes from the pest was studied. The partial purification of these enzymes

were done and their application as a destainer was also studied. It was found that the amylase enzyme extracted from the pest, was found to have a higher destaining ability than cellulase.

## REFERENCES

- Bagheri-Zenouz, E. (1995). Stored products pests and its control methods. 309 pp.
- Hmidet, N., Ali, N. E. H., Haddar, A., Kanoun, S., Alya, S. K., & Nasri, M. (2009). Alkaline proteases and thermostable  $\alpha$ -amylase co-produced by *Bacillus licheniformis* NH1: Characterization and potential application as detergent additive. *Biochemical Engineering Journal*, 47(1-3), 71-79.
- Liu, Z. L., & Ho, S. H. (1999). Bioactivity of the essential oil extracted from *Evodia rutaecarpa* Hook f. et Thomas against the grain storage insects, *Sitophilus zeamais* Motsch. and *Tribolium castaneum* (Herbst). *Journal of Stored Products Research*, 35(4), 317-328.
- Magan, N., Hope, R., Cairns, V., & Aldred, D. (2003). Post-harvest fungal ecology: impact of fungal growth and mycotoxin accumulation in stored grain. In *Epidemiology of Mycotoxin Producing Fungi* (pp. 723-730). Springer, Dordrecht.
- Miller, G. L. (1959). Use of dinitrosalicylic acid reagent for determination of reducing sugar. *Analytical chemistry*, 31(3), 426-428.
- Rehman, F. U., Aslam, M., Tariq, M. I., Shaheen, A., Sami, A. J., Naveed, N. H., & Batool, A. I. (2009). Isolation of cellulolytic activities from *Tribolium castaneum* (red flour beetle). *African Journal of Biotechnology*, 8(23).
- Teeri, T. T. (1997). Crystalline cellulose degradation: new insight into the function of cellobiohydrolases. *Trends in biotechnology*, 15(5), 160-167.
- Via, S. (1999). Reproductive isolation between sympatric races of pea aphids. I. Gene flow restriction and habitat choice. *Evolution*, 53(5), 1446-1457.
- Weston, P. A., & Rattlingourd, P. L. (2000). Progeny production by *Tribolium castaneum* (Coleoptera: Tenebrionidae) and *Oryzaephilus surinamensis* (Coleoptera: Silvanidae) on maize previously infested by *Sitotroga cerealella* (Lepidoptera: Gelechiidae). *Journal of Economic Entomology*

# PHYTOPLANKTON DIVERSITY AND WATER QUALITY ASSESSMENT OF TAPI RIVER AT UTRAN, SURAT (GUJARAT)

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## ABSTRACT

The present work deals with the Phytoplankton diversity and water quality assessment of Tapi River at Utran, Surat (Gujarat). To fulfill the aim, Phytoplankton and water samples were collected on monthly basis from September-2015 to February-2016. Phytoplankton samples were collected using 20 $\mu$  mesh size plankton net and preserved simultaneously. Various water quality parameters like pH, Temperature, Dissolved Oxygen, Nitrate, Nitrite and Phosphate were analyzed in to the laboratory using standard methods. Quantitative estimation of Phytoplankton was done by using standard method. Identification of Phytoplankton was carried out by using standard references. During the study period, Monthly variations in water quality parameters were recorded. Phytoplankton comprised the members of Bacillariophyceae, Chlorophyceae, Cyanophyceae and Dinophyceae. Total 27 genera of phytoplankton were recorded. Among all Bacillariophyceae (13 genera) comprised highest generic diversity followed by Chlorophyceae (9 genera), Cyanophyceae (4 genera) and Dinophyceae (1 genera).

Key-words: Phytoplankton diversity, Water quality, Bacillariophyceae, Tapi River, Utran

## INTRODUCTION

Phytoplanktons are tiny aquatic flora present in all water bodies. They are the chlorophyll bearing organisms act as Primary producers in aquatic food chain. They are the basic component through which energy in transferred to the higher trophic levels in aquatic food chain. Phytoplankton are either present as unicellular, colonial or filamentous forms in the water body. The environmental health of a particular aquatic ecosystem depends upon spatial-temporal distribution, species composition, relative abundance and biomass of phytoplankton (Khattak *et al.*, 2005). The nutrient factors, Physico-chemical parameter, biological interactions, and carbon exchange significantly influence the diversity and population of phytoplankton (Rajagopal *et al.*, 2010). Phytoplanktons are very sensitive to the environment in which they live. They are used as "Bio indicator" to evaluate water quality deterioration and its impacts on biological communities. Alteration in water quality ultimately affecting the phytoplankton community in terms of their diversity and abundance. Keeping in view , the importance of Phytoplankton in aquatic ecosystem present investigation was attempted to study the Plankton diversity and water quality in Tapi river at Utran, Surat, Gujarat.

## MATERIALS AND METHODS

The present study was carried out monthly on monthly basis during the September-2015 to February-2016. For the study, Utran was selected as site. Utran is situated on bank of Tapi River in to the Surat district. Gas based thermal power plant located near by the pre-selected site. Tapi River at the Utran site affected by mainly due to the anthropogenic activities. For Phytoplankton analysis, surface Water samples were collected on monthly basis at pre-selected site. Phytoplankton samples were collected by filtering 50L of water through plankton net of having 20 $\mu$  mesh size. The samples were concentrated up to 100ml and preserved with 5% formalin. The quantitative estimation

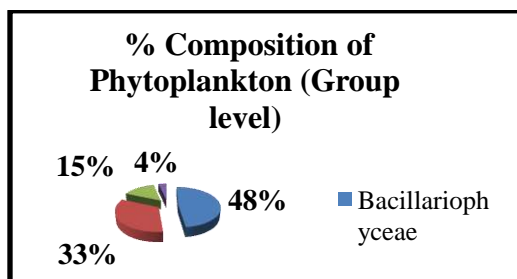
of Phytoplankton was carried out by Lackey's drop method (APHA, 2005). Phytoplankton were identified by using standard literatures viz. Sarode and Kamat (1984), Desikachary (1959), Edmondson (1959) and Prescott (1962).

Water quality parameters were analyzed once in month. Water samples were collected from the pre-selected site. Temperature and pH were recorded immediately at the sites. Other Physico-chemical parameters viz., Dissolved Oxygen, Nitrate, Nitrite and Phosphate were analyzed in to the laboratory by using standard methods (APHA, 2005).

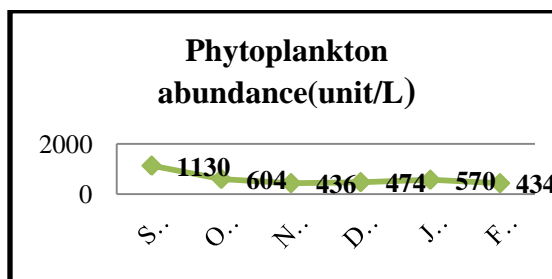
## RESULTS AND DISCUSSION

Phytoplankton mainly represented by four taxonomic groups: Bacillariophyceae, Chlorophyceae, Cyanophyceae and Dinophyceae. Percentage wise composition of Phytoplankton groups are shown in FIG-1. Maximum composition were represented by Bacillariophyceae (48%) followed by Chlorophyceae (33%), Cyanophyceae (15%) and Dinophyceae (4%). Phytoplankton abundance was varied between 434 to 1130 (unit/L) were recorded during the study period shown in TABLE-1. FIG-2 shows Graphical representation of monthly variation in Phytoplankton abundance (unit/L). PLATE-I shows commonly found Phytoplankton during the study period. The water quality parameters of Tapi River at Utran site have been depicted in Table-1. During the study period, Temperature was varied between 24 to 30 °c. pH of Tapi river fluctuated between 7.39 to 8.64. Dissolved Oxygen of Tapi river varied between 5.87 to 7.9 mg/L. Nutrients like Nitrate, Nitrite and Phosphate were found as 2.764 to 1.78 mg/L, 0.029-0.06 mg/L and 0.03 to 1.68 mg/L respectively.

**Fig-1 Graphical representation of percentage wise composition of Phytoplankton**



**Fig-2 Graphical representation of monthly variation in Phytoplankton abundance (unit/L)**



**Table-1 Monthly variation in water quality parameters and phytoplankton abundance**

Month	Temp (°c)	pH	Dissolved Oxygen (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	Phosphate (mg/L)	Phytoplankton abundance (Unit/L)
Sep-15	30	8.1	5.87	1.78	0.047	0.15	1130
Oct-15	29	8.64	7.29	2.75	0.021	0.14	604
Nov-15	28.5	7.81	7.5	2.761	0.06	1.68	436
Dec-15	24	7.83	7.9	2.764	0.045	0.22	474

Jan-16	25	7.59	7.09	1.896	0.029	0.03	570
Feb-16	26.5	7.39	6.08	2.016	0.038	0.19	434

For the growth and development of Phytoplankton, healthy environment is very necessary in which they exists. Water temperature plays an important role in influencing the periodicity, occurrence and abundance of phytoplankton.(Tripathi and Pandey, 1995). pH is a major environmental factor of aquatic ecosystems at the interface of physicochemical and biological processes and It is regulated by carbonate equilibrium in inland water (Weisse and Stadler ,2006). Dissolved oxygen is an important parameter of aquatic system, which is essential to the aerobic metabolism of all aquatic organisms (Wetzel, 1975). Nutrients availability in water is a one of key factor important for the Phytoplankton growth. Alteration in nutrient level in water alters the abundance and composition of Phytoplankton in water body. During the study, Total 13 genera of Bacillariophyceae group were recorded which were represented by, *Aulacoseira sp.*, *Bacillaria sp.*, *Coscinodiscus sp.*, *Cyclotella sp.*, *Cymbella sp.*, *Diadesmis sp.*, *Fragilaria sp.*, *Gomphonema sp.*, *Gyrosigma sp.*, *Navicula sp.*, *Nitzchia sp.*, *Surirella sp.* and *Synedra sp.* Nirmalkumar *et al.*,2011 reported that alkaline pH supporting good population of Bacillariophyceae.

#### Plate-I commonly found Phytoplankton during the study period



*Synedra sp.*



*Nitzchia sp.*



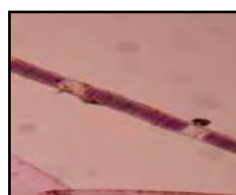
*Closterium sp.*



*Spirogyra sp.*



*Oscillatoria sp.*



*Lyngbya sp.*

Total 9 genera of Chlorophyceae group were recorded during the study period, it included, *Coelastrum sp.*, *Closterium sp.*, *Cosmarium sp.*, *Hydrodictyon sp.*, *Pediastrum sp.*, *Pleodorina sp.*, *Scendesmus sp.*, *Spirogyra sp.*, and *Volvox sp.* Nirmal Kumar *et al.*, 2005 reported that high water temperature, phosphate, nitrate and low DO support the growth of Chlorophyceae .Total 4 genera of Cyanophyceae group were recorded which included *Oscillatoria sp.*, *Lyngbya sp.*, *Merismopedia sp.*, and *Microcystis sp.* The distribution of Cyanophyceae depends upon availability of nutrients like nitrates and phosphates (Smith, 1983). *Ceratium hirudinella* belongs to Dinophyceae were recorded during the study period.

#### CONCLUSION



In the Present investigation attempts have been made to ascertain the Phytoplankton diversity and variation in water quality parameter of Tapi River at Utran, Surat, Gujarat. Phytoplankton dominated by Bacillariophyceae followed by Chlorophyceae, Cyanophyceae and Dinophyceae. Monthly variations in water quality were recorded. The study reveals that Phytoplankton diversity and abundance are depended on the water quality.

## **REFERENCES**

- APHA, (2005) Standard Method for the Examination of Water and Wastewater (21<sup>th</sup> ed.), New York.
- Desikachary, T.V (1959) Cyanophyta. Indian council of Agriculture Research.
- Edmondson W.T. (1959) Freshwater Biology, 2<sup>nd</sup> edition, John Wiley and Sons, Inc., New York
- Khattak, T.M., Bhatti, N., Murtaza, G., (2005). Evaluation of algae from the effluent of Dandot Cement Company, Dandot, Pakistan. J. Appl. Sci. Environ. Manage. 9, 147–149.
- Nirmal Kumar, J.I., Sharma, Geetika, Rita N. Kumar and Shintu Joseph (2005). An assessment of eutrophication and weed growth of certain wetlands of Gujarat. In: (Eds. Trivedy, R. K.) Recent Advances in Water Pollution Research. Book Enclave, Jain Bhavan, Jaipur, pp. 129-150.
- Prescott G.W(1962) Algae Of The Western Great Lakes Area WM. c brown company publisher.
- Rajagopal, T., Thangamani, A., Sevarkodiyone, S.P., Sekar, M. and G. Archunan, G. (2010). Zooplankton diversity and physico-chemical conditions in three perennial ponds of Virudhunagar district, Tamilnadu. J. Environ. Biol. 31: 265-272.
- Sarode, P.T. and Kamant, N.D. (1984), Freshwater diatoms of Maharashtra, Saikrupa Prakasan, Aurangabad.
- Smith, V.H., (1983). Low nitrogen to phosphorous ratio favour dominance by blue-green algae in lake phytoplankton. Science 221:669–670.
- Tripathi, A.K., and Pandey, S.N., (1995). Water pollution, Ashish publishing House New Delhi-110026.

# **EXTRACTION AND CHARACTERIZATION OF PECTIN FROM TWO DIFFERENT FRUIT PEEL WASTE**

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## **ABSTRACT**

*Food processing industries like fruit and vegetable processing are the second largest generator of wastes into the environment. Wastes from such processing units include peels, seeds, stones, and unused flesh. Disposal of these wastes has become a problem of both environmental and economic concern. But, these wastes can be utilized economically in the production of products of bio-value like pectin. Pectin is a type of fiber found in a variety of fruits and vegetables. It can be extracted from the cell wall of plants, especially the leaves, roots, and fruits. A number of fruits are a very good source of pectin. In food processing industries, after extracting the juice from fruits, its peel and other wastes are often thrown away. The present work focuses on the extraction of pectin from fruit peels such as that of banana and papaya. Pectin extraction was carried out using 1N hydrochloric acid followed by ethanol precipitation and the reaction parameters were optimized. The extracted pectin was characterized by the properties like methoxyl content, degree of esterification, equivalent weight, and total anhydrouronic acid content (TAUA%) as these properties determine the suitability of pectin for different purposes. The results reveal that the pectin obtained from papaya and banana peels are very low methoxyl pectin. The extracted pectin was used to assess its potential as a gelling agent and it was found to have a good gelling ability in the presence of Calcium ions. Hence, it is used commercially in making jams and jellies. Pectin also has medicinal properties like in the prevention of cholesterol, colon cancer, prostate cancer, and diabetes.*

**KEYWORDS:** *Extraction, fruit waste, methoxyl content, pectin, total antihydrouronic acid*

## **1. INTRODUCTION**

Fruit waste serves a major portion of municipal solid wastes (MSW), which is posing tough environmental issues. Different techniques used to dispose MSW are landfill and incineration. However, improper management of landfill will produce emissions of methane and carbon dioxide. Whereas incineration of the organic waste involves the formation of pollutants such as dioxins, furans, acid gases as well as particulates [3], which pose serious risks to the environment and health. These fruit wastes are a rich source of organic matters that can be utilized as natural substrates for microorganisms for its bioconversion to useful enzymes, a product of bio-value, which will also reduce risks of pollution caused by the dumping of such wastes [2]. In this paper, fruit wastes like banana and papaya peels are used as substrates for the production of pectin. Pectins are high molecular weight complex polysaccharides (heteropolysaccharides) widely spread in the plant kingdom. They can be found as an integral part of the primary cell wall and middle lamella of higher plants. Different factors like pH, presence of other solutes, molecular size, degree of methoxylation, number and arrangement of side chains, and charge density on the molecule — influence the gelation of pectin. The manufacture of pectin is an expensive and complicated process involving the preparation of raw materials including deactivation of enzymes, removal of bitter glycosides and crude sugars, conversion of protopectin into soluble pectin, filtration of the extracted pectin, precipitation of the pectin, purification and drying of the pectin. The present work focuses on the extraction of pectin from fruit peels such as that of banana and papaya.

## 2. MATERIALS AND METHODS

### 2.1 Sample Collection

Fruit wastes such as peels of banana and papaya were collected from different locations like houses, fruit stalls, bakeries, etc. Collected fruit wastes were cut into pieces for easy drying at 60°C for 24. The samples were ground to powder and kept separately in air-tight moisture free bags for extraction purposes.

### 2.2 Extraction of Pectin From Fruit Peel

Extraction was done using 1N HCl and the filtrate obtained was alcohol precipitated using 96% ethanol and kept overnight. Later centrifuged and pellet was collected and dries in an oven. The dried pectin was obtained and stored in a cool dry place until further analysis.

### 2.3 Optimization of Reaction Parameters

The optimization of the parameters such as pH (2,3,4) Temperature(60,70,80) and incubation time (30,45,60 mins) was performed in order to obtain maximum pectin yield.

### 2.4 Physicochemical Characterization of Pectin

- Pectin Yield:

The yield of the pectin extracted from both banana and papaya peels were calculated using the following formula

$$\text{Pectin (g/100g)} = \frac{(\text{weight(g) of dried pectin} \times 100)}{\text{weight (g) dried peel powder taken for extraction}}$$

- Moisture Content:

Moisture content was determined according to the Association of Analytical Chemists (AOAC) method [1].

- Equivalent Weight:

Equivalent weight was determined by the standard methods of Owens *et al.* [6].

$$\text{Equivalent weight} = \frac{(\text{weight of sample} \times 1000)}{\text{volume of alkali} \times \text{Normality of alkali}}$$

- Methoxyl Content:

Methoxyl (MeO) content was determined by adding 25ml of 0.25N NaOH to the neutral solution, mixing thoroughly, and allowed to stand for 30 minutes at room temperature in a stopper flask. 25ml of 0.25N HCl was then added and titrated with 0.1N NaOH to the same end point as before.

$$\text{Methoxyl content (\%)} = \frac{(\text{ml of alkali} \times \text{Normality of alkali} \times 3.1)}{\text{weight of sample}}$$

- Total Anhydrouronic Acid Content (TAUA):

Total AUA of pectin is obtained by the following formula as per Mohamed and Hasan [5].

$$\text{TAUA (\%)} = \frac{(176 \times 0.1z \times 100)}{W \times 1000} + \frac{(176 \times 0.1y \times 100)}{W \times 1000}$$

- Degree of Esterification (DE):

DE of extracted pectin was calculated from methoxyl and anhydrouronic acid content using the following expression

$$DE = \frac{(176 \times \text{methoxyl content}(\%) \times 100)}{31 \times AUA(\%)}$$

### 2.5 Evaluation of the Gelling Property of the Extracted Pectin:

A mixture of pectin powder and sucrose were dissolved in 100 mM sodium chloride solution, under gentle stirring, at room temperature for 15–16 h. The pH of the solutions obtained was finely-tuned to 3.0. The mixtures were then heated to boiling point ( $85 \pm 2$  °C) under stirring and an appropriate amount of a pre-heated calcium chloride dihydrate solution, prepared in 100 mM sodium chloride, was slowly added under vigorous stirring until the desired calcium content was reached. The pH of the mixtures was controlled and kept constant during gelation. The prepared gels were molded and allowed to cool to room temperature, and were finally rested for 24 h at 4 °C

## 3. RESULTS AND DISCUSSION

Pectin was extracted from the fruit peels of papaya and banana. Extraction of pectin were carried out in both peels separately and their reaction parameters such as pH(2,3 and 4), incubation time(30,45,&60min) and temperature (60°C,70°C,80°C) were optimized. Alcohol precipitation was done with ethanol and the pectin was separated via centrifugation

### 3.1. Effect of pH, Temperature & Incubation Period on the pectin

The yield of pectin from papaya peel was maximum for the pH 3 (23.15%) at 80°C for 30min (9.31%). Hence, we can infer that the standard conditions for the production of pectin from papaya peel is pH 3, temperature 80°C and incubation time 30 min. For banana the pectin yield was relatively low, the maximum yield was found at the pH 4 (7.692%) during the temperature 60°C and incubation time 30 min (14.31%). The pectin yield from papaya was 6.804% and that of banana was 3.19%. The results obtained were compared with the previous findings found in the literature. Rehman *et al.* investigated the optimum conditions for extraction and precipitation of pectin from mango peels which was found to be at pH 2.5, 80 °C and 120 minutes [7]. In the present work, only alcoholic precipitation was done and the results were found to have a good yield of pectin.

### 3.2. Characterization of the Extracted Pectin

Extracted pectin was characterized by the different properties to determine the suitability of pectin for different purposes. It is clear from the results that pectin from papaya and banana peel are very low methoxylpectins with 5.456% and 3.968% respectively. Equivalent weight was found to be 568.182 and 781.25 respectively. Anhydrouronic acid content of pectin from banana peel is least with 45.056 to highest, 61.95 in pectin obtained from papaya peel and DE was found to be 50% for both pectins. Madhav and Pushpalatha studied on the pectin extraction and preparation of jelly from different fruit wastes, jackfruit rind, nutmeg rind, passion fruit rind, mangosteen rind, pomello peel, mango peel, pineapple peel, citrus peel, banana peel and cocoa pod husk [4].

### 3.3. Gelling Property of the Extracted Pectin

The gelling property test revealed the low gelling grade of the extracted pectin. Owing to the low methoxyl content, the extracted pectin can thus have applications in bakery industries.

## CONCLUSION

The present study focused on the production of pectin from fruit wastes that are rich in organic matter. This study is solution the serious problems caused by the dumping of food waste to the environment to a large extent. Pectin is a high value functional food ingredient with many other uses. The main use for pectin is as a gelling agent, thickening agent and stabilizer in food.

## REFERENCES

1. Association of Official Analytical Chemists Method 985.29. 1990. *Total dietary fiber in food*. Enzymatic-gravimetric method. Official Methods of Analysis of the Association of Official Analytical Chemists. 15<sup>th</sup> ed. Arlington, VA: AOAC International.
2. Bacha, U., M. Nasir, a. Khalique, a. a. Anjum, and M. a. Jabbar. 2011. "Various Agro-Industrial Wastes for Saccharomyces Cerevisiae Biomass Production and Its Quality Evaluation As Single Cell." *The Journal of Animal & Plant Sciences*, 21 (4), 844–49.
3. Boonrod D, Kamonrad R and Hataichanoke N, Extraction and physicochemical characteristics of acid-soluble pectin from raw papaya (*Carica papaya*) peel, Chiang Mai J Sci 2006, 33(1), 129-135.
4. Madhav, A. and Pushpalatha, P.B., 2006. Characterization of pectin extracted from different fruit wastes. *Journal of Tropical Agriculture*, 40, 53-55.
5. Mohamed, S., and Hasan, Z. (1995) "Extraction and characterisation of pectin from various tropical agrowastes," *Asean Food Journal*, 10(2). 43-50.
6. Owens, H. S., McCready, R. M., Shepherd, A. D., Schultz, S. H., pippen, E. I., Swenso, H. A., Miers, J. C., Erlandsen, R. F. and Maclay, W. D. 1952. Methods used at western regional research Laboratory for extraction and Analysis of pectic materials. Western regional Research Laboratory, Albania california AIC340.
7. Srivastava, P. and Malviya, R., 2011. "Sources of pectin, extraction and its applications in pharmaceutical industry– An overview." *IJNPR*, 2(1), 10-18.

# **PREDOMINANT HISTOLOGICAL ALTERATIONS IN AN EDIBLE SHELL FISH – *Scylla serrata* OF ASHTAMUDI LAKE, THE RAMSAR SITE, KOLLAM, KERALA.**

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## **ABSTRACT**

Day by day our aquatic bodies have been severely contaminated with various toxic pollutants. Anthropogenic influences such as discharge of heavy metals from industries, oil hydrocarbons from fishing trawlers, fertilizers and pesticides etc. play a major role in enhancing the toxicity of pollutants in the water bodies. Ashtamudi lake, one of predominant Ramsar site in Kerala, is widely disturbed with the above mentioned pollutants. The toxicity of aquatic pollutants in the water and sediment samples of Ashtamudi lake has been extensively studied by many authors. Aquatic organisms especially shell fishes are one of the recipients of various pollutants which resides in the lake. Shell fishes are notorious for their ability to concentrate different aquatic pollutants in their body. Pollutants can be transferred through the upper classes of the food chain once accumulated by an aquatic organism and paves way for biomagnifications. It is very important to determine the accumulation levels of pollutants in shell fishes since they contributes high proportion of protein sources in the food chain for human. The Shell fish, mud crab - *Scylla serrata* constitute one of the prime food source of humans in the domestic and international market. Consumption of fishes loaded with severe pollutants poses serious threat to the health of humans as well. Two important vital organs of *Scylla serrata* – muscle and liver were targeted for the present study. Comparison of normal histological samples with that of polluted ones have done. The results of the study revealed the fact that the accumulation of toxic pollutants alter the normal histological architecture of the samples collected from polluted region of the lake. Degenerated hepatocytes with swollen cells, necrosis, loss of tubular structures etc. were apparent in the distorted liver samples. Splitting of muscle fibres, focal area of necrosis and muscular oedema were some of the prominent histological alterations observed in the muscle samples.

**Key words** – Histology, Liver, Muscle, Pollutants, *Scylla serrata*.

## **INTRODUCTION**

Ashtamudi lake is one of the famous Ramsar site located in Kollam, Kerala. The delicate balance of this aquatic ecosystem has been completely altered due to the presence of numerous pollutants accumulated in the lake. Several anthropogenic disturbances such as discharge of heavy metals from industries, pollutants from coconut husk retting area, domestic garbage, sewage, oil hydrocarbons from fishing trawlers, fertilizers and pesticides through surface run off etc. play a major role in enhancing the toxicity of pollutants in the Ashtamudi lake. The effect of the toxicity of aquatic pollutants in the water and sediment samples of Ashtamudi lake has been reported by [3], [5] and many others.

Mud crabs are the most traded food commodity in India and elsewhere. Mud crab - *Scylla serrata* of Ashtamudi lake, is selected for the present study. Two important vital organs of *Scylla serrata* – muscle and liver were targeted for the study. The aim of this study is to draw a clear cut indication of the impact of aquatic pollutants on the selected species by comparing the histological samples from the polluted region of Ashtamudi with that of the control ones.

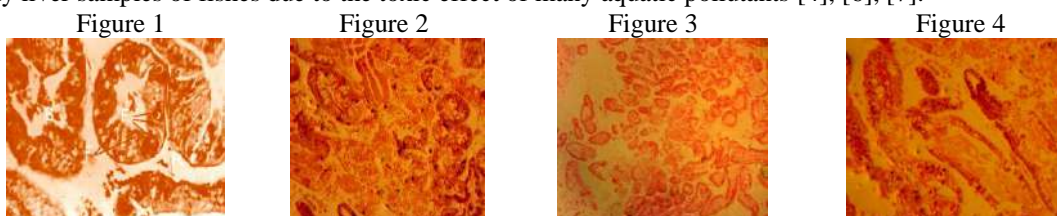
## **MATERIALS AND METHODS**

Healthy and active *Scylla serrata* of approximately equal carapace width (45-50 mm) and body weight (50 to 55 g) were collected from the fish farm, of Kollam district for the histological investigation. For comparing the pollution

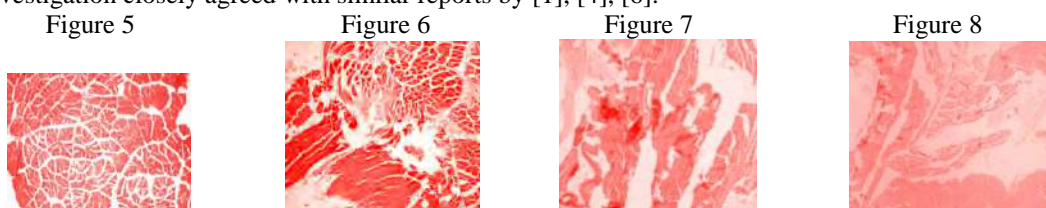
status of crabs, the live ones of approximately equal carapace width (45-50 mm) and body weight (50 to 55 g) were collected from a polluted region (Kureepuzha) of Ashtamudi lake by using cast net with the help of traditional fishermen. Crabs from both the control and polluted site were sacrificed, the liver and muscle samples were quickly excised and utilized for histological studies. The excised tissues were fixed in aqueous Bouins fluid. After fixation for 24 h, the tissues were further processed to study histological details as per procedure of Bancroft and Stevens [2].

## RESULTS AND DISCUSSION

Histologically, the hepatopancreas of the control crabs consisted of an epithelium composed of four cell types. E-cells (embryo nalenzellen), the F-cells (fibrillenzellen), the B-cells (blazen zellen), and the R-cells (rest zellen). The E-cells, were generally smallest of the hepatopancreatic cell types. The F-cells, were striated in nature. The B-cells, were the largest of hepatopancreatic cell types. The R-cells, the most abundant of the four cell types, had multi vacuolated cytoplasm (Figure 1). General degeneration of the tubular and intertubular tissues was observed in the samples of crabs collected from the polluted site. Disfigured and disoriented cells types were noticed in the liver samples (Figure 2). Loss of tubular structures and necrosis were other predominant changes noticed (Figure 3). Extensive vacuolation were also monitored in many histological samples (Figure 4). Similar results were noticed in many liver samples of fishes due to the toxic effect of many aquatic pollutants [4], [6], [7].



Muscle tissues of the control crabs were made up of muscle cells containing contractile filaments. Muscle tissue derived from mesoderm contains protein, and myosin filament form multi nucleate cells that assemble into fibers called myofibrils (Figure 5). When compared to the control samples, atrophy and wavy appearance of the muscle fibers (Figure 6), fragmentation and focal disappearance of the muscle fibers (Figure 7), necrosis and splitting of the muscle fibres (Figure 8) were well marked in the samples collected from the polluted study site. The present investigation closely agreed with similar reports by [1], [4], [6].



## CONCLUSION

Organisms in general and aquatic ones in particular are more sensitive to the harmful effects of the contaminants. Among the aquatic organisms fishes are one of the prime recipients of the detrimental effects of pollutants. So it is very important to analyse the accumulation levels of pollutants in fishes since they contributes high proportion of protein sources in the food chain for human. The results of the present study revealed the fact that the normal histological structure of the tissues were completely deviated from the crabs of polluted area. This inturn indicates the status of the impact of aquatic pollutants on the organisms. Pollutants can be transferred through the upper classes of the food chain once accumulated by an aquatic organism and paves way for biomagnifications.

### Acknowledgement

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## **REFERENCES**

- Andreji, J. (2006). Accumulation of some metals in muscles of five fish species from Lower Nitra River. *Journal of Environmental Science and Health, Part A: Toxic/Hazardous Substances and Environmental Engineering*, 2607–2622
- Bancroft, J.D. and Stevens, A. (1982). *Theory and practice of histological techniques*. Churchill Livingstone. Publ. New York.
- Geetha, B. (1997). Heavy metal pollution in ashtamudi estuarine system. Ph.D. Thesis. University of Kerala. Trivandrum .
- Hawkes, J.W. 1980. The effect of xenobiotic on fish tissues: Morphological studies. *Fed. Proc.* 39: 3230-3236.
- Karim, L.R., Williams, E.S. and Jaya, D.S. (2011). Studies on the ground water and surface water quality in the surroundings of Kureepuzha solid waste dumping site in Kollam district, S. India. *Research Journal of Chemistry and environment*. 15 (2): 952- 958.
- Sherly williams, E. And Lekshmi priya, V. (2017) An electron microscopic investigation on the effect of aquatic pollutants in an edible fish of Ashtamudi lake, the Ramsar site, Kerala. *International Journal of Research in Engineering and Applied Sciences* 7 (8): 79-85.
- Stentiford, G.D and Feist, S.W. (2005) A histopathological survey of shore crab (*Carcinus maenas*) and brown shrimp (*Crangon crangon*) from six estuaries in the United Kingdom. *Journal of Invertebrate Pathology* 88:136–146.  
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## **HISTOLOGICAL ALTERATIONS ON THE INTESTINE OF *ETROPLUS SURATENSIS* OF ASHTAMUDI LAKE ON EXPOSURE TO CERTAIN PESTICIDES**

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### **ABSTRACT**

*Humans have long interfered in nature by extracting natural resources and discarding residues into the environment. This impact has been intensified since the Industrial Revolution with many chemicals now being released into aquatic and terrestrial ecosystems as well as the atmosphere. Chemical pollutants enter aquatic environments as agricultural pesticides in run-off water, urban drainage, and precipitation. Punctual-sources of pollution, including industrial discharges, which can contain harmful residues and domestic waste water discharges also damage aquatic environments. Streams and rivers are generally the collecting environment for these pollutants. Toxic effects can be sensed immediately after exposure to toxicants or when followed by a lag. These effects are determined by the toxicological characteristics of the substance and the ability of the organisms to metabolize it. Aquaculture apart from agriculture is common in India, where fish, the non-target organisms are directly exposed to pesticides used for the control of insects and pests. The wide spread use of synthetic organic pesticides over decades has led to their frequent exposure in the environment. Evaluation of ecotoxicological risks caused by pesticides is based on the toxic effects to non-target organisms like fish. Fish are used as excellent indicator of aquatic pollution due to their high sensitivity to environmental contaminants which may damage certain physiological and biochemical processes when contact with the organs of fishes. Hence histopathological biomarkers provide a rapid method to detect effects of pesticides. The exposure of fish to chemical contaminants is likely to induce a number of lesions in different organs including the intestine. The intestine is the first organ to come into contact with food-borne contaminants. The intestine is a complex multifunctional organ and the first organ to come into contact with food-borne contaminants. In addition to digesting and absorbing feedstuffs, the intestine is critical for water and electrolyte balance, endocrine regulation of digestion and metabolism, and immunity. The present study aims to assess the pathological alterations in the intestinal tissues of a freshwater teleost, *Etroplus suratensis* obtained from Koivila, after a 96 hour exposure to Lindane, an organochlorine and Nuvan, an organophosphorus. A sub-lethal dose of 0.5 ppm was selected and the test was as that of its natural habitat. Light microscopic study, with Haematoxylin and Eosin stain, showed severe vacuolation and disintegration of mucosal folds in the intestine of the fish exposed to Nuvan. The study also revealed structural damages like inflammatory cell infiltration in the intestine of fish exposed to Lindane. Hence this study is indicative of a direct correlation between pesticide exposure and severity of effects.*

**Keywords**– *Etroplus suratensis*, Histology, Lindane, Nuvan

### **INTRODUCTION**

Pesticides, while of undeniable value to agriculture, are also significant agents of environmental impact. Frequently, organo-phosphorous contamination has been found in environments, elements of the food chain and humans. These products enter water bodies as a consequence of rain and leaching from the soil or because it is carelessly discharged directly into aquatic ecosystems. Therefore fish and other aquatic organisms may show its effects. Histopathological investigations on different tissues of fish are valuable tools for toxicology studies and monitoring water pollutions. Knowledge on pesticide toxicity levels, either by acute toxicity, residual or physiological studies, is essential to develop effective protective measures for time conservation of our already depleted freshwater fauna. Studies on the sub-lethal effects of pesticides have gained a great deal of impetus in the last decade, partly because of their practical importance and partly owing to academic interest [2].

*Etroplus suratensis* commonly known as “Karimeen” is often a delicacy to humans. This fish is fairly expensive and is available throughout the year. The present study is an attempt to study the histopathological changes in the intestine of *Etroplus suratensis* from Koivila region of Ashtamudi lake on exposure to two pesticides – Lindane and Nuvan. Lindane belongs to the organochlorine (OC) pesticide class. This is one of the oldest classes of pesticides, and few OCs are still in use today. The water-soluble organophosphorus insecticide “Nuvan ” is widely used in the Kolleru region of Andhra Pradesh for controlling the ectoparasites such as *Lernea*, *Argulus*, etc [3] ,[4].

#### **MATERIALS AND METHODS**

*Etroplus suratensis* collected from Koivila area were brought to the laboratory and acclimatized for a period of 7 days prior to the experiment. The fishes were divided into four groups of 6 each and subjected to different treatments viz ; Lindane and Nuvan, while maintaining its salinity at 10ppt. One tank of 6 fishes were taken as control for the comparative studies. After 7 days of acclimation, the tank 1 fishes were treated with Nuvan and the tank 2 fishes with Lindane for a period of 96 hrs. They were then dissected and intestines were collected and washed.

Tissues were fixed in Bouin’s solution ( prepared with saturated picric acid ,formaldehyde and acetic acid) for 48hrs and then dehydrated through graded alcohol series (70%-100%), cleared in xylene and embedded in paraffin. 5m paraffin sections were cut, ribbon of sections were taken on slides and excessive wax was removed heating slide on lamp. The sections were stained with haematoxylin-eosin, investigated and analysed under a light microscope. Histological alterations induced in the tissues by treatment were analysed and photographed by light microscope.

#### **RESULTS AND DISCUSSION**

Longest mucosa folds and thickest muscularis were well noticed in the control samples. Lamina propria and microvilli were also well developed and can be clearly observed in the control sample. (Figure 1) Several histological alterations were noticed in the treated samples of *Etroplus* when compared with the control ones. The intestine of fish exposed to Nuvan showed severe vacuolation and disintegration of mucosal folds (Figure 2) Inflammatory cell infiltration was the major histological alteration noticed in the intestine of *Etroplus* on exposure to Lindane (Figure 3). Similar histological alterations were noticed in many fish species on exposure to similar pesticides [1], [5].

Figure 1



Figure 2

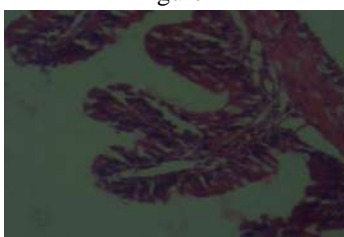
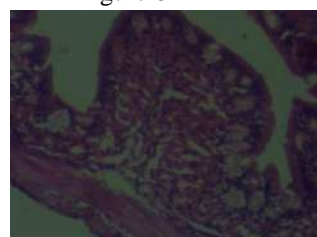


Figure 3



#### **CONCLUSION**

The histological changes in fish is a noteworthy and promising field to understand the extent to which changes in the structural organization are occurring in the organ due to environmental pollution. The histological changes observed in the intestine of *E. suratensis* indicates the chronic effects of the two selected pesticides.

#### **ACKNOWLEDGEMENT**

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#### **REFERENCES**

Debasish Bhattacharjee and Suchismita Das (2015) Intestinal Histopathology as a Biomarker for Lindane Toxicity in Teleost Fish, *Channa punctata* Global journal of biology agriculture and health science., Vol.4(3):16-18.

Kishor Haloi and Ramesh Nath (2013).The Study on the Histopathological Changes of Stomach of *Channa punctatus* (Bloch). By used Pesticide Endosulfan, Global Journal of Science Frontier Research Biological Sciences Vol.13,(2)1: 390-410.

Marko B. Stankovic ,Vesna D Poleksic (2011). Histological methods in the assessment of different feed effects on liver and intestine of fish , J. of agricultural science vol.56:87-100.

Mutukumaravel K, P. Rajaraman (2013). A study on the toxicity of chromium on the histology of gill and liver of freshwater fish *Labeo rohita*, J. of pure appl. zool., 1(2):122-126

Sadhna Kesharwani , K. K. Dube and Rizwana Khan (2018) International journal of science and research methodology. Effect of Dichlorvos (Nuvan) on Behaviour, Haematology and Histology of Freshwater Teleost *Labeo rohita* Vol.:8 (3).

# MICROBIOLOGICAL ASSESSMENT OF *RASTRELLIGER KANAGURTA* COLLECTED FROM THE LOCAL FISH MARKET OF PUNALUR

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## ABSTRACT:

Fish is an important food stuff and source of protein all over the world. In India especially Kerala, fisheries sector contributes a lot in case of earning foreign currency and meeting domestic need of animal protein. To meet the domestic need, fish and fish products are procured from the neighboring states. But it is evident from several studies that raw fish items sold in Kerala are heavily contaminated with pathogenic bacterial and toxin chemicals like formalin, ammonia etc which are highly hazardous and carcinogenic. Contamination may be caused by food-borne pathogens which are naturally present in aquatic environments, such as *Vibrio spp.*, *E. coli* etc, or derived from sewage contaminated water such as *Salmonella spp.* Consumption of these contaminated fish may cause infection or intoxication to the consumers. Water and ice quality is also an important factor for good quality fish, because water and ice used for fish processing may contaminate the quality. Therefore, the present study was carried out to investigate the microbiological quality of the edible fish, Indian Mackerel - *Rastrelliger kanagurta* collected from the local markets of Punalur town, for raising food safety concern and awareness in the public.

**Key words:** Fish quality, Microbial analysis, *Vibrio spp.*, Carcinogenic, *Salmonella spp.*

## INTRODUCTION

Fish contributes about 60% of the world supply of protein, and 60% of the developing world derives more than 30% of their animal protein from fish (Emikpe *et al.*, 2011, Sami *et al.*, 2016). Fishes are generally regarded as safe, nutritious and beneficial but aquaculture products have sometimes been associated with certain food safety issues (WHO, 2007). The contamination often occurs from human and animal sources, and thus, fish and seafood can be involved in the transmission of pathogenic microorganisms and toxins (Pal, 2012). Bacteria may also infect the fish from outside during careless handling of landed fish, its stowing and cutting. Among major external sources of bacterial contamination are ice and salt, crushed ice is known to carry heavy bacterial loads. Microorganisms exist on the skin/slime, gills and the gut of live and newly caught fish. The proportion of commercially occurring microorganisms on the surface and guts of fish are  $10^2$ - $10^7$  colony forming units (cfu) /cm<sup>2</sup> and  $10^3$ - $10^9$  cfu/g, respectively (Huss, 1995). Microbiological assessment of fish is the overall checking of fish and examines its quality. Fish and fish products are contaminating in various ways so it causes diseases. So the microbiological assessment is essential to understand the quality of fish. In microbiological assessment mainly checking the presence of microorganisms especially *vibrio spp.*, *salmonella spp.* and *E. coli* because these are the major organisms which cause disease to human. Ice quality is also an important factor for good quality fish because ice used for fish preservation may contaminate the whole fish preservation unit. It is important to find out the quality of fish we consume. In the present study Mackerel collected from Punalur local market were microbiologically assessed. It is a common fish among rural areas in India. It is less costly so common people prefer this fish mainly in their food. The 95% of people in the Punalur area buy fish from Punalur local market and majority of them used it as food. So it is very important to maintain the quality of the fish for avoiding the health problems of consumers. The fish reaching in Punalur market is directly from the sea there is no fish processing unit between them. Due to the absence of fish processing unit the preservation of fish is not on plants but in the refrigerators in the shop. These make challenges to the hygiene and quality of fishes. Fish are of great concern for export earnings because of their higher nutritive value such as high protein content with little or no carbohydrate and fat value. But fish may be contaminated at various

stages of transport, handling and preservation. This contamination may be related to raw materials, by some elements like mercury, phosphorous etc... these are from pesticides and by leakage, insect and pest seafood can become contaminated during storage and processing. Contamination may be caused by food borne pathogens which are naturally present in aquatic environment such as *Vibrio spp.*, *Salmonella spp.* and by *E. coli*. Consumption of these contaminated fish may cause infection or intoxication to the consumers. Fish are conditioned by their environment and hence it is obvious that if the growing and harvesting environment of fish is polluted chemically or microbiologically, the fish are also polluted. There for the present study has carried out to investigate the microbiological quality of the marine fishes for raising food safety concern. In the present study, we applied sensory and certain microbial analysis to assess quality of raw fish sold at a market in punalur, the hillock town in Kollam district Kerala.

## MATERIALS AND METHODS

**Study Area:** The study was carried out in the local markets of Punalur. The study was conducted in March 2018. During the study period, the presence of pathogenic organisms namely, *Salmonella spp.*, *Staphylococcus aureus*, *E.coli* and *Vibrio cholerae*, of public health significance from the Indian Mackerel - *Rastrelliger kanagurta* and total coliforms and *E.coli* in ice (storage temperature  $-20^{\circ}\text{C}$ ) which were used during the processing of samples were investigated. All the frozen fishes were gutted and organoleptically good enough to carry out further bacteriological analysis. During study periods, triplicate samples for each fish species as well as for ice samples were analyzed independently.

The Mackerel is a nutritive fish in the genus *Rastrelliger* (Fig 2). It is one of the two most important commercial fishes in India. It's scientific name is *Rastrelliger kanagurta*.

The body of the Indian Mackerel is moderately deep and the head is longer than the body depth. These fish have the thin dark longitudinal bands on the upper part of the body. They are generally found in shallow and coastal waters. They feed diatoms and zooplanktons. Mackerel is a nutritive, highly commercial, affordable and a reliable fish.

**Sample Collection:** For microbiological analysis, raw fish samples were collected from the punalur market during 10:00 to 11:00 AM in the morning and transferred to the laboratory in a using a sterile aseptic polythene bags together with ice Fig 3. Samples were processed within an hour of collection. For the analysis of microbial load of Indian mackerel were selected. In the present study, six microbiological parameters for examination of sample fish were considered including- Total Coliform Counts (TCC) and *Vibrio cholerae* of ice and qualitative analysis of *Vibrio cholerae*, *Salmonella spp.*, *Staphylococcus aureus*, *E.coli* of raw fish.

**Fish Samples Preparation.** All glassware was sterilized ( $121^{\circ}\text{C}$ , 15psi, 20minutes) before use. Triplicate fish samples each about 25gm of each fish type were measured separately in an analytical balance (Model: ML204/01, Mettler Toledo, Switzerland) in aseptic condition and then dissolved into about 225mL buffered peptone water (BPW) and blended for (30–60) seconds in a sterilized blender machine. Each fish sample was blended and homogenized separately. Microbiological analyses were carried out according to the APHA[7]

Small quantities (about 1 g) of scales or an upper layer of the skin surface (for scale-less fish samples) were aseptically removed by a forceps. Other organs like gill, liver and a portion of gut with gut-contents were also aseptically removed and transferred to a 0.85% NaCl solution. The organs were then macerated and serial dilution was made from the washing. The total aerobic heterotrophic bacteria were enumerated in nutrient agar by the conventional spread plate method (Chen and Kueh, 1976; Cappuccino and Sherman, 1992). *Salmonella spp.* was enumerated on Bismuth Sulphite Agar, while for the coliform count, MacConkey Agar was used. All the bacteriological media were obtained. After inoculation, the petridishes containing the culture media were incubated at  $37^{\circ}\text{C}$  for 24 hr..

### Isolation and Identification of pathogens of public health significance hours.

All media used in the present study were from Himedia Laboratories Ltd., Mumbai, India and prepared according to the standard procedure. Media were sterilized by autoclaving at  $121^{\circ}\text{C}$  at 15 psi pressure for 15 minutes, unless otherwise specified. Sterility of the media was checked by incubating at  $37^{\circ}\text{C}$  for 24 hours. Enumeration of Total

Coliforms and *Vibrio cholerae* in Ice, and assessment of *Vibrio cholerae*, *Salmonella spp.*, *E. coli* and *Staphylococcus aureus* in raw fish were done according to the taxonomic guides of Bergey's Manual of Determinative Bacteriology, 8th ed. The populations of bacteria were expressed in terms of cfus. g-1 (colony forming units).

## RESULTS

The source and QIM score of *Rastrelliger kanagurta* is recorded in the present experiment are presented in Table 1. The sensory quality parameters like general appearance, colour of the eyes and smell of the fish scored the lowest QIM scores (0) which emphasize the freshness of the fish. Tables 2, shows the result prevalence of Total Coliform Bacteria and *Vibrio cholerae* in ice associated with *Rastrelliger kanagurta*. Results shows that Total Coliform bacterial count was higher in ice used to preserve *Rastrelliger kanagurta*. But the prevalence of *Vibrio cholerae* was absent in ice. Tables 3, shows the results of the qualitative analysis of pathogenic strains of bacteria like *Vibrio cholerae*, *Salmonella spp.*, *Staphylococcus aureus*, *E.coli* associated with *Rastrelliger kanagurta*. Of the four species analysis *Staphylococcus aureus* and *E.coli* were the prevalent species present in the raw fish but I both case it was present within the minimum limit ie., <10 CFU/GM . Both *Vibrio cholerae*, *Salmonella spp* were completely absent in the *Rastrelliger kanagurta* collected from the local market. The total colonies in agar media for the pathogenic strains of bacteria like *Vibrio cholerae*, *Salmonella spp.*, *Staphylococcus aureus*, *E.coli* associated with *Rastrelliger kanagurta* and ice.

**Table- 1: Quality Index Method (QIM) as applied to assess quality of *Rastrelliger kanagurta*.**

**Tables - 2. Microbiological assessment of ice associated with - *Rastrelliger kanagurta*.**

Quality parameter		Character	Observation	Score
General appearance		Skin	bright	0
		Blood spot	None on gill cover	0
		Stiffness	Stiff, in rigor mortis	0
		Smell	Fresh	0
Eyes		Clarity	Clear	0
Gills		Colour	Red	0
		Smell	Fresh	0

SL.NO	PARAMETER TESTED FOR	TEST RESULT	MAXIMUM LIMIT	TEST METHOD
1	Total coliforms	7.8MPN/GM	<1.8MPN/GM	USFDA(8AM)
2	<i>Vibrio cholerae</i>	Absent	Absent	USFDA(8AM)

**Tables 3. List of Bacterial species isolated from raw fish - *Rastrelliger kanagurta*.**

SL.NO	PARAMETER TESTED FOR	TEST RESULT	MAXIMUM LIMIT	TEST METHOD
1	<i>Staphylococcus aureus</i>	<10 CFU/GM	100 CFU/GM	USFDA(8AM)8Edn
2	<i>E.coli</i>	<10 CFU/GM	20 CFU/GM	USFDA(8AM)8Edn
3	<i>Salmonella.spp</i>	Absent	Absent	USFDA(8AM)Edn

4	<i>Vibrio cholerae</i>	Absent	Absent	USFDA(8AM)Edn
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## DISCUSSION

In samples collected from the local market of Punalur, the predominant pathogenic bacteria include *Staphylococcus aureus* and *E.coli*, but they are present in a specified range. Presence of *Staphylococcus aureus* in some fishes may be due to poor handling, improper storage system and sanitary condition at all the steps in the fish processing and selling. *Staphylococcus aureus* are not part of the normal fish microbiota (Huss, 1988; Van den Broek *et al*, 1984). They are frequently found in the nose, respiratory tract, skin of the human scalp, face, neck, ears, axillae, perineum and the pubic region. They can cause food poisoning and may occasionally cause infections in patients whose immune system is compromised (Karl, 1975; Wesley, 1975). Hence, the presence of *Staphylococcus aureus* in seafood samples indicates the post-harvest contamination due to poor personnel hygiene or due to the disease in fish (Austin and Austin, 2007; Huss, 1988). The presence of such microorganisms in fish which are not the part of microbiota of these aquatic organisms indicates the occurrence of food contamination due to poor hygiene in handling and lack of preservation techniques (Evelyn *et al.*, 2015).

The present study revealed that the microbial quality of mackerel samples collected from Punalur fish market was good due to the absence of *Vibrio cholerae* in the samples. Since the presence of *Vibrio sp.*, can be a cause of infection to the consumers. Vibrios are responsible for a number of clinical conditions such as cholera, gastroenteritis, septicaemia and wound infections. The artisanal fisherman, fishing for a few hours and returning to sell his catch while the fish is still alive or very fresh, does not need a complicated quality assurance system. The customers know very well the quality of the fish, and most often the fish are caught, sold and consumed within the same day (Huss, 1995). For fish culturists, netting out fish for sale depends on the demand of the market, and higher demand invariably results in greater harvest. Both, freshly caught fish from a river or fish netted out from a pond were of good quality, as indicated from the QIM scores. The problem of quality generally arises with iced fish supplied from far off places since it is very difficult to adjudge the duration of storage. In our study revealed that the raw seafoods sold at Punalur fish market is good to consume. It has also shown that samples of seafoods used in this study were grossly contaminated by coliforms present in the ice used. The use of dirty polluted water from various sources for makes unhygienic ice with harmful pathogenic bacterium. This, constitute potential public health hazard due to the unhygienic nature of fish handlers. This call for public health concerns and improvements in handling and processing are needed to minimize the prevalence of the pathogens. The levels of Total Coliforms Count in ice indicate the urgent need require improving the Quality control and Quality assurance systems of Punalur Fish Market.

## CONCLUSION

Although sea food is part of a healthful diet, its consumption is not out of risk. World wide continued outbreaks of sea food associated infections have rendered the existing control strategies questionable. An understanding of the etiologic agents, seafood commodities associated with illness, and mechanisms of contamination that are amenable to control is thus necessary for the prevention of seafood-associated infection outbreaks. Coordinated efforts from government sector and private industry together with federal agencies are urgently needed in this context. There is a need for routine surveillance systems using pathogen-specific techniques to avoid any future outbreaks. However, the current study revealed that microbiological quality of the investigated raw fish was within the specified limit of International Commission on Microbiological Specifications for Foods (ICMSF) but fish processing materials (ice and water) were highly contaminated with coliform bacteria. So it can be concluded that the sea fishes were processed with properly treated pathogen-free water and ice and, finally, maintained at good storage condition.

### Acknowledgment

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## REFERENCES

- Adedeji, O. B. and Adetunji, V.O. 2004.** Pests in farm animals and stored animal products. agriculture, renewable natural resources, animal husbandry and health. Published by General Studies Programme (GSP), University of Ibadan, Nigeria. Pp. 141 – 151.
- Austin, B., Austin, D.A. 2007.** Bacterial Fish Pathogens: Disease of Farmed and Wild fish, 4th ed. Springer-Praxis, London, England.
- Emikpe, B.O., Adebisi, T. and Adedeji, O.B. 2011.** Bacteria load on the skin and stomach of *Clarias Gariepinus* and *Oreochromis Niloticus* from Ibadan, South West Nigeria: Public health imp
- Evelyn Ivana Trindade Damasceno, Lawana Natasha da Gama pantoja, Hamilton Mendes de Figueiredo, Luiza Helena Meller da silva and Antonio Manoel da Cruz Rodrigues, 2015.** Microbiota of two species of commercially important fish in the Amazon region (Belem-Para-Gayil) Butterfly Peacock Bass (*Cichla ocellaris*) and Piramutaba (*Brachyplatystoma vailantii*), African J. Microbiol. Res., Vol 9(9), pp 572-580. lications.
- ICMSF (International Commission for Microbiological Specification for Foods) 1998:** Micro-organisms in Foods 6. Blackie Academic and Professional, London
- Mahendra Pal, Asnake Ketema, Manyazewal Anberber, Selamawit Mulu, Yashodhara Dutta. 2016 .** Microbial quality of Fish and Fish Products. BEVERAGE & FOOD WORLD - Vol. 43 - No. 2. Email : palmahendra2@gmail.com.
- Prithwiraj Jha\*, Rudra Prasad Roy and S. Barat. 2010.** Application of sensory and microbial analysis to assess quality of fish in Siliguri city of West Bengal, India. *Journal of Environmental Biology.* 31(5) 587-594.
- Sami Shabeeb Al Shabeeb, M.A. Mohamed Ibrahim and Ghamri H. Al Ramadhan. 2016.** A Comparative Microbial Quality Assessment among Fishes, Prawns and Cuttlefishes collected from Dammam Fish Market. *Int.J.Curr.Microbiol.App.Sci.* 5(9): 405-418. doi: <http://dx.doi.org/10.20546/ijcmas.2016.509.044>.
- Van den Broek, M.J.M., Mossel, D.A.A., Mol, H. 1984.** Microbiological Quality of retail fresh fillets in the Netherlands, *Int. J. Food Microbiol.*, 1: 3-61.
- Wesley, E., kloos and Karl, H., Schleifer, Isolation and characterization of Staphylococci from Human skin, 1975.** II. Descriptions of Four New Species: *Staphylococcus warneri*, *Staphylococcus capitis*, *Staphylococcus hominis* and *Staphylococcus simulans*. *Int. J. Systematic Bacteriol.*, pp. 62-79
- WHO. 2007.** Food safety issues associated with products from aquaculture.T.R.S.No.883, World Health Organization, Geneva, Switzerland.



# AN ANALYSIS ON THE HAEMOGLOBIN LEVEL IN COLLEGE STUDENTS: A DESCRIPTIVE CORRELATIONAL STUDY

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## ABSTRACT

The purpose of this study was to assess the haemoglobin levels in male and female college students. It was conducted over a period from October 1, 2017 to March 30, 2018 in 100 B. Sc Zoology students from Fatima Mata national college. Of the 100 students, there was 30 males (30 %) and 70 females (70 %). Ages ranged from 18 to 23 years. The Normal haemoglobin levels are 14-18 g/dl for an adult male and 12-16 g/dl for an adult female. Study revealed that the in males 10 (33.33 %) have a haemoglobin level 14 -16, 10 (33.33 %) have 12 -14, 7 (23. 33 %) have haemoglobin level 10-12 and 2 (6. 66 %) have 8- 10 and 1 (3. 33 %) has 16-18. So from the study it is clear that only 36% have normal haemoglobin 14-18 g/dl [10 (33.33 %) have 14 -16 and 1 (3. 33 %) has the haemoglobin level 16-18] others are anemic in nature. In females, 36 (51. 42 %) have a haemoglobin level 10-12, 22 (31. 42 %) have 12-14 and 4 students (5. 71 %) have haemoglobin level 14- 16 and 6 students (8. 57 %) have haemoglobin level 8-10. The Normal levels are 12-16 g/dl for an adult female. So from the study it is clear that only 37.13 % female students have the normal haemoglobin 12-16 g/dl [22 students (31. 42 %) have haemoglobin level 12-14 and 4 students (5. 71 %) have haemoglobin level 14- 16] others are anemic. A level is referred to as anemia or low red blood count. Lower number of red blood cells is referred to as anemia and haemoglobin levels reflect this number. There are many reasons (causes) for anemia. From the study it is concluded that the most of the college students are anemic in nature so it is necessary to advise the importance of Hb and how to improve the levels of haemoglobin in their blood.

## KEYWORDS

Haemoglobin, Anemia, Correlation

## INTRODUCTION

Haemoglobin is a protein in red blood cells (RBCs) that carries oxygen from the lungs to the tissues in the body. The pigment in haemoglobin is responsible for the red colour of blood. Haemoglobin in the blood carries oxygen from the respiratory organs to the rest of the body. There it releases the oxygen to permit aerobic respiration to provide energy to power the functions of the organism in the process called metabolism. In mammals, the protein makes up about 96% of the red blood cells' dry content and around 35% of the total content. Haemoglobin tests are usually conducted to test the blood for the amount of haemoglobin present in the blood. This blood test can be used to detect a number of health conditions that may be present. It is the protein portion of the blood. Besides carrying oxygen to the tissues and organs of the body, it also carries the carbon dioxide from the body back to the lungs. This portion of the blood is what gives the blood the red color. The purpose of this study was to assess the haemoglobin levels in male and female college students. Haemoglobin test are often given to test for underlying health conditions. This test measures the body's blood levels of haemoglobin. Haemoglobin is needed in the body to carry oxygen throughout the body.

## METHODOLOGY

0.1 N HCl was taken in a Sahli's tube upto 3g% the tube was kept in the slot of comparator. The finger tip was wiped with spirit and allowed to dry. It was then pricked with a sterilized lancet. The first two drop of blood was wiped out. When a good sized blood drop was formed, it was sucked into the pipette upto the 20 l mark. The pipette should be held vertically while sucking the blood. The blood from the pipette was expelled into the HCl taken in a Sahli's tube. HCl was sucked into pipette and expelled twice to completely wipe out the blood into the Sahli's tube was mixed gently using stirrer. The tube was then kept inside the comparator for a minimum of 10 minutes. Add distilled water into the mixture drop wise drop. After the addition of each drop of water the contents were mixed gently. Then compared with the brown coloured tube of comparator. The addition of water was continued till colour of the solution exactly matches the standard colour provided in the comparator. Now the tube was taken out and the level of the coloured solution (upper meniscus) was read in g% and recorded.

## RESULTS

The purpose of this study was to assess the haemoglobin levels in male and female college students. The study was conducted over a period from October 1, 2017 to March 30, 2018. It was conducted in 100 B. Sc Zoology students from Fatima Mata national college. Of the 100 students, there was 30 males (30 %) and 70 females (70 %). Ages ranged from 18 to 23 years. The Normal levels are 14-18 g/dl for an adult male and 12-16 g/dl for an adult female. Study revealed that in males 10 (33.33 %) have a haemoglobin level 14 -16, 10 (33.33 %) have 12 -14, 7 (23.33 %) have haemoglobin level 10-12 and 2 (6.66 %) have 8- 10 and 1 (3.33 %) has 16-18. So from the study it is clear that only 36% have normal haemoglobin 14-18 g/dl [10 (33.33 %) have 14 -16 and 1 (3.33 %) has the haemoglobin level 16-18] others are anemic in nature. In females 36 (51.42 %) have a haemoglobin level 10-12, 22 (31.42 %) have 12-14 and 4 students (5.71 %) have haemoglobin level 14- 16 and 6 students (8.57 %) have haemoglobin level 8-10. The Normal levels are 12-16 g/dl for an adult female. So from the study it is clear that only 37.13 % female students have the normal haemoglobin 12-16 g/dl [22 students (31.42 %) have haemoglobin level 12-14 and 4 students (5.71 %) have haemoglobin level 14- 16] others are anemic. A level is referred to as anemia or low red blood count. A lower than normal number of red blood cells is referred to as anemia and haemoglobin levels reflect this number. There are many reasons (causes) for anemia.

## CONCLUSION

From the study it is concluded that the most of the college students are anemic in nature so it is necessary to advise the importance of Hb and how to improve the levels of haemoglobin in their blood. Iron deficiency is the most common cause of low haemoglobin levels, according to the National Anemia Action Council. The top iron rich foods include green leafy vegetables like spinach, beetroots, tofu, asparagus, chicken liver, whole egg, oyster, apple, pomegranate, apricot, water melon, prunes, pumpkin seeds, dates, almonds, raisins, amla, and jaggery. So by intaking these food items they can improve the Hb level in their blood.

## REFERENCES

- Anees, M., Hameed, F., Mumtaz, A., Ibrahim, M., & Khan, M., (2011). Dialysis-related factors affecting quality of life in patients on hemodialysis. *Iranian Journal of Kidney Diseases*, 5 (1), 9-14.
- Barnes-Jewish Hospital, (2014). *Kidney Transplant, FAQs for Kidney Recipients*. Retrieved on May 9, 2014 from <http://www.barnesjewish.org/transplant/kidney-transplant/recipient-FAQ>.
- Baskale, H., & Baser, G., (2011). Living with haemodialysis: The experience of adolescents in Turkey. *International Journal of Nursing Practice* 17, 419-427.
- Bayakki, & Hathakit, U., (2012). Lived experiences of patient on hemodialysis: A meta-synthesis. *Nephrology Nursing Journal*, 39 (4), 295-304.
- Bossola, M., Vulpio, C., & Tazza, L., (2011). Fatigue in chronic dialysis patients. *Seminars in Dialysis*, 24 (5), 550-555.

- Clarkson, K., & Robinson, K., (2010). Life on dialysis: A lived experience. *Nephrology Nursing Journal*, 37(1) 29-35.
- DaVita, (2014). What is Hemodialysis? Available at <http://www.davita.com/treatment-options/hemodialysis/in-center-hemodialysis/what-is-hemodialysis/?t/5594>. Accessed March 1, 2014.
- Ferrans, C., Zerwic, J., Wilbur, J. Larson, J., (2005). Conceptual model of health-related quality of life. *Journal of Nursing Scholarship* 37(4), 336-342. 22
- Goldstein, S., Graham, N., Warrady, B., Seikaly, M., McDonald, R., Burwinkle, T., Limbers, C., & Varni, J., (2008). Measuring health-related quality of life in children with ESRD: Performance of the generic and ESRD-specific instrument of the Pediatric Quality of Life Inventory (PedsQLTM). *American Journal of Kidney Disease* 51(2), 285-297.

## MORPHOMETRIC ANALYSIS OF *Etroplus maculatus*

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### ABSTRACT

The major objective of the present study is to investigate the Morphometric Analysis in *E. maculatus* from Ashtamudi lake, the Ramsar site in Kerala. A total of 130 *E. maculatus* fishes were collected. The results revealed a reasonable degree of variation in populations of *E. maculatus* in Ashtamudi lake in Kerala, India. Of the 16 Morphometric characters examined, all exhibit a significantly positive correlation ( $p < 0.01$ ) between X and Y, indicates the growth in all organs of the fish but the level of significance vary with features indicate that different organs grow differently. Among 16 parameters some features of some variants showed significant relationship (The standard length and body weight ( $r = 0.89$ ), Total length and standard length ( $r = 0.97$ ), standard length and head depth ( $r = 0.042$ ), standard length and anal fin length ( $r = 0.84$ ) etc. Thus the increase of total length synchronized with different degree of the increase to the various factors denoted by "Y". In future, additional methods such as microsatellite and sequence analysis can be used to maximize the efficiency of the study. Extensive phenotypic and genotypic studies of this valuable food fish, using individuals from a wide array of habitats, would facilitate their conservation and management programmes in natural water bodies and help identification of better stocks for artificial propagation

### KEY WORDS

Ashtamudi lake, Morphometry, *E. maculatus*

### INTRODUCTION

Morphometric analysis help to understand the relationship between body parts (Carpenter, 1996). Further, the morphometric study is a suitable technique for recognizing, comparing anatomical features and a primary source of information for taxonomic and evolutionary studies. Morphometric characters can be used to assess the influence of environmental factors on fish populations. In this regard, it is common to use measurements such as body length, body depth, head length, eye diameter, jaw length of fishes not only to assess fish habitat peculiarities and ecological criteria in water bodies, but also to measure discreteness and relationships among various taxonomic categories (Omoniyi *et al.*, 2010). There are many well documented morphometric studies which provide information on growth patterns of many freshwater fish species of Ashtamudi lake. However, information on the morphometrics and characterization of *E. maculatus* are scarce. Hence, the present study was undertaken to understand the relationship between the various morphological body parts of *E. maculatus* and to find mathematical equations relating to the various morphometric relationships which could be utilized for the conversion of one measurement into another..

### METHODOLOGY

Samples of fishes were collected from Ashtamudi lake using different types of nets like cast net, gill net and drag net. Fishes were brought to the laboratory, preserved in 10% formalin solution in separate specimen jars according to the type of the species. Small fishes were directly placed in the 10% formalin solution. Whereas large fishes were given an incision in their abdomen and preserved. Meristic and morphometric characters were measured and fishes were identified up to the species level, with the help of standard keys given by Day (1967), Jayaram (1999), Talwar and Jhingran (1991). Care was taken to select only intact specimens for the taxonomic studies. Following measurements and counts were taken for the study. Total length (TL), Standard length (SL), Snout length (SnL),

Head length (HL), Predorsal length (PrL), Body Depth (BD), Peduncle depth (PD) and Eye diameter (ED) were measured in nearest millimeters. Numbers of dorsal, pectoral, ventral, anal and caudalfin rays were also counted.

## RESULTS

*E. maculatus* is a slightly elongated, deep bodied oval shape fish with dots. Abdomen rounded, head moderately compressed. Mouth terminal cleft small; Snout spouts like, eyes large, lateral in middle of head, lips thin, jaws equal, villiform teeth in two or three rows on jaws; compressed and lobate at their summit. Dorsal fin inserted above base of pectoral fins with 15-18 spines and 48 rays spinous portion larger than soft part. Pelvic fins thoracic with 13 spines and 26 soft rays. Anal fin with 10-13 spines and 614 rays, caudal fin lunate or emarginated. Scales vary slightly ctenoid of moderate size extending to base of the soft dorsal and anal fin, lateral line interrupted or abruptly ceasing and there after continuing small open pores with 30-40 scales. Air bladder is large and simple. The body of the adult is yellow to bright orange in colour with several rows of small red-orange dots marking the body. The belly is light orange while the fins are transparent with an orange tint. The fins are close to the body and the tail is slightly forked. The eyes are dark and large. In male, in between the rays of pelvic fin, small barbs are present and they are absent in female fish. Based on the number of black spots and transverse lines the variants were categorized.

A total of 130 individuals of *E. maculatus* (4.0 cm 9.2 cm length) representing all the sizes were selected and measured. Of the 16 Morphometric characters examined, all exhibit a significantly positive correlation ( $p < 0.01$ ) between X and Y, indicates the growth in all organs of the fish but the level of significance vary with features indicate that different organs grow differently. Among 16 parameters some features of some variants showed significant relationship eg: the standard length and body weight ( $r = 0.89$ ), Total length and standard length ( $r = 0.97$ ), standard length and head depth ( $r = 0.042$ ), standard length and anal fin length ( $r = 0.84$ ). Thus the increase of total length synchronized with different degree of the increase to the various factors denoted by "Y".

**Table 1 Summary of Descriptive Statistics of Morphometric parameters in *E. maculatus***

X-axis	Y- axis	Y = a + bx	r
Total length	Standard Length	0.7062 + 0.4981	0.92
Pre pectoral Length	Standard Length	0.6801-2.216	0.80
Pre anal Length	Standard Length	0.7294-1.3008	0.72
Head length	Standard Length	0.5167-1.3547	0.67
Upper caudal fin length	Standard Length	0.3854-0.7864	0.52
Lower caudal Fin length	Standard length	0.4387 - 1.1486	0.51
Caudal peduncle length	Standard length	0.0981-0.1878	0.51
Weight	Standard length	1.3359-3.6373	0.82
Dorsal fin Length	Standard length	0.2848+1.66	0.038
Dorsal finHeight	Standard length	0.021+0.2073	0.0018
Dorsal finBase	Standard length	0.2191+1.5448	0.047
Pectoral finLength	Standard Length	0.0766+0.8253	0.027
Pectoral fin Height	Standard length	0.0718+0.9362	0.026
Pectoral fin Base	Standard length	0.0146+0.1825	0.006
Pelvic fin Length	Standard length	0.0744+0.2557	0.019
Pelvic fin Height	Standard length	0.0975+0.0273	0.033
Pelvic fin Base	Standard length	0.0783-0.1733	0.0143
Anal fin Length	Standard length	0.0686+2.1171	0.005
Anal fin Height	Standard length	0.0173+0.4063	0.0014
Anal fin Base	Standard length	0.0167+1.9501	0.0004

Morphometric analysis of *E. maculatus* was attempted by Kurup (1982) in Kerala waters and Cecilia pandian (1994) in muthupet estuary, but their data restricted to 20 fishes of larger size only. Thus their data may not be suitable for comparison here using the regression equation ( $Y=a+bx$ ) the relationship of total length. Presently arrived regression formula would help the inter conversion of total length data with other morphometric characters including weight. Here the influence of various factors and total length of *E. maculatus* was listed with correlation coefficient and regression equation. Morphometric measurements have been widely used to discriminate the populations of various fish species (Elliott et al., 1995 and Hurlbut and Clav 1998) the conventional approach for such analysis is based on measurement along the antero posterior body axis and the depth measurement. In this study variation in the various morphological characters of the fishes was found. Morphological divergence has been reported in the estuarine fish population that are not completely geographically separated, suggesting that partial isolation may play a role in population sub divisions.

The results of the present study can also explain that *E. maculatus* living in the same place showed morphological divergence. It would indicate the possibility for microhabitat restriction that may influence this variation. Population differentiation may also occur despite opportunity for extensive gene flow between populations then there are relatively strong differential selective pressures exerted on the different population by local environmental factors, such as temperature. As the present analysis does not include environmental data for the sample localities, it is not possible to confirm whether the observed variation is associated with environmental conditions, and therefore, further environmental comparisons of these areas would be worthwhile. In general health, reproduction status and survival of the animal are endorsed by growth pattern. Therefore, such a growth evaluation of a species in a locality can help to understand to a larger extent the relevance of ideal conditions to the species in that environment.

## CONCLUSION

Present study concluded that a reasonable degree of variation in populations of *E. maculatus* in Ashtamudi lake in Kerala, India. Of the 16 Morphometric characters examined, all exhibit a significantly positive correlation ( $p<0.01$ ) between X and Y, indicates the growth in all organs of the fish but the level of significance vary with features indicate that different organs grow differently. Thus the increase of total length synchronized with different degree of the increase to the various factors denoted by "Y". In future, additional methods such as microsatellite and sequence analysis can be used to maximize the efficiency of the study. Extensive phenotypic and genotypic studies of this valuable food fish, using individuals from a wide array of habitats, would facilitate their conservation and management programmes in natural water bodies and help identification of better stocks for artificial propagation.

## REFERENCES

- Begum, M., Alam, M. J., Islam, M. A. and Pal, H. K. (2008). On the food and feeding habit of an estuarine catfish (*Mystus gulio* Hamilton) in the south-west coast of Bangladesh. *J. Zool.*, **27**, 91-94.
- Begum, M., Islam, M. A., Pal, H. K. and Alam, M. J. (2010). Reproductive characteristics of *Liza parsia* (Ham.) inhabiting south west coast of Bangladesh. *J. Bangladesh Agril. Univ.*, **8(1)**, 173-178.
- Carpenter, K. E., Sommer, H. J. and Marcus, L. F. (1996). Converting truss inter land mark distances to Cartesian Coordinates. In LF Marcus, Mcorti, Aloy, Gnaylor, DE slices. Advances in morphometrics, *ATO ASI series A; Life Sciences*, New York Plenum publication, **284**, 103-111.
- Chatterjee, A., Siddiqui, A. Q. and Khan, A. A. (1977). Morphometric studies on *Labeo bata* (Ham.) from the different freshwater environments, *Indian J. Ani. Res.*, **11(1)**, 47-49.
- Day, F. (1878). *The fishes of India, being a natural history of fishes known to inhabit the seas and freshwaters of India, Burma, and Cylon*. Text and Atlas parts. London, xx+778, 195 pls.
- Jayaram, K. C. (1999). *The fresh water fishes of the Indian Region*. Narendra Publishing house. Delhi, 551.
- Khumar, F. and Siddiqui, M. S. (1991). Length weight relationship of the carp *Puntius sarana* (Ham.) of a reservoir and three riverine ecosystems in North India. *J. Freshwater Biol.*, **3(1)**, 81-88.

- Omoniyi, I. T., Oyewumi, J. O. and Ezeri, G. N. O. (2010). Morphometric structuring of Nile tilapia *Oreochromis niloticus* from three man-made lakes in South West, Nigeria. *Nigerian Journal of Fisheries*, **7**(1 & 2), 39 - 48.
- Talwar, P. K. and Jhingran, A. G. (1991). *Inland Fishes of India and adjacent countries*. Oxford and IBH Pub. Co, New Delhi, **1 & 2**, 1158.
- Tarique, H., Khan, A. A. and Chatterjee. (1977). A. Sexual diamorphism in the morphometric characters of a carp, *Labeo calbasu* (Ham.). *J. Zool. Res.*, **1**(2), 90-92.
- Tiwari, V. K. and Qureshi, T. A. (2003). Morphometric characters of the catfish, *Rita pavimentata* (Gunther) from the river Narmada. *J Inland Fish Soc India.*, **35**(1), 68-72.

## PROTECTIVE EFFICACY OF CURCUMIN AGAINST ROGORIN TOXICITY IN *L.ROHITA*

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### ABSTRACT

Impact of sub lethal toxicity of Rogorin and the protective efficacy of dietary curcumin against the toxicity in fresh water fish, *Labeorohita*, on biochemical parameters were studied. The fish were exposed to 0.2ppm and 0.4ppm for short term (96 hrs) and long term (10 days). After exposure, the fish showed a significant change in the biochemical parameters like AST, ALT, and blood glucose. A significant ( $p < 0.05$ ) increase in the ALT, AST, and blood glucose were observed in the Rogorin exposed fishes. Hence the aim of the present study was to determine the protective efficacy of dietary curcumin against rogorin toxicity in *L.rohita*.

Keywords: Aspartate aminotransferase, Alanine aminotransferase, Curcumin, *L.rohita*, Rogorin

### INTRODUCTION

Pesticides, the biologically active chemicals are used to a great extent for pest control but their spectrum of activity often extends far beyond the pest. Rogorin (O,O-dimethyl S - (N-Methyl carbamoylmethyl) is an organophosphorous insecticide widely used against vegetables and fruit sucking aphids, mites, saw flies and boring insects on cereals, cotton, chilly, tobacco, and oilseeds (Mirajkaret *al.*, 2005). Hence the aim of the present study was to determine the protective efficacy of dietary curcumin against rogorin toxicity in *L.rohita*.

### MATERIALS AND METHODS

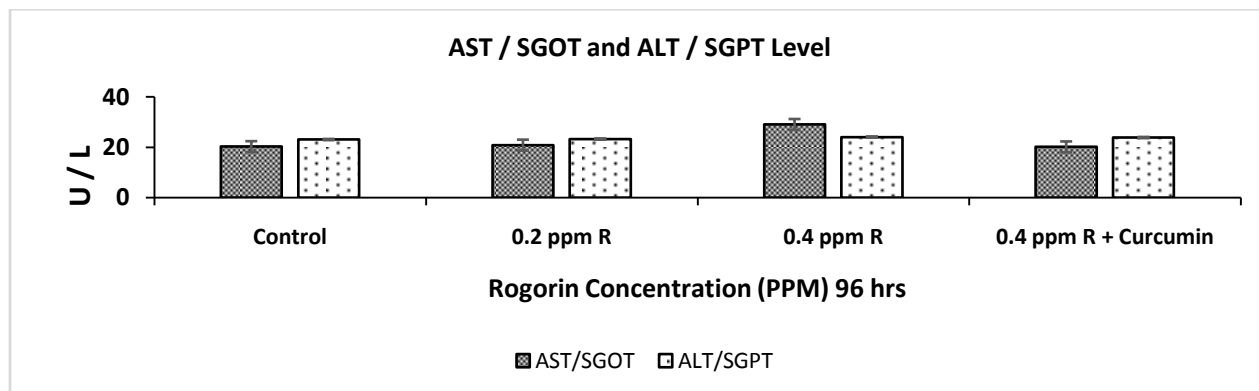
The healthy and adult fish, *Labeorohita* of approximate  $30 \pm 5$ g of body mass were collected from a local supplier near the Vellayani lake Trivandrum, and treated with 0.05% KMnO<sub>4</sub> to remove any parasitic infections, and they were transferred to large glass aquaria and acclimatized for 20 days. The average values for water characteristics data holding in aquaria were temperature  $25 \pm 3^\circ\text{C}$ , pH 6.8. Twenty-four fish were divided into four groups of six each and placed in separate glass aquaria. The fish of group I were freshwater control, group II and III were treated with 0.2 PPM and 0.4 PPM Rogorin for 96 hr respectively (short term treatment) and supplemented with commercial fish feed. The group IV fish were first treated with 0.4 PPM Rogorin for 96h and were supplemented with 1% curcumin in the 40% protein feed and fed to fish for the periods 96 hrs. The same experiment was conducted for 10 days (long term) also. Blood was taken from the caudal vein with heparinized syringes. The collected blood was transferred to clean dry test tube for investigation of biochemical parameters i.e, SGOT/AST and SGPT/ALT activity of enzyme by IFCC Method. Plasma glucose (GOD/POD test kit; Span Diagnostics Ltd., New Delhi) concentrations were measured colorimetrically in a Systronics Spectrophotometer 2202 (Systronics, New Delhi) using commercial test kits.

### RESULT AND DISCUSSION

The result of the present study clearly revealed that there was a significant increase ( $p < 0.05$ ) in the AST (aspartate aminotransferase; GOT, glutamate oxalacetate transaminase) and ALT (alanine aminotransferase; GPT, glutamate pyruvate transaminase) activity and blood glucose level in fish. The elevated AST and ALT values in the blood sample of Rogorin exposed groups indicate liver damage or injury. Hence present study clearly revealed the pathological conditions of fish. Findings indicate that turmeric serves as a useful reserve of phenolics, flavonoids and ascorbic acids, which are natural source of antioxidants and play a significant role as a single oxygen quencher and free radical scavenger that, can minimize molecular damage to the cell. Hyperglycemia was evident in the

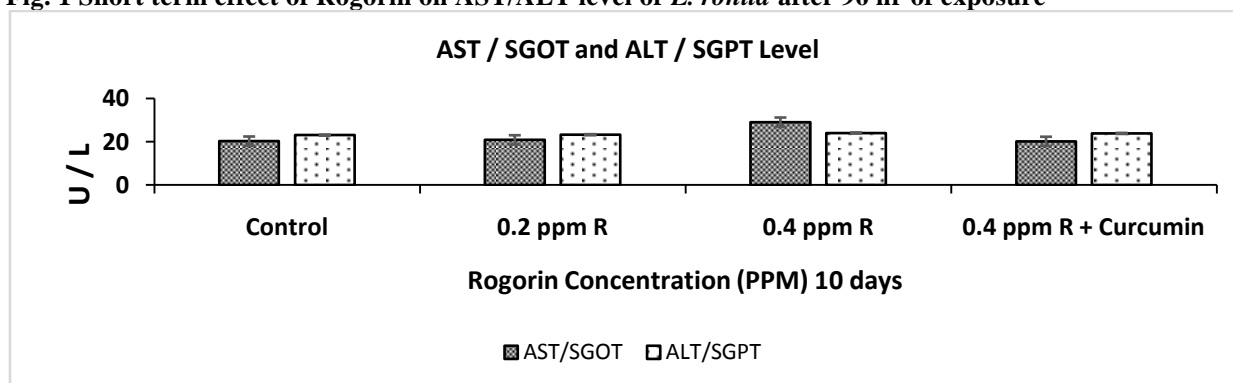


blood of exposed fish which may help fish to meet critical needs of energy. Such elevation may also be due to enhanced gluconeogenesis response of stressed fish in their attempt to satisfy their new energy demands. So that, increasing blood glucose levels is widely used as a secondary marker of a stress response. Similar results were recorded in *Clarias gariepinus*, Bakhshwanet al. (2009) and *O. niloticus* (Al-Ghanim,2012) after exposure to diazinon and malathion, respectively.



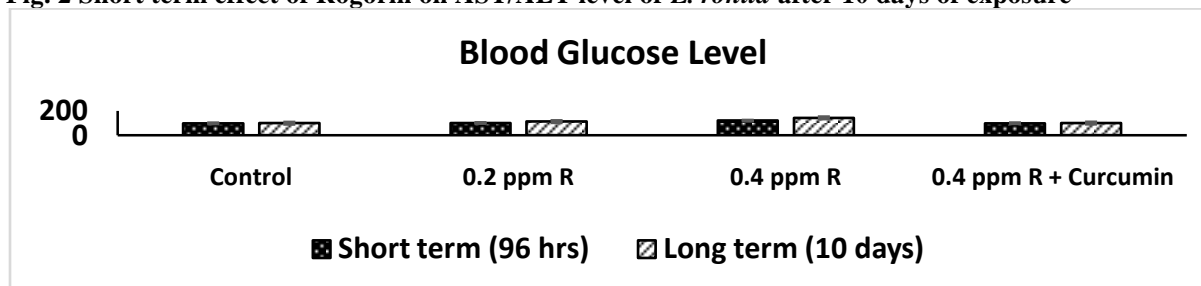
Data are represented as means  $\pm$  SE (n = 6). Values with different superscript letter in the same column for each group are significantly different ( $P < 0.05$ ).

**Fig. 1 Short term effect of Rogorin on AST/ALT level of *L. rohita* after 96 hr of exposure**



Data are represented as means  $\pm$  SE (n = 6). Values with different superscript letter in the same column for each group are significantly different ( $P < 0.05$ ).

**Fig. 2 Short term effect of Rogorin on AST/ALT level of *L. rohita* after 10 days of exposure**



Data are represented as means  $\pm$  SE (n = 6). Values with different superscript letter in the same column for each group are significantly different ( $P < 0.05$ ).

**Fig. 3 Short term and long term effect of Rogorin on Blood glucose level of *L. rohita* after exposure**

**CONCLUSION**

Oxidative stress parameters may be highly recommended as an early-warning bio-indicator of environmental pollution. The increased AST / ALT activity indicates the pathologic conditions in fish. Hyperglycemia was evident in the blood of exposed fish which may help fish to meet critical needs of energy. The findings of the present study concluded that short-term (96 hrs) and long term (10 days) exposure to Rogorin even at sub lethal concentrations, induced biochemical alterations in *L. rohita* and led to oxidative damage. But, the administration of curcumin was considered as an effective way to counter the toxicity of Rogorin in fish and curcumin supplemented feed can improve the growth of fish in aquaculture. Therefore, it can be concluded that curcumin is beneficial to fish which produce positive effects in aquaculture of fish. In summary, it can be concluded that the dietary curcumin not only effectively protects against the deleterious effects of pesticides but also stimulates nutrient utilization, growth and may improve health status of fishes.

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**REFERENCES**

- Al-Ghanim KA. (2012) Acute toxicity and effects of sub-lethal malathion exposure on biochemical and haematological parameters of *Oreochromis niloticus*. *Scientific Research and Essays*, 7(16), pp. 1674-1680.
- Bakhshwan, M. S. Marzouk, M. I. Hanna, and H. S. Hamed (2009) Some investigation on the clinical and biochemical alterations associated with diazinon toxicity in *clarias gariepinus*, *Egypt. J. Aquat. Biol. Fish*, 13(2), 173 -197.
- Mirajkar N, Pope CN (2005) Dimethoate. *Encyclopedia of toxicology*, pp. 47-49.

## ASSESSMENT INTO THE BIOPOTENTIATION IMPACT OF CURCUMIN ON *L.ROHITA* EXPOSED TO MALATHION

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### ABSTRACT

Pesticides are the major potential environmental hazards to humans and animals as these are present and concentrated in the food chain. Malathion (O,O-dimethyl-S-1,2-bis ethoxycarbonyl ethyl phosphorodithioate) is a non-systemic, wide-spectrum pesticide in the organophosphate chemical family and is widely used throughout the world. The fish were exposed to 0.2ppm and 0.4ppm for short term (96 hrs) and long term (10 days). After exposure, the fish shows significant changes in the biochemical parameters like AST, ALT, and Blood glucose. A significant ( $p < 0.05$ ) increase in the ALT, AST, and blood glucose were observed in the malathion-exposed fishes and it indicates the pathologic conditions in fish. Hyperglycemia was evident in the blood of exposed fish which may help fish to meet critical needs of energy. Hence, the present study was aimed to investigate the biopotential of curcumin in a fresh water fish, *Labeorohita* against the toxicological impacts of Malathion at 0.4 ppm and 0.8 ppm/gm body wt respectively.

**.Keywords:** Carp, Curcumin, Malathion, Pesticides, *Labeorohita*

### INTRODUCT

Pesticides are used for preventing, repelling, destroying, mitigating and controlling agricultural and household pests (Ullah, 2015). Malathion is a common pesticide in the organophosphate chemical family and is widely used throughout the world. Natural agents like Curcumin may have the potential to enhance disease resistance in aquaculture. Hence the aim of the present study was to determine the protective role of dietary Curcumin and the toxicological effects of Malathion (EC 50%) in fresh water fish, *Labeorohita*.

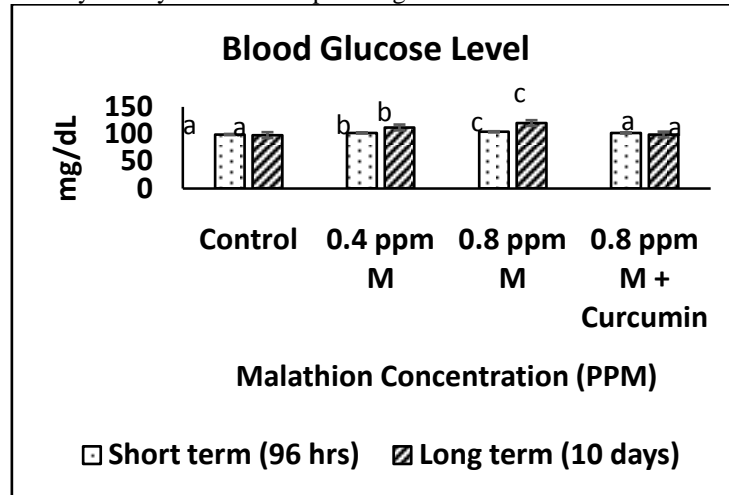
### MATERIALS AND METHODS

The healthy and adult fish, *L.rohita* of approximate  $30 \pm 5$ g of body mass were collected from a local supplier near the Vellayani lake Trivandrum, and treated with 0.05% KMnO<sub>4</sub> to remove any parasitic infections, and they were transferred to large glass aquaria and acclimatized for 20 days. The average values for water characteristics data holding in aquaria were temperature  $25 \pm 3^\circ\text{C}$ , pH 6.8. Twenty-four fish were divided into four groups of six each and placed in separate glass aquaria. The fish of group I were freshwater control, group II and III were treated with 0.4 PPM and 0.8 PPM Malathion for 96 hr respectively (short term treatment) and supplemented with commercial fish feed. The group IV fish were first treated with 0.8 PPM Malathion for 96h and were supplemented with 1% curcumin in the 40% protein feed and fed to fish for the periods 96 hrs. The same experiment was conducted for 10 days (long term) also. Blood was taken from the caudal vein with heparinized syringes. The collected blood was transferred to clean dry test tube for investigation of biochemical parameters i.e, SGOT/AST and SGPT/ALT Activity of enzyme by IFCC Method. Plasma glucose (GOD/POD test kit; Span Diagnostics Ltd., New Delhi) concentrations were measured colorimetrically in a Systronics Spectrophotometer 2202 (Systronics, New Delhi) using commercial test kits.

### RESULTS AND DISCUSSION

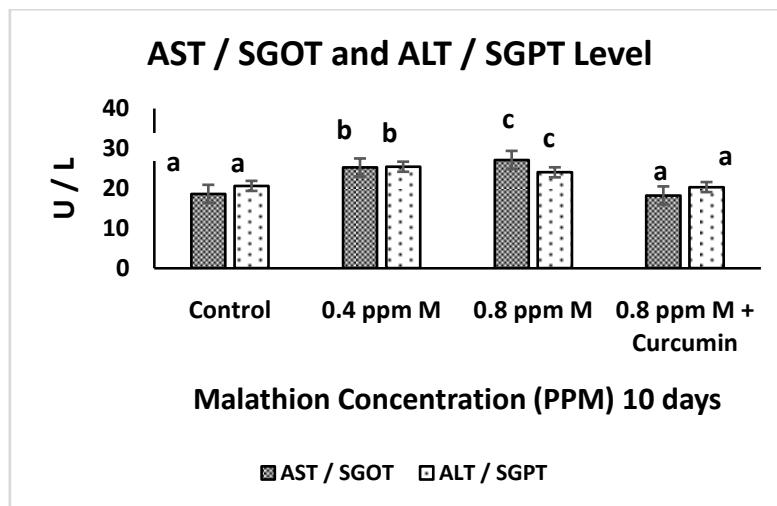
Blood glucose level was significantly increased by malathion exposure (Fig.1) compared to the control and significantly recovered to the normal control value after the supplementation with Curcumin for both 96 hr and 10 days. Aspartate aminotransferase (AST) and alanine aminotransferase (ALT) significantly increased in malathion high dose (0.8ppm) treatment (Fig.2&3). Hyperglycemia was evident in the blood

of exposed fish which may help fish to meet critical needs of energy. Such elevation of glucose also be due to enhanced gluconeogenesis response of stressed fish in their attempt to satisfy their new energy demands. So that, increasing blood glucose levels is widely used as a secondary marker of a stress response. AST and ALT are sensitive indicators to monitor the liver function under drugs treatment or with acute viral hepatitis. The elevated AST and ALT values in the blood sample indicate liver damage or injury. Hence present study clearly revealed the pathological conditions of fish.



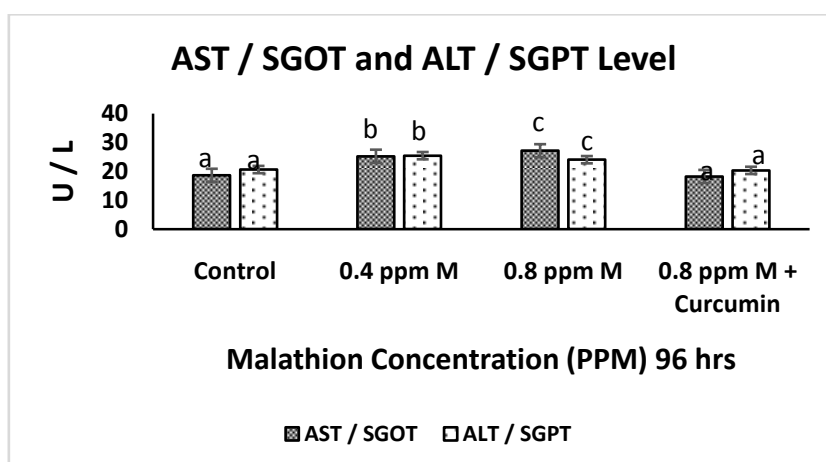
Data are represented as means  $\pm$  SE (n = 6). Values with different superscript letter in the same column for each group are significantly different ( $P < 0.05$ ).

**Fig. 3 Short term and long term effect of Malathion on Blood glucose level of *L. rohita* after exposure**



Data are represented as means  $\pm$  SE (n = 6). Values with different superscript letter in the same column for each group are significantly different ( $P < 0.05$ ).

**Fig. 1 Short term effect of Rogorin on AST/ALT level of *L. rohita* after 96 hr of exposure**



Data are represented as means  $\pm$  SE (n = 6). Values with different superscript letter in the same column for each group are significantly different ( $P < 0.05$ ).

Fig. 2 Short term effect of Rogorin on AST/ALT level of *L. rohita* after 10 days of exposure

## CONCLUSION

Oxidative stress parameters may be highly recommended as an early-warning bio-indicator of environmental pollution. The increased AST / ALT activity indicates the pathologic conditions in fish. Hyperglycemia was evident in the blood of exposed fish which may help fish to meet critical needs of energy. The findings of the present study concluded that short-term (96 hrs) and long term (10 days) exposure to Malathion even at sub-lethal concentrations, induced biochemical alterations in *L. rohita* and led to oxidative damage. But, the administration of curcumin was considered as an effective way to counter the toxicity of Malathion in fish and curcumin supplemented feed can improve the growth of fish in aquaculture. Therefore, it can be concluded that curcumin is beneficial to fish which produce positive effects in aquaculture of fish. In summary, it can be concluded that the dietary curcumin not only effectively protects against the deleterious effects of pesticides.

## Acknowledgement

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## REFERENCES

- Ullah, S, Begum M, Dhama K, Ahamad S, Hassan S and Alam I, (2015). Malathion induced DNA Damage in freshwater fish *Labeorohita* (Hamilton, 1822) using alkaline single cell Gel electrophoresis, *Asian Journal of Animal and Veterinary Advances*, Volume 11(2), 98-105.
- Ahmad Z. (2012) Toxicity bioassay and effects of sub-lethal exposure of malathion on biochemical parameters of *Clarias gariepinus*. *African Journal of Biotechnology*, 11(34), pp. 8578-8585.
- Venkitaramana, P. N. Sandhya Rani, and P. S. Murthy (2006) Impact of malathion on the biochemical parameters of gobiid fish, *Glossogobius giuris* (Ham). *J. Environ. Biol.* 27(1):119-122.

# **MONSOONAL WASH-OFF EFFECT ON PHYSICO-CHEMICAL PARAMETERS OF NATIONAL WATER WAY 3, NEAR TITANIUM PLANT INDUSTRIAL AREA, KOLLAM, KERALA**

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## **ABSTRACT**

National Water Way (NWW) No.3 in Kerala, run parallel to Arabian sea is a coastal inland water body, which receives effluents and wastes from different factories and industries apart from municipal and household sewage wastes throughout its course of passage. The effect of pollution is very high at Chavara region due to effluent discharges from Kerala Minerals and Metals Limited (KMML) and Indian Rare Earths (IRE) Limited. A monthly water quality assessment before and after monsoon season showed a significant ( $P < 0.05$ ) reduction in pollution level due to monsoonal wash off. A total of 29 water quality parameters including nutrients and heavy metal concentrations were assessed from five different locations of NWW and statistically evaluated for pre and post monsoonal difference. Results suggests that monsoonal wash off is an inevitable natural process, which sustain the ecosystem and further more suggests that the effluent discharge pose severe threat to ecology even beyond the monsoonal wash off effect.

**Key Words:** Water Quality, Monsoon Wash-off, Pollution

## **INTRODUCTION**

Kerala is bestowed with 44 rivers and several backwaters which receive rainwater and other water runoff from the terrestrial mass. There are two monsoons, southwest and northwest monsoon prevails in Kerala of which southwest monsoon during June-July is the prominent one to which the climate, agriculture and other anthropogenic activities are synchronized. The monsoon effects in many very ways to the terrestrial, areal and aquatic ecosystems of which the polluted aquatic ecosystems are 'cleaned' by monsoonal wash off during the period. Kerala Minerals and Metals limited (KMML) is one of the leading public sector company producing Titanium sponge, located at Chavara, Kollam district of Kerala, which expels 40,000 MT waste products (sludge) per annum during the production of titanium dioxide pigment. One more industry, Indian Rare Earths Limited (IRE), a Government of India enterprise is also located adjacent to the KMML and discharge effluents to the National Water Way 3 (NWW 3) and to Arabian sea (Jayasree *et al.*, 2009). Heavy metals are natural constituents of the earth crust which are persistent environmental contaminants as they are non-biodegradable. Effluent discharge to aquatic habitat leads to the reduction in pH Weichert, (1972). Pollution due to heavy metals is very prominent in regions with mining and old mine sites (Geetha, 1997). Elevated levels of heavy metals in aquatic ecosystems have raised public concern around the world due to their high potential to enter and accumulate in food chains (Ivan *et al.*, 2011). National Water Way 3 (NWW 3) which connects Kollam and Kottappuram (205 km), having 24 hrs navigation facilities is a biodiversity rich backwater river which joins with several estuaries during its course. it is one of the most navigable and tourism potential aquatic ecosystem and its tourism potential is utilized at Kollam, Alappuzha and Ernakulam districts. It have 4 sea opening in Munambam, Kayamkulam, and Neenadakara. Greenpeace (2003) documented the presence of more than 240 industrial units operating in Eloor, Kalamasery industrial belt alone with an average release of about 2.6 million liters of untreated effluents per day into the backwaters system. The effect of monsoonal wash off on the pollutant clearance or the water quality parameters are understudied and an assessment has been attempted in the present study to evaluate the monsoonal wash off effect on water quality parameters of NWW 3 at Chavara region.

## **MATERIALS AND METHODS**

### **Study Site and Collection Methods**

The present investigation was carried out on the National waterway3 near Chavara industrial area, Kollam district, Kerala, The anthropogenic activity has threatened the ecological status of the backwaters and nearbyland area especially by the Industries, KMML (Kerala Minerals and Metals Ltd.) and adjacent Indian Rare Earths Limited (IRE). The NWW 3 joins Vattakayal backwater at its north and Ashtamudi backwater

system at its south. Two sampling stations were selected for the study of which site 1 (Fig. 1) near Ashtamudi estuarine area and site 2 was selected near industry discharge. Surface water sampling was done on a monthly basis from March to June, 2018, in which March and April collections were considered as premonsoon and May and June months were considered as monsoon period. The samples were brought to the laboratory for further analysis following standard procedure.

#### **Physico-chemical analysis**

Physico-chemical analysis was carried out using standard procedures. Physical parameters like Temperature ( $^{\circ}\text{C}$ ) atmospheric and water temperature, flow rate (m/sec), conductivity (ms/cm; Eutech instrument PCD 650), Total dissolved solids (TDS, g/L; Eutech instrument PCD 650), Total suspended solids (TSS, g/L) and total solids (TS; g/L) were estimated using APHA, (1998) methods. Chemical parameters like pH (Eutech instrument PCD 650), Salinity (ppt), dissolved oxygen (mg/L), dissolved carbon dioxide (mg/L) alkalinity (mg/L), Calcium, Magnesium and total hardness (mg/L) were also analysed following APHA (1998) methods. Nutrients (mg/L) like phosphate, nitrite, nitrate, silicate and sulphate were also estimated using spectrophotometer method (Grasshoff 1999). Heavy metal such as cadmium, chromium, iron and zinc were analysed using atomic absorption spectrophotometer (AAS GBC Avantaver 1.33). Primary and net productivity was measured using light and dark bottle method (Grasshoff 1999). All the data were analysed using Student's t test to compare between seasons and a probability value  $< 0.05$  considered significant.

FIG. 1. Station 1; South of National Water Way 3



FIG. 2. Station 2; Effluent discharge area



#### **RESULT AND DISCUSSION**

The analysis results of two stations are given in table 1 for station 1 and in table 2 for station 2. Several parameters showed significant difference between premonsoon and monsoon period which may be due to the monsoonal wash off effect in aquatic ecosystem. Several studies reported seasonal difference in water quality parameters from the area (Geetha, 1997; Koshy, 2013). The water temperature ranged from 28 in premonsoon and 26.5 $^{\circ}\text{C}$  in monsoon season. The mean value of temperature shows that in all station, the highest value of water temperature and atmospheric temperature were noticed during premonsoon season and lowest is obtained during monsoon season. Nair (1983) studied the physico-chemical characteristics of the waters of mudbank region, situated south of Cochin, observed the lowest temperature (29 $^{\circ}\text{C}$ ) in monsoon and highest in post monsoon season (33 $^{\circ}\text{C}$ ). High value during summer could be attributed to high solar radiation (Govindasamy *et al.*, 2000). Similarly the dissolved oxygen ranged between 1.2 - 2.6 mg/l during premonsoon season and 6.9 - 8.0 mg/l in monsoon season, which showed a significant increment in monsoon seasons, which was a good sign for monsoonal wash off. The mean value of dissolved oxygen during premonsoon ranged 1.80-2.5 mg/l and 5.60-6.7mg/l in monsoon season The high dissolved oxygen content in the monsoon season may be due to the influx of rainwater runoff into the estuarine system and heavy rain fall (Zindge and Desai, 1980; Anila Kumari and Abdul Azis, 1992). Flow rate was found to be high during monsoon season along both the study stations, which may be due to rain fall and local flooding, which wash off the pollution due to effluent discharge.

The lowest value of hardness was recorded in monsoon ranged from 80 mg/l - 120 mg/l and highest in premonsoon season 295 mg/l - 495.5mg/l, the high rate in premonsoon with respect to Ca and Mg hardness may be attributed to hardening of water due to detergent and soaps used for washing. The monsoonal water dilutes and washes off hard water from system and hence reduced the hardness during monsoon period. Similar studies or reduced hardness during monsoon and post monsoon period was reported by Jayaraman *et al.* (2003). Singh *et al.* (1999) reported that high hardness indicates the pollution due to domestic and industrial effluents.

The TDS, TSS and TS from the two stations shows that the highest values was in the premonsoon and the lowest in the monsoon in all stations, The high TDS level is generally due to the accumulation of effluents discharged from industrial complex (Rani *et al.*, 2003; Regina and Nabi, 2004). In the present work the pH

value was maximum in summer and minimum in monsoon 5.7-6.5, the minimum value of pH in monsoon season is mainly due to the monsoon wash off of effluent water near the surrounding of the industry to the water way. As per Lokhande (2013), the pH showed varied fluctuations during the pre and monsoonal period (7.0 to 8.6). Free CO<sub>2</sub> in the present study varied from 5.6 to 17.6 mg/L. The lowest mean value of free carbon dioxide was recorded in monsoon season (0-5.1) where as the highest value (4mg/l-12.7mg/l) in summer which may be due to the influx of rainwater. Similar observations recorded by Ishaq and Khan (2013).

The electrical conductivity is ranged from 19.71 premonsoon season to 96.84 in monsoon season, the highest value of electrical conductivity is due to monsoon flow of effluent water from the factory to the water way. Electrical conductivity is used to check the accuracy and purity of water and also explains the ionic status of all waters. Alkalinity ranged from 20mg/l to 98mg/l in premonsoon season and 300mg/l in monsoon season. High alkalinity in the monsoon due to flushing of household and sanitary waste from surrounding by rain water in to the water body. Alkalinity measures the capacity of water to neutralize acids and is influenced by the presence of alkaline compounds in the water such as bicarbonates, carbonates, and hydroxides. A minimum level of alkalinity is desirable because it is considered a "buffer" that prevents large variations in pH (Lawson, 2011). Analysis of heavy metal shows that Cr and Zn contents were high in premonsoon season. The ranges from 0.456 ppm - 0.356 ppm and 0.106 ppm - 0.04 ppm respectively, during the monsoon season the values were went down below detectable level. Cr, and Zn ranges 0.02ppm in site 1 and no detection in site 2. Generally the major source of Cr in water is through industrial effluents (Kamal *et al.*, 2007). Exposure of man to high concentration of Cr may cause dermatitis, ulcer, destruction of mucus of nose and cancer of the stomach. Fe shows high range in monsoon season, 0.768 ppm - 1.703 ppm and during the premonsoon season, it range from 0.196 ppm - 0.173 ppm. Seasonal variation showed high content of iron in the premonsoon season, the present study results were in tune with the reports of heavy metal pollution in the Ganga River (Kar *et al.*, 2008). Cadmium in station 1 show slightly higher in monsoon season 0.436 ppm and in premonsoon season 0.286ppm, The prolonged consumption of Zn and Cd in high quantity can result in health complications such as fatigue, dizziness and Neutropenia (Hess and Schmid, 2002) in aquatic and other animals. Nutrients like Phosphate, nitrite, nitrate, silicate and sulphate analyses indicate that in both the stations, the content was high during monsoon season, which may be due to terrestrial run off taken by the rain water to the backwater system. Sulphate shows high concentration (0.01 - 3.76 mg/L) in pre monsoon season and low concentration (0.0035 - 1.16 mg/l) in monsoon season. Similarly phosphate also shows higher concentration during monsoon season ranging from 2.651 - 11.97mg/l. Very high concentration of phosphate is the result of industrial discharge. Considering the near normal values of all water quality parameters, monsoonal wash off effect reduced the pollution level near industrial complex area of Titanium sponge factory at Chavara region, Kollam district.

#### Acknowledgement

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Table 1. Effect of monsoon wash off on water quality parameters at station I

	Parameter	Season	Mean	± SD	t value
Physical Parameters	Atmospheric Temperature	( <sup>0</sup> C) PreMonsoon	30.00	1.15	3.873**
		Monsoon	27.50	0.58	
	Water Temperature	( <sup>0</sup> C) PreMonsoon	28.50	0.58	4.899**
		Monsoon	26.50	0.58	
	Flow Rate	m/sec PreMonsoon	18.00	2.31	3.873**
		Monsoon	13.00	1.15	
	Conductivity	ms/cm PreMonsoon	22.65	2.60	-42.665**
		Monsoon	82.92	1.10	
	TDS	g/L PreMonsoon	12.78	0.02	0.786
		Monsoon	8.92	9.83	
	TSS	g/L PreMonsoon	7.63	0.04	6.551**
		Monsoon	4.28	1.02	
	Total Solids	g/L PreMonsoon	19.57	0.98	1.439
		Monsoon	13.19	8.81	



Chemical Parameters	pH		PreMonsoon	6.03	0.08	
			Monsoon	6.58	0.17	-5.755**
	Salinity	ppt	PreMonsoon	20.00	0.00	
			Monsoon	2.60	2.77	12.557**
	Dissolved Oxygen	mg/L	PreMonsoon	1.80	0.69	
			Monsoon	5.60	2.77	-2.661*
	Dissolved CO <sub>2</sub>	mg/L	PreMonsoon	24.20	12.70	
			Monsoon	8.80	0.00	2.425*
	Alkalinity	mg/L	PreMonsoon	57.50	8.66	
			Monsoon	700.00	0.00	-148.379**
Ca Hardness	mg/L	PreMonsoon	77.75	6.48		
		Monsoon	31.66	0.46	14.194**	
Mg Hardness	mg/L	PreMonsoon	1058.60	431.07		
		Monsoon	430.47	110.29	2.824*	
Total Hardness		PreMonsoon	295.00	81.98		
		Monsoon	120.00	23.09	4.109**	
Nutrients	Phosphate	mg/L	PreMonsoon	3.34	0.53	
			Monsoon	11.97	7.02	-2.453*
	Nitrite	mg/L	PreMonsoon	0.48	0.16	
			Monsoon	0.71	0.27	-1.480
	Nitrate	mg/L	PreMonsoon	0.68	0.16	
			Monsoon	0.84	0.04	-1.860
	Silicate	mg/L	PreMonsoon	1.16	0.18	
			Monsoon	3.76	1.66	-3.108*
	Sulphate	mg/L	PreMonsoon	0.00	0.00	
			Monsoon	0.01	0.00	-0.624
Heavy Metals	Iron	ppm	PreMonsoon	0.20	0.00	
			Monsoon	1.70	0.00	2.568**
	Chromium	ppm	PreMonsoon	0.46	0.00	
			Monsoon	0.00	0.00	2.887**
	Zinc	ppm	PreMonsoon	0.11	0.00	
			Monsoon	0.02	0.00	1.987*
Cadmium	ppm	PreMonsoon	0.29	0.00		
		Monsoon	0.44	0.00	1.358*	
Biological Parameters	GPP	mg/L	PreMonsoon	1.00	0.23	
			Monsoon	1.60	0.46	-2.324*
	NPP	mg/L	PreMonsoon	1.20	0.92	
			Monsoon	1.60	1.39	-0.480

\* P < 0.05; \*\* P < 0.01

Table 2. Effect of monsoon wash off on water quality parameters at station 2

	Parameter	Season	Mean	± SD	t value	
Physical Parameters	Atmospheric Temperature	( <sup>0</sup> C) PreMonsoon	27.00	0.00		
		Monsoon	26.00	0.00	4.899**	
	Water Temperature	( <sup>0</sup> C) PreMonsoon	28.50	0.58		
		Monsoon	26.50	0.58	17.472**	
	Flow Rate	m/sec PreMonsoon	15.00	5.20		
		Monsoon	19.00	1.15	- 30.327**	
	Conductivity	ms/cm PreMonsoon	23.57	2.62		
		Monsoon	71.62	1.79	2.221	
	TDS	g/L PreMonsoon	11.84	2.02		
		Monsoon	5.19	5.64	5.608**	
TSS	g/L PreMonsoon	10.98	1.46			
	Monsoon	2.41	2.68	2.290*		
Total Solids	g/L PreMonsoon	17.57	2.57			
	Monsoon	7.59	8.33	2.309		
Chemical Parameters	pH	PreMonsoon	6.30	0.00		
		Monsoon	5.66	0.55	84.437**	
	Salinity	ppt	PreMonsoon	20.00	0.00	- 26.696**

			Monsoon	0.50	0.46	
			PreMonsoon	2.50	0.12	
	Dissolved Oxygen	mg/L	Monsoon	6.65	0.29	0.179
			PreMonsoon	9.40	4.39	-11.318**
	Dissolved CO <sub>2</sub>	mg/L	Monsoon	8.80	5.08	
			PreMonsoon	61.50	42.15	31.852**
	Alkalinity	mg/L	Monsoon	300.00	0.00	
			PreMonsoon	80.56	3.24	24.779**
	Ca Hardness	mg/L	Monsoon	28.45	0.46	
			PreMonsoon	1992.80	136.76	32.206**
	Mg Hardness	mg/L	Monsoon	290.16	13.52	
			PreMonsoon	489.50	24.83	
	Total Hardness	mg/L	Monsoon	88.00	2.31	-1.796
			PreMonsoon	2.66	0.53	-7.637**
	Phosphate	mg/L	Monsoon	12.00	10.39	
			PreMonsoon	0.30	0.10	-1.765
	Nitrite	mg/L	Monsoon	0.83	0.10	
			PreMonsoon	0.38	0.03	-2.092
	Nitrate	mg/L	Monsoon	1.43	1.18	
			PreMonsoon	0.46	0.16	-4.066*
	Silicate	mg/L	Monsoon	7.08	6.33	
			PreMonsoon	0.00	0.00	-
	Sulphate	mg/L	Monsoon	0.01	0.00	
			PreMonsoon	0.17	0.00	3.568**
	Iron	ppm	Monsoon	0.77	0.00	
			PreMonsoon	0.36	0.00	2.814*
	Chromium	ppm	Monsoon	0.00	0.00	
			PreMonsoon	0.04	0.00	1.025
	Zinc	ppm	Monsoon	0.00	0.00	
			PreMonsoon	0.08	0.00	3.368*
	Cadmium	ppm	Monsoon	0.02	0.00	
			PreMonsoon	1.20	0.92	-1.596
	GPP	mg/L	Monsoon	2.15	0.75	
			PreMonsoon	1.70	0.12	3.286*
	NPP	mg/L	Monsoon	1.10	0.35	

\* P < 0.05; \*\* P < 0.01

## REFERENCES

- Anilakumary, K.S., Abdul Azis P.K. and Natarajan, P.J. (2007). Water quality of the Adimalathura Estuary, southwest coast of India., *Mar. Biol. Ass. India.*, 49 (1) : 01– 06.
- APHA. (1998). Standard methods for the examination of water and wastewater, United Book Press, Inc, Baltimore, Maryland, USA.
- CPCB. 2006. Water quality status of Yamuna River (1999-2005). Report, Central Pollution Control Board, Government of India, India, 136 pp
- Geetha Bhadrans, (1997). Heavy metal pollution in Ashtamudi estuarine system. Ph.D. Thesis, University of Kerala.
- Govindasamy C., Kannan L., Azariah J., (2000), Seasonal variation in Physico-chemical properties and primary production in the coastal water biotopes of Coromandel Coast, India journal of environmental biology, **21**, pp 1-7
- Grasshoff, K, Ehrhardt, M., and Kremling, K. 1999. Method of sea water analysis. Pp.159-226
- Greenpeace. (2003). *Status of Periyar's health at the Eloor industrial estate, Kerala India*. Greenpeace Research Laboratories, University of Exeter..
- Hess, R. and Schmid, B. (2002). Zinc supplement over dose can have toxic effects. *J. Paediatr. Haematol./Oncol.*, 24 : 582-584
- Ishaq Fouzia and Khan Amir (2013). Seasonal limnological variation and macro benthic diversity of river Yamuna at Kalsi Dehradun of Uttarakhand. *Asian Journal of Plant Science and Research*, (2): 133-144.
- Ivan, J., Z'eljka, V.J., Gorc'in, C., Zoran, G., Ljubinko, J., Stefan, S., Mirjana, L. (2011). Determination of differential heavy metal and trace element accumulation in liver, gills, intestine and muscle of sterlet (*Acipenser ruthenus*) from the Danube River in Serbia by ICP-OES. *Microchem. J.*, 98, 77–81

- Jayasree, P. K., Sheela, Y., Evangeline, and K. J. Sudhir. (2009). Remediation of hazardous solid waste from titanium industries. Indian geo technical society. Guntur, India, pp. 296- 300
- Jayaraman, P.R., Ganga Devi, T. and Vasudevan Nayar, T. (2003). Water quality studies on Karamana river, Thiruvananthapuram, District South Kerala, India, *Poll. Res.*,32(1) : 89-100
- Jha, P.K., Subramanian V. and Sitasawad R. (1988). Chemical and sediment mass transfer in the Yamuna river- A tributary of the Ganges system. *Journal of Hydrology*, 104: 237-246
- Kamal, D., Khan, A.N., Rahman, M.A. and Ahamed, F. (2007). Studies on the PhysicoChemical Properties of Water of Mouri River, Khulna, Bangladesh. *Pakistan Journal of Biological Sciences*, 10 (5) : 710-717
- Kar, D., Sur, P., Mandal, S.K., Saha, T and Kole, R.K. 2008. Assessment of heavy metal pollution in surface water. *Int. J. Environ. Sci. Tech.*, 5(1), 119-124
- Lawson, E.O (2011). Physico chemical parameters and heavy metal content of water from mangrove swamps of Lagos Lagoon, Lagos, Nigeria, *Advances in biological research*. 5(1):1-6p
- Lokhande, M.V. (2013). Limnological studies on Dhanegaon reservoir, Dhanegaon, Dist-Osambad, Maharashtra, India, *Indian Stream Research Journal*, 2(12): 1-6
- Nair, N. B., Abdul Aziz, P. K., Krishnakumar, K., Dharmaraj, K., Arunachalam, M. and Balsubramanian, N. K. (1983). Ecology of India estuaries. Part I- Physico chemical features of water and sediment nutrients of Ashtamudi Estuary. *Indian J. Mar. Sci.* 12: 145-150
- Rani, D.F.G., Geetha, S. and Ebanazar, J. (2003). The drinking water quality characteristics of five rural places in and around Thittagudi, Tamil Nadu, India. *Poll.Res.*,22(1): 111-115.
- Regina, B. and Nabi, B. (2004). Physico-chemical characterization of Cauvery and Bhavani River at the confluence point  
Koodithurai River. *Eco. Env. and Cons.*,10: 541-543
- Saxena, M.M. (1994). *Environmental analysis- water, soil and air*. Agrobotanica Publishers, India.185pp.
- Singh, H.P., Mahaver, L.R. and Mishra, J.P. (1999). Impact of industrial and sewage wastes on water qualities in middle stretch of river Ganga from Kanpoor to Varanasi. *J.Environ.Biol.*,3: 279-285.
- Zindge, M.D. and Desai, B.N. (1980). Wastewater discharge and its effect on the quality of water of Mahim creek and Bay. *Mahasagar*,13: 204-213.

# **SEASONAL VARIATIONS OF HYDROGRAPHICAL PARAMETERS IN VATTAKAYAL LAKE, KOLLAM DISTRICT, KERALA**

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## **ABSTRACT**

*Lakes are superb habitats for the study of ecosystem dynamics; to study the interactions among biological, chemical and physical process are frequently either qualitatively or quantitatively distinct from those on land or in air. The water samples were collected from the Vattakayal Lake, Kollam, Kerala from October 2012 to September 2013. The physico- chemical analysis of the study noticed that water temperature was slightly higher than atmospheric temperature. Depth and transparency in the study period showed positive correlation. Through the period of study  $p^H$  remain acidic to alkaline nature. Slightly high value of DO was observed during monsoon season . Alkalinity was higher in the bottom water than surface water indicating vertical stratification . The highest dissolved free  $CO_2$  at all stations was noted during pre monsoon and the lowest during post monsoon. The hardness at all stations was registered highest values during post monsoon and lowest during monsoon. A good number of people use lakes for bathing, washing and quite often for drinking. This is very pathetic situation because many of the lakes are unhygienic. Continous monitoring of these water bodies and implementing corrective measures to restore their quality is of utmost importance from the public health point of view. It was bearing this need in mind that present study was conceived, which aimed at analysis the water quality of a Vattakayal Lake.*

**KeyWords:** *VattakayalLake , hydrological parameters , public health.*

## **INTRODUCTION**

Lakes are superb habitats for the study of ecosystem dynamics. The inter relation between physical, chemical, biological and organic activities, is the lake ecosystem plays significant role in maintaining fresh water habitat to a variety of flora and fauna and they improve the aesthetic beauty of the landscape. Ecological monitoring and assessment provides the restoration, conservation and management of lakes. It was bearing this need in mind that present study was conceived , which aimed at analyzing the water quality of a vattakayal lake.

## **MATERIALS AND METHODS**

The vattakayal Lakes was selected for the present study. Vattakayal Lakes in Sakthikulangara Gama Panchayat of Kollam District lies between  $8^{\circ}56'$  N and  $8^{\circ}53'$  N latitude and  $76^{\circ}32'E$  and  $76^{\circ}34'E$  longitude. This brackish water lakes is connected to kattakayal stream that flows through Sakthikulngara into the Ashtamudi estuary. The samples for the present study were collected monthly for a period of 12 months from October 2012 to September 2013. All

collections were made in the morning hours between 6.am to 10.am water samples were collected in BOD bottles and polythene bottles and brought to the laboratory for estimation of hydro graphical parameters.

The atmospheric temperature at the study area and the hydrographical parameters such as water temperature,  $p^H$ , transparency, depth, dissolved oxygen free  $Co_2$ , alkalinity, total hardness, total solids, total suspended solids nutrients (Nitrite, Nitrate, phosphate, sulphate and silicate ), were estimated employing internationally accepted standard methods.

## **RESULTS AND DISCUSSIONS (Table 1)**

In the present study the minimum atmospheric temperature during monsoon it may due to more rainfall cloudy sky and cold weather and the maximum during pre monsoon season due to high intensity of solar radiation and evaporation. Surface and bottom water temperature showed maximum values during premonsoon due to the intensity of solar radiation and minimum during monsoon due to heavy rainfall and cloud cover. The water temperature were slightly higher than the atmospheric temperature(Ruttner 1963).Considering the seasons maximum depth at all stations during monsoon and minimum during pre monsoon and minimum during monsoon. Due to high solar radiation and low rainfall prevalent during premonsoonperiod could be the reason for maximum transparency.

P<sup>H</sup> of the vattakayallake ,seasonally highest surface and bottom water P<sup>H</sup> at all stations were registered during pre monsoon due to the utilization of bicarbonates and carbonates buffer system, increased photosynthesis and algal blooms ( Patil*etal*, 2011) and lowest during monsoon due to influx of fresh water, rainfall and the decomposition of organic matter and resultant of lake water Santhosh and Perumal(2011).

Considering the seasons, the highest surface and bottom water DO was registered during monsoon season it could be due to high rate of photosynthesisby the phytoplankton and high solubility of oxygen in water.(Anilakumary*etal* 2007). The minimum value of DO during pre monsoon may be due to high salinity and low solubility of DO in water.(Krishnakumare*etal*2002).

The highest surface and bottom water total alkalinity was noted during pre monsoon period is due to concentration of salts in water due to evaporation and decrease in alkalinity due to monsoon period is attributed to the dilution of lakes.(Radhika*etal*,2004).

Total hardness of vattakayallake ,the highest surface and bottom water was registered during postmonsoon and minimum during monsoon. Ca<sup>2+</sup> and mg<sup>2+</sup> hardness highest during postmonsoon may be due to solar radiation and lowest during monsoon it may be due to heavy rainfall, less solar radiation(Sumesh ,2013).

Considering the seasons highest surface water total solids registered during premonsoon and lowest during monsoon. The highest bottom water TS was registerd during monsoon and lowest during post monsoon. Seasonally highest surface water TDS was registered during post monsoon and lowest during monsoon. The highest bottom water TDS was registered during monsoon and lowest during premonsoon. Saesonally the highest surface water TSS was regestered during pre monsoon and lowest during post monsoon. The highest bottom water TSS was registered during monsoon and lowest during post monsoon.

Nitrite, Nitrate and silicate of the Vattakayal Lake, Considering the seasons the highest surface and bottom water was registered during monsoon and lowest during premonsoon. Phosphate of the vattakayal Lake, considering the seasons and the highest during post monsoon and lowest during premonsoon. Sulphate content of the Vattakayal Lake the highest surface and bottom water was registered duringpre monsoon and lowest during monsoon.

## **CONCLUSION**

The observed slightly higher temperature in water than atmospheric temperature is in conformity with observation in lentic system in the tropics and it is attributable to the higher heat capacity of water.The lake is moderately productive one in respect of P<sup>H</sup> content of the lake .Low levels of Co<sub>2</sub>, DO, Alkalinity are optimum not provide a conducive environment for aquatic life. Ecological monitoring , assessment provides the restoration conservation and management of lakes .

## **ACKNOWLEDGEMENT**

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## **REFERENCES**

- Anilakumary; K.A; P.K.Abdul; Aziz and P.Natarajan 2007. Water quality of the Adimalthura estuary, south west coast of India *J.Mar.Biol.Assoc.India* **49** :1-6
- Krishnakumar,A; V.Shobha and D.Padmamal 2002. Hydrogeochemistry of the Vellayani Lake with special reference to its drinking water potential. *In,Conservation and Management of aquatic ecosaystem* (K.Sankaran Unni,ed.), 45-61
- Pattil,J.V; A.P.Ekhande and G.S.Padate 2011. Study of Lotus Lake: Its abiotic factors their correlation with reference to seasonal changes and attitude. *Ann.Biol.Resi.*,**2**: 44-56
- Radhika,C.G. ,I.Mini and T.Gangadevi 2004. Studies on biotic parameters of tropical freshwater lake-vellayani lake, Thiruvanthapuram, Kerala.*Poll.Res.*,**23**:49-63
- Ruttner,F.1963 *Fundamentals of Limnology*.Univ.Toronto Press,Toronto,Canada,295 P
- Santhosh Kumar,C,And P.Perumal 2011. Hydrobiological investigations in Ayyapattinam Coast (South east coast of India with special reference to Zooplankton *Asian journal of Biological Sciences*.**4**:25-34
- Sumesh,C.2013.Ecobiological status of the The kkumbhagam Kayal of the Ashtamud iEstuary kerala, India,ph.D.Thesisi,Univ. Kerala,Thiruvanthapuram

# **EVALUATION OF WATER QUALITY INDEX (WQI) OF PARAPPAR RESERVOIR IN KOLLAM DISTRICT, KERALA, INDIA.**

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## **ABSTRACT**

The Water Quality Index (WQI) is a single number that express the quality of water by integration of water quality variables. Water quality index of Parappara reservoir, Kollam district was studied for a period of six months from November 2017 to April 2018. The reservoir was constructed across the Kallada river for generating electricity, irrigation purpose and domestic use. The water samples from the reservoir was collected at an interval of 30 days and analysed for physico-chemical parameters as per the standard procedures of APHA (2005). The weighted Arithmetic Index method (Brown et al., 1970) was used for the calculation of WQI of the reservoir.

**Key words:** *parappara reservoir, water quality index, weighted arithmetic index method.*

## **INTRODUCTION**

It is well known that clean water is absolutely essential for several purposes for healthy living. Rivers are the most important natural resources for human development but it is being polluted by indiscriminate disposal of sewage, industrial waste and plethora of human activities, which affects its physico-chemical parameters.

So it is necessary to assess the quality of water as it is continuously being used by all organisms including humans. Water is indispensable and it is essential to sustain life on earth. Increasing problem of deterioration of river water quality, it is necessary to monitoring of water quality to evaluate the production capacity (Mishra et al., 2009). Water quality index was constructed in the present study for the evaluation of water quality of a Hydroelectric plant reservoir at Thenmala in Kollam District.

A water quality index (WQI) can be defined as any mathematical approach which aggregates data on two or more water quality variables to produce a single number . Water quality index is a useful statistical tool for simplifying, reporting and interpreting complex information obtained from any body of water. A simple number given by any WQI model explains the level of water contamination. The water quality index measures the scope, frequency, and amplitude of water quality exceedances and then combines the three measures into one score. This calculation produces a score between a value of 0 and 100.

## **STUDY AREA**

The Parappara reservoir ( Latitude 8°49' and Longitude 77° and 76°24'E) was constructed by damming the Kallada river at Thenmala with the gravity masonry dam, aligned perpendicular to the centre line of the Kallada river. The water shed upstream of the dam covered mainly by forests and plantations. The catchment area of the reservoir is represented by the forest area consisting of teak and soft wood plantations.

## **MATERIALS AND METHODS**

The water samples from the reservoir was collected at an interval of 30 days and analysed for physicochemical parameters as per the standard procedures of APHA (2005). The parameters P<sup>H</sup> and

dissolved were monitored at the sampling site and parameters like BOD, TDS,TS,TSS,CO<sub>2</sub>, turbidity etc were analysed in the laboratory.

In this study 7 important parameters were chosen for the calculation of Water quality index. The WQI was calculated by using the standard for drinking quality recommended by the WHO in 1992 and Bureau of Indian standards (BIS) in 1983. The weighted Arithmetic Index method (Brown et al., 1970) has been used for the calculation of WQI of the reservoir. Further quality rating or Sub index ( $q_n$ ) was calculated using the following expressions.

$$q_n = 100[V_n - V_{io}] / [S_n - V_{io}]$$

(Let there be  $n$  water quality parameters and quality rating or subindex ( $q_n$ ) corresponding to  $n$ th parameter is a number reflecting the relative value of this parameter in the polluted water with respect to its standard permissible value.)

$q_n$  =Quality rating for the  $n$ th Water quality parameter  $V_n$  = Estimated value of the  $n$ th parameter at a given sampling station.

$S_n$  = Standard permissible value of the  $n$ th parameter.

$V_{io}$  = Ideal value of  $n$ th parameter in pure water. (i.e., 0 for all other parameters except the parameter pH and Dissolved oxygen (7.0 and 14.6 mg/L respectively)

Unit weight was calculated by a value inversely proportional to the recommended standard value  $S_n$  of the corresponding parameter.

$$W_n = K / S_n$$

$W_n$  = unit weight for the  $n$ th parameters.

$S_n$  = Standard value for  $n$ th parameters

$K$  = Constant for proportionality.

The overall Water Quality Index was calculated by aggregating the quality rating with the unit weight linearly.

$$WQI = \sum W_n q_n / W_n$$

## RESULT AND DISCUSSION

TABLE:1 Physico-chemical status and water quality index of parappan reservoir

parameters	turbidity		DO		BOD		CO <sub>2</sub>		TS		TSS		TDS		WQI
Standard value as per WHO	5 NTU		5mg/l		6mg/l		10mg/l		500mg/l		500mg/l		500mg/l		
$W_n$	0.20		0.20		0.166		0.100		0.0020		0.0020		0.0020		
Quality rating ( $q_n$ )	OV	$q_n$	OV	$q_n$	OV	$q_n$	OV	$q_n$	OV	$q_n$	OV	$q_n$	OV	$q_n$	
November	1.2	24	8	68.7	1.1	18.33	5	50	102	20.4	50.8	10.16	28	5.6	39.86
December	1	20	8	68.75	1	16.66	5	50	113	22.6	50.7	10.14	18	3.6	38.07
January	1.2	24	7.2	77.08	1.8	30	4.8	48	121	24.2	110	12.2	18	3.6	45.07
February	2	40	7.8	70.83	2	33.3	4.7	47	135	27	81	16.2	17	3.4	29.45
March	2	40	8	68.75	1.7	28.33	5	50	140	28	89	17.8	19	3.8	34.97
April	2	40	7.1	78.12	2.2	36.66	4	40	141.6	28.3	88	17.6	20	4	50

TABLE2: WQI and status of water quality.



Water quality index level	Water quality status
0-25	Excellent
26-50	Good
51-75	poor
76-100	Very poor
>100	Unsuitable for drinking

The water quality indices that for 6 months is presented in table 1. The value of various physic-chemical parameters for the calculation of WQI are presented in the table. The present study shows that the water is good for human use and is safe for drinking purpose.

Table 1 explains water quality classification based on WQI criteria, which in turn, indicates the WQI of all the six months is within the category of Good water (WQI – 26 to 50 ). The water quality index value obtained in the month of November is 39.86 and that of December is 38.07.WQI value of February is 29.45 and is varied by 34.97 in March.

Maximum water quality index value of 50 was noted in the month of April and minimum of 29.45 in February .maximum value in April could be due to pollution low rainfall and absence of surface runoff in the catchment area etc.

The concentration of dissolved oxygen regulates the distribution of flora and fauna. The present study indicate that the concentration of dissolved oxygen fluctuated between 7mg/l and 8mg/l.Biochemical oxygen demand is another parameter which assess the health of the water body. In this study the value of BOD is within the range of standard value hence there was relatively low organic pollution.High DO, low BOD and low turbidity indicate the good status of the reservoir.

## CONCLUSION

The present study reveals that the water in the reservoir can be used for public consumption without any treatment. From the study it is clear that the dam water is of good quality (WQI-26 to 50). All other parameters were satisfactory .Weighted Arithmetic Index method appears to be more systematic and gives an overall idea about the quality of water.

The water from the Parappan reservoir is being used for drinking purpose in the Thenmala panchayath for the last 15 years.WQI of the reservoir has not been estimated yet. The fresh water is vital concern for mankind since it is directly linked to human welfare. Most of the water bodies disappeared due to encroachment and pollution. It is with this background the present work was done.

## REFERENCES

- APHA, AWWA, and WEF (2005). Standard Methods for the Examination of Water and Wastewater, 21st ed. American Public Health Association, Washington, D C.
- Brown, R. M., McClelland, N. I., Deininger, R. A., & Tozer, R. G. (1970) "A water quality index: Do we dare?"Water & Sewage Works, 117, 339–343
- Bureau of IndianStandards (BIS) 1983 . Indian Standard for Drinking Water as per BIS specifications (IS 10500-1991)
- Padmanabha, B. and Belagali, S.L. (2005).Comparative study on the water quality indexof four lakes in the Mysore city. *IJEP*, 25,873-876
- Sanchez, M. F. Colmenero, J. Vicente, A. Rubio, M. G. Garcia, L. Travieso and R. Borja, (2007)“Use of the Water Quality Index and Dissolved Oxygen Deficit as Simple Indicators of Watersheds Pollution,” Ecological Indicators, Vol. 7, No. 2.
- Ward,H.B.&Wipple(1992).FreshwaterBiology,(W.T.Edmondson.ed).,Internat.Books &Period., New Delhi. 1246pp

World Health Organisation (WHO) (1992) Guidelines for drinking-water quality. - 2nd ed. Contents: v.2. Health criteria and other supporting information 1. Drinking water – standards ISBN 92 4 154480 5 (v. 2) (NLM Classification: WA 675.

# ECOLOGICAL ASPECTS OF AYIROOR RIVER IN SOUTH INDIA WITH SPECIAL REFERENCE TO HYDROGRAPHICAL CHARACTERISTICS

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## ABSTRACT

The present study was carried out to determine the hydrographical characteristics of a freshwater river, Ayiroor (8.75°N&76.71°E) in Kerala, South India for a period from February 2014 to January 2015. The analysis was done for the physico-chemical parameters like Temperature, Total Dissolved Solids (TDS), P<sup>H</sup>, Alkalinity, Dissolved Oxygen (DO), Dissolved CO<sub>2</sub>, Nitrate and Phosphate. The seasonal average of various parameters were; temperature- 26.17±0.34 to 29.06±0.55, TDS - 59±33.22 to 77.6±49.44, P<sup>H</sup>- 6.53±0.01 to 7.17±0.05, alkalinity -25.33±4.79 to 33±5.10, DO - 4.73±0.17 to 5.47±0.05, dissolved CO<sub>2</sub>- 2.43±0.05 to 2.87±0.05, nitrate- 0.02±0.01 to 0.04±0.01 and phosphate - 0.02±0.01 to 0.04±0.01. The three way ANOVA results reveal that most of the water quality parameters show significant seasonal variations. At station 1, PCA analysis recorded PC 1 with 89.34% of the total variance and Eigen value 33.38, PC 2 recorded 9.94 % variance with Eigen value 3.71 and PC 3 showed 0.616 % variance with Eigen value 0.23. At station 2, PC 1 contributed 77.36% of the total variance with Eigen value 98.69. PC 2 revealed 22.36 % variance with Eigen value 28.53 and PC 3 showed (0.242 % of variance with Eigen value 0.308). At station 3, PC 1 recorded 97.23% of the total variance with Eigen value 29.42, PC 2 revealed 2.46 % variance with Eigen value 0.75 and PC 3 revealed 0.22 % variance with Eigen value 0.07. The overall results of the hydrographical studies of Ayiroor River show that the river is ecologically stable and the water is not severely polluted and more or less suitable for aquatic life and useful for various purposes.

**KEY WORDS:** Ayiroor River, physicochemical parameters, alkalinity, three way ANOVA, PCA analysis

## INTRODUCTION

Deteriorating quality of aquatic systems is a major concern faced by the modern society especially in the developing countries. For effective maintenance of water quality through appropriate control measures, continuous monitoring of a large number of quality parameters is essential. It determines the quality of water favourable for fish and other aquatic organisms and governs the diversity, distribution, abundance and behaviour of organisms in them (Joshi, 1988). Knowledge on the spatial and temporal variations in the physicochemical parameters is highly useful in formulating the management strategies for the water body. The water quality parameters determined seasonally in the water samples of Ayiroor River are temperature, P<sup>H</sup>, TDS, alkalinity, DO, dissolved CO<sub>2</sub>, nitrate and phosphate.

## MATERIALS AND METHODS

**STUDY AREA :** Ayiroor River (8.75°N&76.71°E), the smallest river in South India, originating from the wet lands in Vilangara, Navayikulam of Chirayinkeezhu taluk in Thiruvananthapuram district is the present study area. For convenient monitoring, systematic field study and regular sampling of water three

permanent sampling stations were selected along the stretch of the river from upstream to downstream (Station1-Panayara, Station2-Ayiroor and Station3-Nadayara).

## **METHODOLOGY**

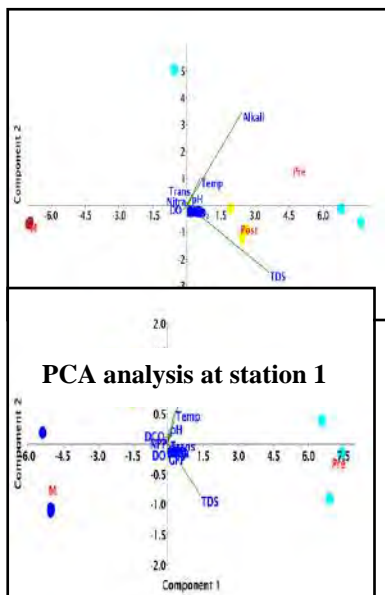
The temperature ( $^{\circ}\text{C}$ ) and  $\text{P}^{\text{H}}$  of the water was recorded in the site itself using a Celsius thermometer of  $\pm 0.10\text{C}$  accuracy and a digital  $\text{P}^{\text{H}}$  pen respectively. The TDS (mg/L) of water samples were estimated by a Water Analyzer (Systronics-model -371), alkalinity (mg/L) by Grasshoff *et al.*, (1983) by DO (mg/L) by Winkler's method (1983) Dissolved  $\text{CO}_2$  (mg/L) by Trivedi & Goel (1986) nitrate (mg/L) by APHA (2005) and Phosphate (mg/L) by Murphy & Riley (1963). The variations and interactions of different hydrographical parameters were done by three way ANOVA (Gomez and Gomez, 1984) and PCA Analysis (SPSS version 24).

## **RESULTS AND DISCUSSION**

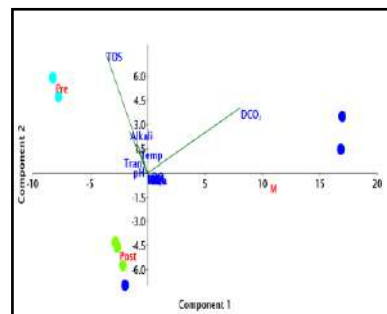
The seasonal average value of water temperature was highest ( $29.06\pm 0.55$ ) in 2013 pre monsoon and lowest ( $26.17\pm 0.34$ ) in 2014 monsoon. In the present study, a fall in water temperature noticed during the monsoon season is due to cold weather, cloudy sky and rainfall. The seasonal mean value of Total Dissolved Solids was highest ( $77.6\pm 49.44$ ) in 2013 pre monsoon and lowest ( $59\pm 33.22$ ) in 2013 monsoon. The minimum TDS values in monsoon may be due to the dilution of water by surface runoff. The seasonal mean of  $\text{P}^{\text{H}}$  was maximum ( $7.17\pm 0.05$ ) during 2013 pre monsoon and minimum ( $6.53\pm 0.01$ ) during 2014 monsoon. Higher value of  $\text{P}^{\text{H}}$  in pre monsoon may be due to the lesser amount of water and higher rate of evaporation. The seasonal average of alkalinity was maximum ( $33\pm 5.10$ ) during 2014 pre monsoon and minimum ( $25.33\pm 4.79$ ) during 2014 monsoon. The highest value of alkalinity was recorded in pre monsoon at all the three sites. Increased rate of decomposition at high temperature and low water level leads to high values of alkalinity in pre monsoon. The seasonal average of DO ranges from pre monsoon ( $4.73\pm 0.17$ ) to monsoon ( $5.47\pm 0.05$ ) in 2013. The minimum DO in pre monsoon may be due to the decrease in solubility of oxygen in water leading to the escape of oxygen to the atmosphere at high temperature. The mean value of Dissolved carbon dioxide (mg/L) was highest ( $2.87\pm 0.05$ ) in 2014-15 post monsoon and lowest ( $2.43\pm 0.05$ ) in 2013 monsoon. Seasonal average of nitrate was maximum ( $0.04\pm 0.01$ ) in 2014 monsoon and minimum ( $0.02\pm 0.01$ ) in 2013 pre monsoon and 2013-14 and 2014-15 117 post monsoon seasons. The high concentration of nitrate observed during the monsoon season might be due to the heavy rainfall, resultant river runoff, land drainage; input of fertilizers from the adjacent agricultural fields. The seasonal average of phosphate ranges from  $0.02\pm 0.01$  in 2013 pre monsoon to  $0.04\pm 0.01$  in 2013 monsoon.

The three way ANOVA showed very significant seasonal variations in water temperature, significant seasonal and station wise variations in TDS and alkalinity and significant seasonal variations in  $\text{P}^{\text{H}}$ , DO, dissolved  $\text{CO}_2$  nitrate and phosphate. At station 1, PC 1 showed 89.34% of the total variance with Eigen value 33.38, PC 2 recorded 9.94 % variance with Eigen value 3.71 and PC 3 showed 0.616 % variance with Eigen value 0.23. At station 2, PC 1 contributed 77.36% of the total variance with Eigen value 98.69, PC 2 revealed 22.36 % variance with Eigen value 28.53 and PC 3 showed 0.242 % of variance with Eigen value 0.308. At station 3, PC 1 recorded 97.23% of the total variance with Eigen value 29.42, PC 2 revealed 2.46 % variance with Eigen value 0.75 and PC 3 revealed 0.22 % variance with Eigen value 0.07.

**Figures: 1 to 3**  
**PCA analysis of hydrographical parameters at the three stations of Ayiroor River**  
**in Kerala South India from 2013-15**



PCA analysis at station 2



PCA analysis at station 3

## CONCLUSION

This study provides an information data that provides basic data to understand the current status of water quality of the Ayiroor River. The overall results of the hydrographical studies of Ayiroor River show that the river is ecologically stable and the water is not severely polluted and more or less suitable for aquatic life and useful for various purposes.

## REFERENCES

- [1]. APHA, 2005. Standard Methods for the Examination of Water and Waste Water, 21<sup>th</sup> ed. American Public Health Association, Washington, D.C. M. Young, The Technical Writer's Handbook. Mill Valley, CA: University Science, 1989.
- [2]. Murphy, J and Riley, J.P. 1963. A modified single solution method for the determination of phosphate in natural waters. *Anal. Chim. Acta*, 27:31 - 36.
- [3]. Trivedy, R.K and Goel, P.K. 1986. Chemical and biological methods for water pollution studies. Environmental Publications, Karad, India; 215 pp.
- [4]. Winkler, L. W. 1883. The determination of dissolved oxygen in water. Berlin. Deut. Chem. Ges, 21: 2843.
- [5]. Gomez, K.A and Gomez, A.A. 1984. Statistical procedures for agricultural research (2 ed.). John Wiley and sons, New York, 680p
- [6]. Grasshoff, K. 1983. Methods of sea water analysis .In: Grasshoff, K., Ehrhardt, M and Kremling, K. (Eds.S). Methods of Seawater Analysis. Veriag Chemic. Weinheim. 419 pp.

## MALATHION INDUCED BIOCHEMICAL AND HISTOPATHOLOGICAL CHANGES IN THE GILL AND LIVER OF TILAPIA, *Oreochromismossambicus* (Peters)

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### ABSTRACT

Malathion is an organophosphate pesticide widely used to control a variety of insects in agriculture. It can reach the aquatic ecosystems affecting non target organisms like fish. The purpose of the study was to determine the biochemical and histopathological changes in the gill and liver of tilapia exposed to two different concentrations of Malathion (0.4 ppm and 0.8 ppm) for 96 hrs. For this study, Control Group was being freed from the treatment of Malathion, whereas experimental group was treated with sub-lethal Malathion concentration of 0.4 and 0.8 ppm. Significant decrease in the serum level of ALT and increase in the AST and Blood glucose were observed in Malathion treated high dose. Liver and gills of fish exposed to Malathion showed different histopathological alterations. The results indicated the toxic nature of the insecticide Malathion.

**KEYWORDS:** Gill, Histopathology, Hyperplasia, Malathion, *Oreochromismossambicus*

### INTRODUCTION

Pesticides are the major potential environmental hazards to humans and animals, as these are present and concentrated in the food chain. (Halappa and David, 2009). Malathion (O, O-Dimethyl-S-1,2-bis ethoxycarbonyl ethyl phosphorodithioate) is a non-systemic, wide-spectrum pesticide in the organophosphate chemical family and is widely used throughout the world. Fishes are very sensitive to changes in their aquatic environment. Insecticides are highly toxic to aquatic organisms and therefore, monitoring the impact of these insecticides is essential. Hence, the present study is aimed at determining the toxicological effects of Malathion (EC 50%) in a fresh water fish, *Oreochromismossambicus*, the Tilapia fish.

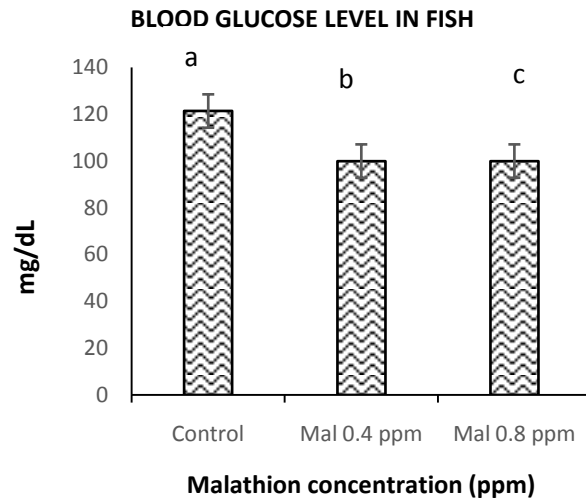
### MATERIALS AND METHODS

Healthy and adult fish of *O. mossambicus*, of approximate  $25 \pm 5$  g of body mass were collected from a local supplier near the Vellayani lake, Trivandrum and acclimated in 50 L glass tanks with tap water at  $28 \pm 1^\circ\text{C}$  (pH 7.2) under natural photoperiod (12L/12D) for three weeks prior to experiment. They were fed with commercial fish feed at a ratio of 1.5% of body mass per day. The fish were starved for twenty-four hours before sacrifice for getting optimum experimental conditions. Malathion (50% E.C) is procured from the local market, OrganoShop, Kollam, India. The stock solution is prepared by dissolving Malathion (50% EC) in double distilled water. Experimental setup consisted of eighteen fishes which were divided into three groups of six each. Group I - Control is being freed from the treatment of Malathion whereas Group II & III were treated with 0.4 ppm and 0.8 ppm Malathion respectively for 96hr and supplemented with commercial fish feed. After experimentation, the fish were anaesthetized in 0.1% 2- phenoxyethanol (SRL, Mumbai) and blood was obtained from caudal vessels using a heparinized syringe. Plasma was separated ( $5,000 \times g$  for 5 min) immediately at  $4^\circ\text{C}$  and stored at  $-20^\circ\text{C}$  until analysis. Fish were then sacrificed by spinal trans-section and pieces of second gill arch, and lower lobe of liver were excised and subjected to histological analysis.

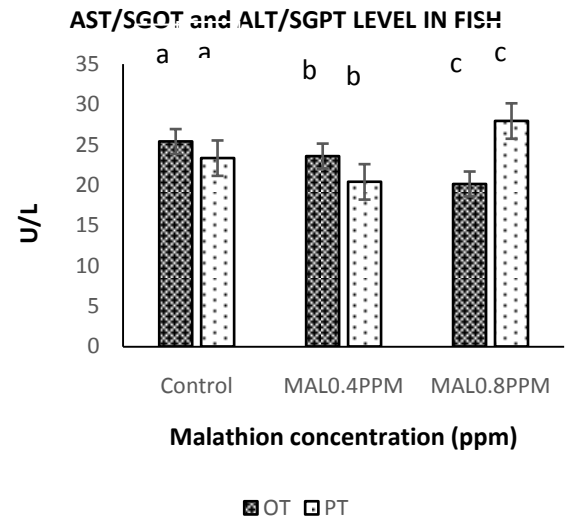
### RESULTS AND DISCUSSION

The results obtained in the present study clearly showed that fishes exposed to high dose of Malathion resulted in a significant decrease in the serum level of ALT and increase in the AST and Blood glucose levels. Gill exhibited marked changes, i.e., hyperplasia of the epithelial cells and lamellar disorganization.

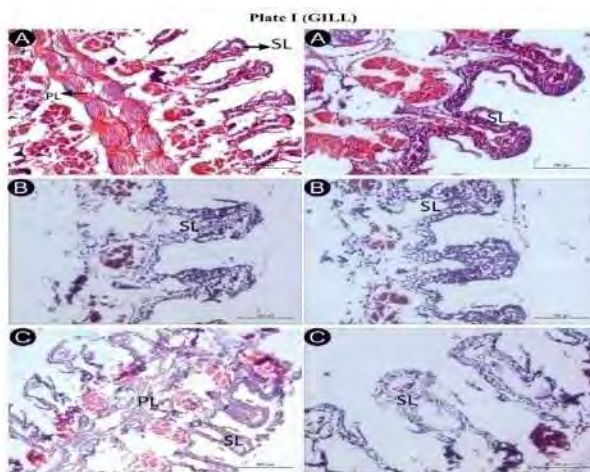
The hepatic parenchyma of fish exposed to Malathion showed an increase of cytoplasmic vacuolation and hepatocellular necrosis.



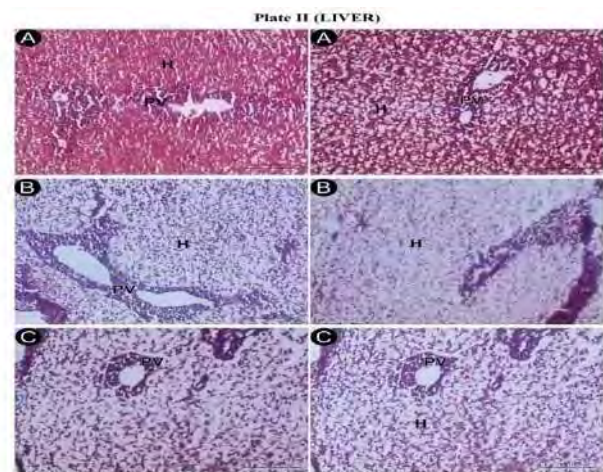
**Fig. 1.** Effect of Malathion on blood glucose levels (mg/dL) of *O. mossambicus* after 96 hr of exposure. Each histogram represents mean  $\pm$  SE (n = 6). Groups with different letter headings are significantly different ( $P < 0.05$ )



**Fig. 2.** Effect of Malathion on AST/SGOT and ALT/SGPT (U/L) of *O. mossambicus* after 96 hr of exposure. Each histogram represents mean  $\pm$  SE (n = 6). Groups with different letter headings are significantly different ( $P < 0.05$ )



**Fig. 3** Photomicrograph of the Gill of *O. mossambicus*: A: Control (10X, 20X) B: Malathion low dose 0.4ppm for 96 hrs, 10X, 20X) C: Malathion high dose, 0.8ppm for 96 hrs showing hyperplasia of epithelium. (Haematoxylin & Eosin staining). PL: Primary Lamellae, SL: Secondary Lamellae



**Fig. 4** Photomicrograph of the Liver of *O. mossambicus*: A: Control (20X) B: Malathion low dose 0.4ppm for 96 hrs, 10X, 20X) C: Malathion high dose, 0.8ppm for 96 hrs. (Haematoxylin & Eosin staining) H: Hepatocytes, PV: Portal vein, S: Sinusoids

The reduction in glucose might be due to increased oxidation of glucose to meet the higher energy demands warranted during chronic exposure. Blood glucose level is widely used as a secondary marker of a stress response. Similar results were recorded in *Clarias gariepinus*, (Bakhshwanet *et al.*, 2009) and *O. niloticus* (Al-Ghanim, 2012) after exposure to diazinon and malathion, respectively. When fish are exposed to environmental pollutants, the vital functions are deleteriously affected and the functional impairment of the gill can significantly damage the health of fish. Hence, the indiscriminate use of these pesticides should be controlled in order to conserve the population of Tilapias and other Cyprinids in the natural aquatic systems. The present study concluded that Malathion is toxic to Tilapia, *O. mossambicus* and

the biochemical and histological observations showed that exposure to the toxic concentration of Malathion caused the alterations in various tissues of *O. mossambicus* to a greater extent. In conclusion, the present investigation on the fresh water fish, *O. mossambicus* treated with Malathion, revealed the susceptibility of the fish to the toxic stress. The findings of this study could be used as a guideline for biomonitoring programs on populations of fish cultured near contaminated areas.

#### **ACKNOWLEDGEMENT**

The authors thank all the teaching and non-teaching staff and BSc Students (2016-18 Batch) of the Dept. of Zoology, Dr. L. Divya and Team, CUK, Kasargod for their valuable support in the successful completion of the work.

#### **REFERENCES**

1. Al-Ghanim K. A. (2012) Acute toxicity and effects of sub-lethal malathion exposure on biochemical and haematological parameters of *Oreochromis niloticus*. *Scientific Research and Essays*. Vol.7(16), pp. 1674-1680.
2. Bakhshwan, M. S. Marzouk, M. I. Hanna, and H. S. Hamed, (2009) Some investigation on the clinical and biochemical alterations associated with diazinon toxicity in *clarias gariepinus*, *Egypt. J. Aquat. Biol. Fish.* 13(2), 173 -197.
3. Halappa R and David M, (2009) Behavioral responses of the freshwater fish, *Cyprinus carpio* (Linnaeus) following sublethal exposure to chlorpyrifos, *Turk. J. Fish. Aquat. Sci.*, **9**, 233-238.



# **A STUDY ON THE MONTHLY VARIATIONS OF SOME WATER QUALITY PARAMETERS AT SELECTED SITES OF NEYYAR RIVER, KERALA, INDIA**

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## **ABSTRACT**

*The southernmost river of Kerala (Neyyar River) is in the situation of stumpy water quality due to indiscriminate pollution activities. An attempt has been made to assess the river water quality with reference to some physico chemical characteristics. The physico chemical parameters are analyzed on monthly basis from May 2015 to April 2016. Six sampling sites namely Neyyar Dam, Kallikkadu, Mandapathinkadavu, Aruvippuram, Neyyattinkara and Poovar were fixed considering physiography as well as pollution. The parameters such as Water temperature, Total alkalinity, TDS, Dissolved oxygen and Phosphate were analyzed for the study. The river water seemed to be of poor quality in downstream stretches probably due to the high anthropogenic activities associated with the region together with the cumulative effect of all the contaminants emerging from highland portion onwards and salt water intrusion from the sea. The present study covers the monthly variation in pollution load and position variation to the respective. Significant variations in parameters were observed in selected six zones starting from reservoir to the end.*

**Key words-** *Physiography, Saline intrusion, Water Quality*

## **INTRODUCTION**

Humans have been enjoying the ecosystem services provided by rivers without understanding how the river ecosystem functions and maintains its vitality (Naiman, 1992). In India, the river water quality problems are intensified during the last few decades and now the situation has become alarming. Studies on the river ecosystems indicate that the major Indian rivers are grossly polluted, especially beside the cities (Srivastava, 1992). Rivers in Kerala face the problem of pollution caused by municipal wastes which include liquid, solid, industrial effluents and agricultural runoffs. Neyyar River is one of the important small catchment rivers in the south-western coast of India. The River is extensively used for domestic, recreational, drinking and irrigation purposes. But different municipal, chemical and domestic wastes are being disposed in to the river and people use this river for extensive sand mining without any concern for the existence of the river. Therefore there is an urgent need for continuous monitoring of the river water quality so as to safeguard public health threats from using this water. In this perspective, the present study tries to focus on the water quality status along the course of Neyyar River from highland to lowland.

## **MATERIALS AND METHODS**

Neyyar, the southern-most river of Kerala having a total basin area of 483sq. km, lies between 8°15' to 8°40'N latitudes and 77°00' to 77°20'E longitudes. Neyyar Dam (S-1), Kallikadu (S-2), Mandapathinkadavu (S-3), Aruvippuram (S-4), Neyyattinkara (S-5) and Poovar-Bund(S-6) are the selected sampling sites (Figure 1). Water samples are collected from six sampling stations of the river for a period of one year (2015-16). Physicochemical parameters such as Water temperature (WT), Total alkalinity (T.ALK), Total dissolved solids (TDS), Dissolved oxygen (DO) and Phosphate (PO<sub>4</sub>) were analyzed. All the analyses were carried out following standard methods (APHA, 2012). Two-way analysis of variance (ANOVA) is used for statistical analysis.

## **RESULTS AND DISCUSSION**

The variations in physico-chemical parameters recorded from six stations, annual mean and standard deviation are depicted in Table 1. Temperature is an important water quality parameter that affects the physico-chemical and biological characteristics of aquatic environments. In the present study, the annual mean values of water temperature revealed that among the six stations, the lowest value recorded in S-1 and highest in S-6. Two way anova showed significant variations for the water temperature between stations ( $F=34.86$ ) and between months ( $F=33.49$ ) at 5% level ( $P<0.05$ ). From February onwards water temperature recoded gradual increase. Murugan and Ayyankkavu (1991) have explained that such high temperature observed during premonsoon months may be due to the high solar radiation. Alkalinity is important in determining the ability of a stream to neutralize acidic pollution from rainfall or wastewater. Present study indicates that alkalinity values are very less all along the river during all the months. The annual mean values of total alkalinity revealed that among the six stations, the lowest value recorded in S-1 and highest in S-6. Two way anova showed significant variations for the alkalinity between stations ( $F=319.50$ ) and between months ( $F=14.41$ ) at 5% level ( $P<0.05$ ).

The annual mean values of TDS revealed that among the six stations, the lowest value recorded in S-1 and highest in S-6. Two way anova showed significant variations for the TDS between stations ( $F=52.94$ ) at 5% level ( $P<0.05$ ) and no significant variation observed between months ( $F=1.03$ ,  $P>0.05$ ). The abnormal rise in TDS observed at Poovar clearly indicates salt water intrusion from the sea. Highest concentration of TDS in the month of March may be due to evaporation and high temperature. Dissolve oxygen is indispensable for the maintenance of life processes of all organisms. Annual mean values of DO revealed that among the six stations, the lowest value recorded in S-6 and highest in S-1. Much evidence has linked low DO levels to the enrichment of estuaries with nutrients (Morris et al., 1978). Two way anova showed significant variations for the DO between stations ( $F=130.08$ ) and between months ( $F=27.72$ ) at 5% level ( $P<0.05$ ). The phosphorus occurs in natural waters almost solely as phosphates rather a free state. Annual mean values of phosphate revealed that among the six stations, the lowest value recorded in S-1 and highest in S-6. Two way anova showed significant variations for the phosphate between stations ( $F=40.08$ ) and between months ( $F=18.16$ ) at 5% level ( $P<0.05$ ). Phosphate values comparatively high at Poovar are possibly due to the continuous contact with seawater. The highest concentration in rainy months is in agreement with the observations of Chakraborty et al., (1959).

## **CONCLUSION**

The downstream stretches of the river showed low surface water quality in this study. This is due to high anthropogenic disturbances associated with the region. Wild use of chemical fertilizers and pesticides, devious dumping of domestic wastes are also the major causes of deterioration of water especially in Neyyattinkara and Poovar sampling stations. Apart from the lowering of water quality, the estuarine contact may also adversely impact the fresh water system at Poovar. Therefore a programme must be devised to educate the general public on the proper disposal of refuse, treatment of sewage for a broader perspective for maintaining fresh water.

## **ACKNOWLEDGMENT**

We are grateful to University of Kerala for the financial assistance in the form of JRF. The facilities provided by Research Department of Zoology, NSS College, Pandalam are greatly acknowledged.

## **REFERENCES**

- [1] APHA. (2012). Standard Methods for examination of water and wastewater (22nd ed.), 1175 pp. American Public Health Association, Washington DC.
- [2] Chakraborty, R.D., Ray, P. and Singh, S.B. 1959. A quantitative study of the plankton and the physico-chemical conditions of the River Yamuna at Allahabad in 1954-55. *Indian J Fish*, **6**, 186-203.
- [3] Morris, A.W., Mantoura, R.F.C., Bale, A.J. and Howland, R.J.M. (1978). Very low salinity regions of estuaries: Important sites for chemical and biological reactions. *Nature*, **274**, 678-680.
- [4] Murugan, A. and Ayyankannu, K. (1991). Ecology of Uppanar Backwater, Cuddalore, 1. Physico-chemical parameters. *Mahasagar*, **24**(1), 31-38.
- [5] Naiman, R.J. (1992). New Perspectives for Watershed Management. In: R. J. Naiman (ed.), Watershed Management: Balancing Sustainability and Environmental Change. *Springer-Verlag*, New York, pp, 3-11.
- [6] Srivastava, C.P. (1992). Pollutants and nutrients status in raw sewage. *Indian Journal Environment Protection*,

**FIGURE AND TABLE**

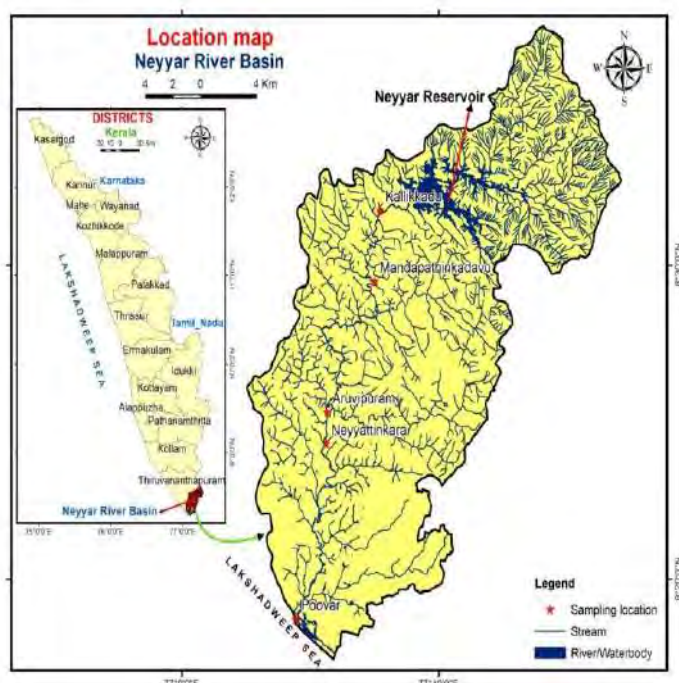


Figure 1. Water sampling locations in Neyyar River

Table 1. Distribution of various Physico chemical parameters in Neyyar River water

S-1	Min	Max	Mean	SD	N	S-2	Min	Max	Mean	SD	N
WT	26.5	31	28.25	1.66	12	WT	26	31	28.71	1.58	12

<b>T.ALK</b>	12.26	21.24	17.04	2.85	12	<b>T.ALK</b>	16.25	25.69	20.81	2.65	12
<b>TDS</b>	17.35	29.36	22.46	3.61	12	<b>TDS</b>	24.56	41.38	32.98	5.53	12
<b>DO</b>	5.04	6.27	5.64	0.4	12	<b>DO</b>	4.21	5.31	4.7	0.38	12
<b>PO4</b>	0.01	0.05	0.03	0.01	12	<b>PO4</b>	0.02	0.09	0.05	0.02	12
<b>S-3</b>	<b>Min</b>	<b>Max</b>	<b>Mean</b>	<b>SD</b>	<b>N</b>	<b>S-4</b>	<b>Min</b>	<b>Max</b>	<b>Mean</b>	<b>SD</b>	<b>N</b>
<b>WT</b>	26.5	32	29.46	1.77	12	<b>WT</b>	27	32.5	29.87	1.66	12
<b>T.ALK</b>	16.62	26.53	21.42	3.08	12	<b>T.ALK</b>	20.6	27.34	24.62	2.38	12
<b>TDS</b>	27.17	43.47	35.03	4.92	12	<b>TDS</b>	28.42	47.74	38.92	5.46	12
<b>DO</b>	4.26	5.91	5.01	0.51	12	<b>DO</b>	4.96	6.22	5.63	0.39	12
<b>PO4</b>	0.04	0.1	0.06	0.02	12	<b>PO4</b>	0.03	0.09	0.05	0.02	12
<b>S-5</b>	<b>Min</b>	<b>Max</b>	<b>Mean</b>	<b>SD</b>	<b>N</b>	<b>S-6</b>	<b>Min</b>	<b>Max</b>	<b>Mean</b>	<b>SD</b>	<b>N</b>
<b>WT</b>	28.5	33.5	30.83	1.42	12	<b>WT</b>	29	33.5	30.87	1.49	12
<b>T.ALK</b>	27.25	36.09	31.73	2.75	12	<b>T.ALK</b>	36.28	56.55	46.08	6.62	12
<b>TDS</b>	31.64	54.11	46.15	7.47	12	<b>TDS</b>	1105.93	7638.72	4579.51	1965.49	12
<b>DO</b>	4.1	5.13	4.47	0.37	12	<b>DO</b>	4.18	4.75	4.4	0.2	12
<b>PO4</b>	0.05	0.12	0.07	0.02	12	<b>PO4</b>	0.054	0.16	0.09	0.04	12

## **EXTENDED ABSTRACTS**

## EFFECTS OF MARINE YEAST FED DIET ON THE HISTOLOGY OF FENNEROPENAEUS INDICUS

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### ABSTRACT

Efficacy of three marine yeasts (*Debaryomyces hansenii* S8, *Debaryomyces hansenii* S100 and *Candida tropicalis* S186) as feed supplement for *Fenneropenaeus indicus* was estimated in comparison with *Saccharomyces cerevisiae* MTCC 36, a commercial feed and a control feed were used for the study. Biomass of yeast strains was prepared using Malt extract agar and incorporated into a standard diet to prepare yeast diets of varying concentrations. *F. indicus* were fed these diets for a period of 28 days and various growth parameters such as production, Food Conversion Ratio (FCR), Specific Growth Rate (SGR), Gross Growth Efficiency (GGE), Relative Growth Rate (RGR), Protein Efficiency Ratio (PER) were performed. Among the three marine yeast diets *Debaryomyces hansenii* S8 supported the best bio growth parameters. Commercial feed was found to be better in efficiency compared to the Bakers yeast diet and control diet. Histological analysis of hepatopancreas of the experimental animals was carried out to examine whether the yeast incorporated feeds do have any toxic effect on the animals. For this, just after the completion of the feeding experiment one animal each was removed from all the six different experimental treatments and the hepatopancreas was dissected out and histological analysis was done. No histopathological alterations indicative of toxic effects could be observed in the prawns fed yeast diets. Histological analysis of the hepatopancreas did not show any structural or functional abnormalities with feeds F8, F100, F 186, F36 and control feed. The cross section of hepatopancreas tubules of the midgut-gland of shrimps fed the control feed has been taken as the reference for the comparative studies to evaluate the toxic effects of the experimental diets. The mature B cells are seen in the tubules, which are compactly arranged. The healthy tubules are with their form intact and possess a characteristic stellate luminal space. Large numbers of R and F cells are also seen showing that the hepatopancreas is in a healthy condition. Healthy F cells have a basic pyramidal or cylindrical shape. Large number of vacuolated cells occupies the epithelium; these could be both R and B cells. Obliteration of the lumen of the tubules was found which was mainly the result of excessive enlargement and vacuolation of B cells. The B cells are more in number and larger suggesting an active and healthy condition of digestive process. Active B cells which are comparable to those fed on the control feed were found. Compression of lumen space is noticed in some tubules. Sloughing off of the cells was noticed in some tubules. The B cells are more in number and larger suggesting an active and healthy condition of digestive process. The normal healthy structure comparable to that of the control is observed and no degenerative changes are noticeable in the tubules. Almost normal condition was noticed in the tubules. They were not completely obliterated or damaged. Slight disruption of the basal membrane was observed. Normal structure of B cells and F cells are noticed. The homogeneity of inclusions on the basal vacuoles was found to be similar to those found in control tubules. Slight disruption of the basal membrane was also observed, no possible reason can be found for this at this point of study. There was no shrinkage in the size of the tubules. F cells retain their pyramidal shape, which is an indication of their healthy condition. The histological examination of the hepatopancreas was carried out in an attempt to evaluate the toxic effects, if any, in prawns fed yeast diets. The cross section of hepatopancreas tubules of the midgut-gland of shrimps fed the control feed has been taken as the reference for the comparative studies. No histopathological alterations indicative of toxic effects could be observed in the prawns fed yeast diets. This study shows the potential of marine yeasts as a feed supplement in aquaculture. Yeasts are nutritionally rich with proteins, vitamins and carbohydrates. Besides being a nutritional source, yeasts serve as an immunostimulant also by virtue of its high carbohydrate ( $\beta$ , 1-3 glucan) and RNA content. Technology for mass production of the marine yeasts, storage and incorporation into diet has to be developed for application in culture systems. Present study

*showed that the three marine yeasts used in the study could very well be used as feed supplement in aquaculture.*

## **EVALUATION OF PHYSICOCHEMICAL AND SENSORY PROPERTIES OF WINE FROM *CITRUS MAXIMA* FRUIT**

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### **ABSTRACT**

*Wine making has been practiced around thousands of years. In its basic form, wine production is a natural process that requires very little human intervention. *Saccharomyces cerevisiae* is the backbone of wine industry. This research is aimed at producing wine from fermented pomelo fruit pulp. Pomelo (*Citrus maxima*), considered as a citrus fruit has a number of surprising health benefits. It is native to South and South East Asia. The health benefits includes its ability to boost the immune system, treat urinary tract infection, improve digestion, lowers blood pressure and reduce cramping. It also has anti-cancerous properties and protects the cardiovascular system. The taste of pomelo is quite pleasant with the consistency of grape fruits without the tart or tangy flavor. Pomelo has strong nutritional values, including its vitamins (especially vitamin C), antioxidant content, reducing sugar, potassium and other organic contents (such as dietary fibers, vitamin B6, magnesium).*

*Saccharomyces was added to the crushed pomelo fruit pulp. Primary and secondary fermentation of pomelo fruit lasted for 21 days, during which aliquots of sample was analyzed for pH, yeast count, alcohol content, specific gravity, poly phenol content, electrical conductivity, antioxidant property and citric acid content using standard procedures. The organoleptic assay of pomelo wine was also carried out at 21<sup>st</sup> day which gives a satisfactory result. The pH of fruit must during the fermentation period was ranging from 6 to 4. As the fermentation proceeds a gradual decline in yeast count from  $8.10 \times 10^6$  cells/ml to  $0.23 \times 10^6$  cells/ml was observed. Specific gravity of wine showed a decrease from 1.13g to 1.12g. An increase of 0.2g to 0.4g in alcohol content was observed during the analysis. Citric acid content increased from 2.56% to 4.99% during the fermentation. As the fermentation proceeds the content of polyphenol showed a gradual decrease from 2.49g to 1.97g. The electrical conductivity of wine when observed on the 21<sup>st</sup> day was found to be 897  $\mu$ S and the Total dissolved solids was found to be 484 ppm at 30°C. The antioxidant activity of the wine was evaluated using DPPH assay and the value was obtained as 86.3%.*



## **PRODUCTION OF WINE FROM CANTALOUPE FRUIT USING *Saccharomyces cerevisiae***

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### **ABSTRACT**

*Wine is an alcoholic beverage of fermented fruit juice which involves the use of yeast to ferment the 'must' of the fruit. *Saccharomyces cerevisiae* is the most commonly used yeast to ferment fruit juice. *Cucumis melo*, cantaloupe is a round melon with reticulated light grey rind enclosing moderately sweet orange coloured flesh. It contains a variety of phytonutrients and flavanoids including the carotenoids,  $\alpha$ -carotene,  $\beta$ -carotene, lutein,  $\beta$ -cryptoxanthin, zeaxanthin and luteolin. Cantaloupe is an excellent source of vitamin A in the form of carotenoid and vitamin C. It is also a good source of potassium, dietary fibres, vitamin, vitamin-B1, vitamin-B6, vitamin-B3 (Niacin), folate, magnesium, copper and vitamin K. It also has many health benefits such as vision improvement, Asthma and cancer prevention, regulation of blood pressure also reduction of blood pressure and reduction of skin dehydration. The present study focused on the production of cantaloupe wine and to identify their nutritional benefits. The following parameters of the wine were studied in comparison with the control and standard. The study involves the analysis of basic parameters such as pH, Total yeast count, estimation of carotenoid content, specific gravity, EC value, antioxidant assay for better understanding of quality and efficiency of the wine. The initial pH of standard was found to be 6 and the final pH was reduced to 3. As the fermentation proceeds a gradual change from  $3.26 \times 10^6$  to  $8.25 \times 10^6$  cells/ml in the yeast count was observed. Carotenoid content was estimated during the following days of wine production which showed a gradual decline in the value from 0.2724mg/ml to 0.0048mg/ml. The antioxidant content was determined using DPPH Assay which was found to be 61.55% after fermentation. Electrical conductivity of the wine was estimated which was found to increase in the EC value from  $468 \mu\text{S}$  to  $651 \mu\text{S}$ . Specific gravity of the wine showed a decrease from 1.16g to 1.13g. Finally the organoleptic characters of wine were observed on 21<sup>st</sup> day of wine production which provides a satisfactory result.*

## **PHYTOCHEMICAL SCREENING AND GC – MS ANALYSIS OF LEAF EXTRACT OF *Terminalia catappa* L.**

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### **ABSTRACT**

Pharmacology and pharmacognosy owe their beginnings to the earlier beliefs and knowledge about medicinal plants. The interest in medicinal plants was especially well-defined among the early botanists who were often physicians. That branch of medical science dealing with the drug plants and its use themselves is known as Pharmacognosy. It is apprehensive with history, collection, selection, commerce, identification and preservation of crude drugs and raw materials. The action of these drugs is known as Pharmacology. There are several million plants that are still being used for medical purposes globally. The use of many of these plants is restricted by native people who have long resided in any given area. *Terminalia catappa* is a widely distributed tree belonging to the family Combretaceae. It is commonly used as shade tree in India and widely used as a folk medicine in Southeast Asia. The leaves of this tree have been used in folk medicine for treating dermatitis and hepatitis in Asian countries. The extract of the leaves shows antioxidative, anti inflammatory and hepataprotective properties. In the present study the phytochemical screening of the leaf of *Terminalia catappa* was evaluated using petroleum ether, chloroform, methanol and water as solvents to determine the active components present in it. The leaf extracts were subjected to qualitative phytochemical screening using standard procedures. The result indicates that *Terminalia catappa* leaf contain pharmaceutically important phytochemicals. Leaf extracts showed the presence of alkaloids, cardiac glycosides, steroids, Terpenoids, Saponins, Flavonoids, phenols and tannin. The phytochemicals constituents were different in different solvents. The compounds present in the methanol extract of leaf of *T. catappa* was identified by using GC-MS analysis. Forty one compounds were identified in the methanol fraction of leaf extract. 3-Methyl-1-phenyl-2-azafluorenone, Benzyl-diseryl phosphate, Phenylethyl Alcohol, 9,12,15-Octadecatrienoic acid, Butanedioic acid, Benzenepropanoic acid etc were the major compounds found in the methanol extract of *T. catappa* leaf. The results of GC-MS analysis revealed that the methanol extract of leaf contains medicinally valuable compounds and can be used for various pharmaceutical applications. The present study thus supports the traditional use of *Terminalia catappa* and is a preliminary scientific validation for the use of this plant for pharmaceutical application. Therefore, further isolation and purification of specific bioactive molecules from the tested plant extracts could serve as a valuable alternative for the synthetic drugs.

## **THE OENOLOGY OF MIXED FRUITS OF *MUSA ACUMINATA* AND *ANANAS COMOSUS***

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### **ABSTRACT**

*Wine is an alcoholic beverage made from fermented fruit juice. Wine making or vinification is the production of wine, which begins with the selection of the fruit, its fermentation into alcohol, and the bottling of the finished liquid. Wine production was carried out with *Musa acuminata* and *Ananas comosus* under controlled fermentation for 21 days. The Pineapple and Banana was chosen for wine preparation as both the fruits contain high amount of sugar content. The Banana contains high amount of carbohydrates, minerals especially potassium and vitamins B1, B2, C and E. The pineapple is an excellent source for antioxidant vitamin C, it also contains vitamins such as vitamin A, B complex vitamins etc. It also contains certain minerals such as potassium, manganese etc. For wine production about 1Kg each of Pineapple and Banana were peeled and sliced; a sugar solution of 1Kg sugar and 500ml of water was prepared. A control (100ml) was prepared in a conical flask. The mixture of sliced Pineapple and Banana with the sugar solution was added to the wine preparation jar. Both the mixture for wine and the control were sterilized at 121°C, 15lbs pressure for 15 minutes. After sterilization both the wine mixture and control were cooled. To the wine mixture about 30 ml of yeast (*S.cerevisiae*) was added, and incubated in dark for 21days at room temperature. The aliquots from both the wine mixture and control were taken under sterilized condition for various physico-chemical test at an interval of 5 days. The yeast cell viable count in the wine production sample was estimated and it was found to rise initially and then decline ( $17.7 \times 10^6$ - $10.1 \times 10^6$  cells/ml). The alcohol content for the wine production sample was estimated using iodoform test (35%). The amount of reducing sugar was estimated using DNS reagent and it was declining gradually (9.458- 7.759mg/ml). The antioxidant property in the samples were estimated using the Radical Scavenging Activity (RSA) method and it was found to be about 22.64%. The specific gravity for the wine sample was estimated to be 0.90166 g/cm<sup>3</sup>. The estimation of carotenoid was carried out using acetone (0.2644 – 0.0152smg/ml), it was found to be gradually declining and polyphenol content was estimated using Folin-Ciocalteus method (22.0328 - 17.8786mg/ml). The quantity of citric acid for both control (0.291g) and sample (0.476g) were estimated using acid-base titrimetric method. The pH was also estimated (before sterilisation 3.5 and after sterilisation 4) for both control and sample. The pH of the sample decreased to 2.5. The EC value was found to be 1.98 mS, TDS was found to be 1.041 ppt at 30.2 °C. The FTIR (Fourier transform infrared spectroscopy) was also analysed, and the main functional group in the sample was found to be OH (alcoholic) group.*

# AN ANALYSIS ON THE HEAVY METAL ACCUMULATION IN WATER AND CRAB, *Scylla serrata* FROM ASHTAMUDI LAKE, RAMSAR SITE, SOUTH INDIA.

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## ABSTRACT

In the present study Water and crab samples were collected from the Ashtamudi Lake in the premonsoon seasons during the period February 2018 for estimating the heavy metals residues. Water Samples were collected in cleaned and dried plastic bottles for the analysis of various heavy metals. Heavy metals in water samples were extracted with conc. HCl and preserved in a refrigerator till analysis for Fe, Cr, Cu, Cd and Pb (Parker, 1972). The crab species, *Scylla serrata* of uniform length were also collected from the selected sites of Kavanad were transported in ice box to the laboratory, where samples of different tissue/organs taken were stored. Concentration of number of heavy metals including Copper, Iron, Chromium, Lead and Cadmium were determined in the samples of Water and Flesh of Crab (*Scylla serrata*) from Ashtamudi Lake. The heavy metals like Lead (0.195mg/l), Chromium (0.001mg/l), Cadmium (0.163mg/l), Copper (0.4mg/l), and Iron (0.5 mg/l) were detected in water samples collected from Kavanad region of Ashtamudi Lake. Heavy metal analysis in crab flesh showed that the metals like Copper (11.5 mg/Kg), Iron (26.85 mg/kg), Chromium (1.84 mg/kg), Lead (0.5 mg/kg) and Cadmium (0.5mg/kg) had a higher level. Here the Iron concentration in crab flesh (26.85 mg/l) is higher than that of Lake water. From the study it is clear that the lake is heavily contaminated it may have a direct impact on the health of aquatic animals as well as of humans. The crab species, *Scylla serrata* highly delicious, and have great demand in the market. The main consumers of these are the local residents of this region. Consumption of this shell fishes intoxicated with heavy metals by human beings may cause accumulation of the toxic metals like cadmium, chromium and lead in human organs through the process of bioaccumulation. It will create severe health hazards to human beings. Also, a potential deterioration of the water quality will be in future, depending on the increasing anthropogenic activities and agricultural development in this region. The study recommends for the implementation of necessary legislative measures by the authorities to conserve the Ashtamudi lake, one of the Ramsar sites.

## PHYSICOCHEMICAL ANALYSIS AND SENSORY EVALUATION OF *Carica papaya* WINE

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### ABSTRACT

Wine is one of the most ancient beverages. It consists of a complex mixture of alcohols, sugars, aldehydes, tannins, pectins, vitamins, minerals and organic acids produced by the action of *S.cerevisiae* on fruit juices.

Papaya (*Carica papaya*) is a common plant native to South America and is widely cultivated in Asian and African countries. Papayas, also known as papaws or pawpaws grow in tropical climates. They are sweet in taste and have vibrant color. They also provide a wide variety of health benefits which make them a popular fruit which includes reducing the risk of [diabetes](#), [cancer](#), [heart disease](#), improving blood glucose control in people with diabetes, aiding in digestion, improving wound healing and lowering [blood pressure](#). It is a fruit growing in a polygamous herbaceous plant and bears fruits throughout the year in a good tropical climate. The fruit remains in clusters near leaves, after maturation and ripening the fruits turn yellow or red. It has high sugar content (59%). Papaya fruit is rich in many vitamins and minerals such as Vitamin C, Vitamin A, Riboflavin, folate, calcium, thiamine, Iron, niacin, potassium and other phytonutrients such as carotenes and alkaloids. Papaya wine is also regarded as a promising nutraceutical as an antioxidant as it has been shown to improve antioxidant defences.

In the present study, the physico chemical and sensory analysis of Papaya wine was carried out. The observations recorded were pH, yeast cell count (OD), specific gravity, carotenoid content, and alcohol content. The analysis was done once in 5 days. FTIR analysis was also done. The pH of different fruit wines will be different. For papaya wine, the pH varied between 5.1 to 4.4. The pH was initially 5.10 and it gradually decreased to 4.45 during the course of fermentation. The decrease in pH indicates increase in acidity.

The yeast cell count during the fermentation process was measured using spectrophotometer. Initially the organism grows rapidly utilizing the sugar present in the substrate provided. As the process of fermentation proceeds, the percentage of alcohol increases. This increased alcohol concentration leads to a decline in the number of organisms. Initial value obtained was  $8.5 \times 10^6$  cells/ml, and then it attained the maximum value of  $9.53 \times 10^6$  cells/ml on the 5th day. It then gradually decreased to a final value of  $2.92 \times 10^6$  cells/ml on the 20th day. The specific gravity was initially 1.1573 and it decreased to 1.1483. Carotenoid value was 0.034 on the first day and it increased to 0.279.

Alcohol content of papaya was found to be increasing during the course of fermentation. It was estimated as 3.01% on the 5th day and it increased to 10.11% on the final day. Fourier Transform Infrared Spectroscopy (FTIR) analysis was performed and OH group was detected. Sensory analysis was done by recording colour, clarity and taste on a five point scale (5 point for excellent quality and 1 point for very bad quality). The overall point obtained was 4.6. Thus the study has shown that papaya can be used to produce wine of an acceptable quality.

## **EVALUATION OF PHYSICOCHEMICAL CHARACTERISTICS OF COCONUT SPROUT WINE**

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### **ABSTRACT**

*Wine is a fermented alcoholic beverage made using yeast. Yeast converts the sugar in the substrate to ethanol and carbon dioxide. Wine has been a traditional drink used as a medicine for almost thousands of years and an important part of various religious myths. Coconut sprout is a big spongy cotton candy mass that is sweet and juicy, found inside coconut during germination produced as an endosperm to nourish the developing embryo. It is well known for its nutritional qualities and is of great medicinal value. They are used to reduce blood pressure, to treat anemia, to lower the cholesterol level, to improve digestion, to boost our immune system etc... The aim of the current study is to combine both the benefits of wine and coconut sprout together and make them beneficial to mankind. The study involves the analysis of basic parameters such as pH, total yeast count, total reducing sugar, total polyphenols and estimation of alcohol content on a regular interval of five days and electrical conductivity and total dissolved solids, antioxidant activity and organoleptic properties of wine was estimated on the 21<sup>st</sup> day to better understand its quality and efficiency during the course of usage. The pH of wine during fermentation ranged from 4 to 2.8. From the first day to last day, the total yeast count showed a gradual increase from 2020000 cells/ml on 5<sup>th</sup> day, 19380000 cells/ml on 10<sup>th</sup> day and 28110000 cells/ml on the 15<sup>th</sup> day. The total reducing sugar in wine was determined by DNS method which showed a gradual decrease from first day to the last day ranging from 8.510 mg/ml on 5<sup>th</sup> day, 7.987 mg/ml on 10<sup>th</sup> day and 6.404 mg/ml on the 15<sup>th</sup> day. The total polyphenol content of wine were estimated ranges from 42.342 mg/ml on the 5<sup>th</sup> day, 24.648 mg/ml on 10<sup>th</sup> day and 21.878 mg/ml on the 15<sup>th</sup> day by Folin Ciocalteu Method. The alcohol content of wine were estimated using iodoform test and shows an increase from 18.01 g/litre on 5<sup>th</sup> day, 22.19 g/litre on 10<sup>th</sup> day and 28.29 g/litre on the 15<sup>th</sup> day. The electrical conductivity and total dissolved solids of wine was estimated as 5.24ms/30°C and 2.765 ppt. The antioxidant assay was carried out using DPPH method and found that it has antioxidant properties with a value of 58.024%. The organoleptic assay was carried out on the 21<sup>st</sup> day which gives a satisfactory result, with an overall acceptancy of 7 out of 10.*

## **TRACE METAL ACCUMULATION ANALYSIS IN CRAB, *Portunus sanguinolentus* FROM ARABIAN SEA.**

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### **ABSTRACT**

Water and crab samples were collected from the Arabian Sea in the pre monsoon seasons during the period February 2018 for estimating the heavy metals residues. Water Samples were collected in cleaned and dried plastic bottles for the analysis of various heavy metals. Heavy metals in water samples were extracted with conc. HCl and preserved in a refrigerator till analysis for Fe, Cr, Cu, Cd and Pb (Parker, 1972). The crab species, *Portunus sanguinolentus* of uniform length were also collected from the selected sites of Kavanad were transported in ice box to the laboratory, where samples of different tissue/organs taken were stored. Concentration of number of heavy metals including Copper, Iron, Chromium, Lead and Cadmium were determined in the samples of Water and Flesh of Crab (*Portunus sanguinolentus*) from Ashtamudi Lake. Concentration of number of heavy metals including Copper, Iron, Chromium, Lead and Cadmium were determined in samples of water and flesh of *Portunus sanguinolentus* from Thirumullavarum Region. Presence of heavy metals like Lead (0.07 mg/l), Chromium (0.01mg/l), Cadmium (0.01mg/l), Copper (0.07 mg/ l), Iron (3.0 mg/ l) were noticed in water. Samples collected from Thirumullavarum Region. Heavy metals like copper (12.2 mg/Kg), Iron (24.46 mg/kg), Chromium (1.65 mg/kg), Lead (0.5 mg/kg), cadmium (0.5mg/Kg) had higher levels in flesh of crab. From the study it is clear that the lake is heavily contaminated it may have a direct impact on the health of aquatic animals as well as of humans. The crab species, *Scylla serrata* highly delicious, and have great demand in the market. The main consumers of these are the local residents of this region. Consumption of this shell fishes intoxicated with heavy metals by human beings may cause accumulation of the toxic metals like cadmium, chromium and lead in human organs through the process of bioaccumulation. It will create severe health hazards to human beings. The study recommends for the implementation of necessary legislative measures by the authorities to ensure the quality of Sea food.

## AN INVESTIGATION ON THE HEAVY METAL ACCUMULATION IN *Peneaus indicus* IN ASHTAMUDI LAKE

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### ABSTRACT

Water and Prawn samples were collected from Ashtamudi lake in the premonsoon seasons during the period February 2018 for estimating the heavy metals. Water Samples were collected from selected site during monsoon seasons in cleaned and dried plastic bottles for the analysis of various heavy metals. Heavy metals in water samples were extracted with conc. HCl and preserved in a refrigerator till analysis for Fe, Cr, Cu, Cd and Pb (Parker, 1972). The Prawn species, *Peneaus indicus* of uniform length were also collected from the selected sites of Kavanad and were transported in ice box to the laboratory, where samples of different tissue/organs taken were stored. Concentration of number of heavy metals including Copper, Iron, Chromium, Lead and Cadmium were determined in samples of water and various tissues (Muscle, Gill, skin) of prawn (*Peneaus indicus*) from Kavanad region of Ashtamudi Lake. The heavy metals like Lead (0.195 mg/kg), Chromium (0.001 mg/kg), Cadmium (0.16 mg/kg), Copper (0.4 mg/kg), and Iron (0.5 mg/kg) were detected in water samples collected from Kavanad region of Ashtamudi Lake. Heavy metal analysis in *Peneaus indicus* muscle showed that the metals like Copper (0.1 mg/kg), Iron (1.5 mg/kg), Chromium (0.058 mg/kg), Lead (0.001 mg/kg) and Cadmium (0.001 mg/kg) had a higher level, where as in gill the heavy metals like Copper (0.328 mg/kg), Iron (2.1 mg/kg), Chromium (0.223 mg/kg), Lead (0.001 mg/kg) and Cadmium (0.001 mg/kg) etc were detected. Analysis of heavy metal in the carapace of prawn showed the accumulation of copper (0.036 mg/kg), Iron (0.35 mg/kg), Chromium (0.057 mg/kg), Lead (0.294 mg/kg), and Cadmium (0.001 mg/kg). Here the Iron concentration in prawn gill (2.1 mg/kg) is higher than that of muscle and skin. From the study it is clear that the lake is heavily contaminated it may have a direct impact on the health of aquatic animals as well as of humans. The Prawn species, *Peneaus indicus* are highly delicious, and have great demand in the market. The main consumers of these fishes are the local residents of this region. Consumption of the fishes intoxicated with heavy metals by human beings may cause accumulation of the toxic metals like cadmium, chromium and lead in human organs through the process of bioaccumulation. It will create severe health hazards to human beings. Also, a potential deterioration of the water quality will be in future, depending on the increasing anthropogenic activities and agricultural development in this region. The study recommends for the implementation of necessary legislative measures by the authorities to conserve the Ashtamudi lake.



## EVALUATION OF THE TRACE METAL CONCENTRATION IN *Oxyurichthys tentacularis* FROM ASHTAMUDI LAKE

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### ABSTRACT

The present work deals with the estimation of the heavy metals residues in Water and fish, *Oxyurichthys tentacularis* samples collected from Ashtamudi lake in the pre monsoon seasons during the period February 2018. Water Samples were collected from selected sites during monsoon seasons in cleaned and dried plastic bottles for the analysis of various heavy metals. Heavy metals in water samples were extracted with conc. HCl and preserved in a refrigerator till analysis for Fe, Cr, Cu, Cd and Pb (Parker, 1972). The fish species, *Oxyurichthys tentacularis* of uniform length were also collected from the selected sites of Ashtamudi lake and were transported in ice box to the laboratory, where samples of different tissue/organs taken were stored. Concentration of number of heavy metals including Copper, Iron, Chromium, Lead and Cadmium were determined in various tissues (Muscle, Gill, skin ) of fish (*Oxyurichthys tentacularis*) from Kavanad region of Ashtamudi Lake. Heavy metals like copper (0.315 mg/kg), Iron (8.76 mg/kg), Chromium (0.94 mg/kg), Lead ( 0.001 mg/kg), cadmium (0.001 mg/kg) had a higher levels in fish muscle, where as in gill copper (1.5 mg/kg), Iron ( 36.1 mg/kg), Chromium ( 4.78 mg/kg), Lead ( 0.001 mg/kg), and Cadmium ( 0.001). The heavy metal concentration is higher than muscles. Analysis of heavy metal in the skin of fish showed that the metals like Copper (1.4 mg/kg), Iron (37.9 mg/kg), Chromium (3.3 mg/kg) , Lead ( 0.001 mg/kg), and Cadmium ( 0.001 mg/kg). Here the Iron concentration in fish skin (37.9 mg/kg) is higher than that of gill and muscle. From the study it is clear that the lake is heavily contaminated it may have a direct impact on the health of aquatic animals as well as of humans. The fish species, *Oxyurichthys tentacularis* are highly delicious, and have great demand in the market. The main consumers of these fishes are the local residents of this region. Consumption of the fishes intoxicated with heavy metals by human beings may cause accumulation of the toxic metals like cadmium, chromium and lead in human organs through the process of bioaccumulation. It will create severe health hazards to human beings. Also, a potential deterioration of the water quality will be in future, depending on the increasing anthropogenic activities and agricultural development in this region. The study recommends for the implementation of necessary legislative measures by the authorities to conserve the Ashtamudi Lake, one of the Ramsar sites.

## HSP70 IN FISH: AN EFFICIENT TOOL FOR BIOMONITORING AQUATIC TOXICANTS

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### ABSTRACT

Metal contamination of aquatic habitat causes physiological and cellular stress response in the resident biota which is manifested in the production of metal chelating gene products. Induction of stress proteins such as Heat shock proteins (HSPs) are considered as important protective, ecophysiological adaptive and genetically conserved biomarkers to assess environmental stress in organisms. The Kerala Minerals and Metals Limited (KMML) titanium dioxide pigment plant situated in Chavara Panmana of Kollam, Kerala, India ( $9^{\circ} 5' N$  &  $76^{\circ} 31' E$ ) is a premier enterprise manufacturing high quality rutile grade titanium dioxide pigments. Highly acidic effluent from the factory is being discharged into the Arabian Sea causing serious environmental issues. Exposure to this complex mixture of pollutants, especially when they occur at low concentrations, do not always result in lethal effect on organisms, but subtle sublethal effects may occur at molecular, biochemical and physiological levels influencing the survival of populations. In this context, a need for analyzing the water quality of Kollam coast is mandatory. Maintaining a good water quality is essential for the survival of the aquatic fauna. Chemical pollution had negatively impacted the diversity and richness of the fauna in the vicinity of the factory.

The aim of present work was to evaluate the xenobiotic effects of pollutants along the Kollam coast using the toxicological biomarker HSP70. *Nemapteryx nenga* was selected as the candidate species for studying the KMML effluent induced stress protein build-up in animals. The hepatocytes of fishes exposed for 15 days to sublethal concentration of effluent were analyzed for the induction of HSP70. For the determination of Hsp 70 several primers were initially designed and then tested using RT-PCR. The reaction was optimized by selecting the best primers and concentration of the remaining components of the master mix optimizing the thermal profile. During optimization, it is essential to find out the fraction of the RT-PCR signal that originated from primer-dimer or by-product production. Before RT-PCR, RNase-free DNase was used to digest the DNA contamination in the RNA samples. In all cases, a control experiment was used to determine the fraction of the RT-PCR experiments, depending upon the choice of PCR primers. The  $\beta$ -actin gene was used as a positive control for the RNA extraction and PCR method. The control and experimental samples were amplified for 35 PCR cycles and the final extension at  $72^{\circ}C$  for 5 min. After the amplification, the PCR product was separated by agarose gel electrophoresis. The result revealed that the level of Hsp70 in the control liver samples showed  $271.0 \pm 7.9$  (arbitrary grey scale intensity), while in the experimental sample, the Hsp 70 increased to a level of  $480.0 \pm 5.0$  (arbitrary grey scale intensity), after 15 days post exposure. Statistical analysis reveal that the effects of KMML industrial effluent on Hsp 70 level are highly significant ( $P < 0.05$ ) when compared to control.

# WATER HYACINTH: A POTENTIAL SUBSTRATE FOR CELLULASE PRODUCTION AND ITS APPLICATION

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## ABSTRACT

Water hyacinth was introduced as an ornamental crop species in many countries more than a century ago, because of their attractive blue, lilac to purplish flowers and round to oval leaves. Soon it was realized to be an invasive species due to their adaptability to a wide type of fresh water ecosystems and interference with human activities. Cellulases can be produced by Solid State Fermentation (SSF) which is widely employed in the production of industrial enzymes, is a fermentation process wherein the solid material acts as both a physical support and nutrient source. *Aspergillus niger* is a fungus and one of the common species of *Aspergillus*. *Aspergillus* species are the major agents of decomposition and decay and thus possess the capability to produce a broad range of enzymes. Water hyacinth for the cellulose production produced from a local pond and it had undergone the physical treatments. The utilization of water hyacinth for cellulose production through Solid State Fermentation provided a suitable and environmental friendly method for reducing the pollution caused by them. The dry powder of water hyacinth leaves were used in Solid State Fermentation by *Aspergillus niger* for cellulose production. About 5 grams of each dried substrate water hyacinth were transferred to 7 conical flasks and inoculated each with *A.niger*. Substrate were analysed for moisture content and the flasks were incubated at 37 °C for 7 days for cellulase enzyme production. After incubation day process acetate buffer (pH 4.8) was added to each of the inoculated substrate beds and the mixture was filtered and centrifuged at 10,000rpm for 10 minutes. The supernatant is collected discarding the pellet and used for further enzyme assay.

Protein estimation done by using the Lowry's method and obtained the maximum enzyme activity obtained is 1355.2µ/ml. The water hyacinth showed higher protein content on seventh day of incubation. Production of reducing sugars (glucose) due to the cellulase enzyme activity is measured by Miller's method of Di Nitro Salicylic Acid (DNSA). The higher CMCase activity obtained is 2144.4µ/ml on the 7<sup>th</sup> day of incubation. Filter paper assay and beta glucosidase assay were also performed to estimate the cellulase activity in the substrate and 7<sup>th</sup> day of incubation showed the best enzyme activity. Water hyacinth substrate were treated at different pH, and carbon sources to estimate the maximum yield of cellulose in different parameters. CMCase, FPase, Beta glucosidase activities of cellulose were analysed and favoured by controlling the pH of the culture medium during fermentation at 7. Water hyacinth substrate showed higher CMCase activity of 9500µ/ml at pH 7 and the Fpase activity obtained was 137.33 µ/ml at pH 7. The water hyacinth substrate produced maximum beta-glucosidase activity on pH 7. The effect of carbon sources on cellulase enzyme activity was studied and obtained glucose as the best carbon source. The maximum CMCase activity obtained was 11,152.33 µ/ml, Fpase activity obtained was 24.66 µ/ml, beta-glucosidase activity was 35.019 µ/ml and these were obtained when glucose was used as the carbon source.

The study showed that all the water hyacinth substrate collected, showed significant effect on incubation day and it depends on a variety of factors like pH value and different carbon sources. These factors were optimised for the maximum yield of cellulose production. CMCase activity was high as compared to other assays. Cellulases were used for destaining of clothes and fruit juice clarifications.

The biological aspects of processing of cellulosic biomass become the crux of future research involving cellulases and cellulolytic microorganisms. Cellulases are being commercially produced by several industries globally and are widely being used in food, animal feed, fermentation, agriculture, pulp and paper, and textile applications. With modern biotechnology tools, especially in the area of microbial genetics, novel enzymes and new enzyme applications will become available for the various industries. Improvements in cellulase activities or imparting of desired features to enzymes by protein engineering are probably other areas where cellulase research has to advance

## OPTIMIZATION OF PROTEASE FROM FISH VISCERAL WASTE AND ITS APPLICATION

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### ABSTRACT

Annually 100 million tons of fish catching happens around the world, out of which 60% is used for human consumption and the rest is utilized as fish meal. The major by-products arising out of fish processing plants and fish markets include viscera, fins, scales, bones and muscle tissue and have long been considered as wastes. Majority of fishery byproducts are presently used for producing fish oil, fishmeal, fertilizer, pet food and fish silage. The fish industry developed around fishing ports at a time when landing were plentiful and there was a little concern about environmental impacts. The fish industry generates a significant amount of waste which has been estimated. Fish waste from the nearby market is dumped into the ocean at the end of each day. . Research has been carried out in order to develop methods to convert these wastes into useful products. Proteases are one of the most important groups of industrial enzymes, representing more than 65 % of the of global industrial enzyme market.

Fish processing waste is an environmental contamination source. So in order to explore the potential of fish processing waste (mainly fish viscera) as natural resources for value added bioactive compounds, the visceral wastes of Indian oil sardine (*Sardinella longiceps*) and Indian mackerel (*Rastrelliger kanagurta*) were tested for their proteolytic enzyme activity and specific activity. Protease production from fish visceral waste was strongly influenced by the genetic capability of the individual fish species. The visceral waste of mackerel shows higher proteolytic activity (2138.68 U) than sardine (1694.73 U) in crude. Similarly the protein estimation shows that mackerel sample contain higher protein content (991.18mg) than sardine (603.08 mg). In the acetone purification of samples sardine (2185.86U) shows higher protease activity than mackerel (2110.29U). Also the protein content was higher in sardine (722.13 mg) than mackerel (669.75mg). But in the case of specific activity mackerel shows higher activity (3.15 U/mg) than sardine (3.02 U/mg).

In the determination of the effect of pH on protease enzyme, sardine had higher proteolytic activity in pH 10 (2091.42 U) and mackerel showed higher proteolytic activity in pH 5(2360.62U). The effect of pH on the protein content of the fish viscera waste was determined over a range of 5-10 and the optimum pH for sardine was 10 and mackerel was 8. From the determination of specific activity on different pH ranges sardine pH 8 (2.81U) and mackerel pH 5(4.05U) shows higher value. The effect of temperature on the activity of protease from the fish visceral waste was determined over a range of 60-80 °c. The optimum temperature shown was 80° c for both samples.

The destaining property of enzyme was checked on blood stained cloth. Fish blood stained cloth was incubated with enzyme for 20 minutes, in two different cottons. The protease enzyme from the sardine showed greater destaining property than mackerel after 20 minutes

Processing of fish leads to enormous amount of waste. It is estimated that fish processing waste accounts for approximately 75% of total weight of fish. About 30% of fish waste remains as waste in the form of skin, bones and other visceral organs. This raw material is an excellent source of high value products including protein foods, pharmaceutical and cosmetic products. The utilization of waste helps to eliminate harmful environmental aspects and to improve quality in fish processing. In Kerala numerous fish processing units are actively functioning both in small scale and in large scales. Tons of fish waste are expelled out routinely from these units without any proper utilization. Limited studies have been

*conducted in Kerala for the utilization of these wastes and converting these waste into valuable nutraceuticals and pharmaceuticals products. Taking into importance of the crucial role played by marine fishes in healthcare, the present project focuses on exploration of protease from two marine food fish wastes and thereby introducing an important waste reduction strategy to the industry.*

## ISOLATION OF PROTEASE ENZYME FROM VISCERAL ORGANS OF SOME MARINE FOOD FISHES

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### ABSTRACT

The potential of Kerala's marine habitat has remained largely unexplored for their potential of new drugs and biotechnological programs. Fish can serve as a source of functional materials, such as polyunsaturated fatty acids, polysaccharides, minerals and vitamins, antioxidants, enzymes and bioactive peptides. Marine fish is a major source of high-quality protein, lipids, and a wide variety of vitamins and minerals. Fishery processing industries generate large amounts of by-products. The disposal of these wastes represents an increasing environmental and health problem. To avoid wasting these by-products, various disposal methods have been applied including, ensilation, fermentation, hydrolysate and fish oil production. Interestingly, fish by-products provide an excellent nutrient source for microbial growth useful in enzyme production process, which is largely governed by the cost related to the growth media. Fish wastes (heads, viscera, chitinous material, wastewater, etc.) are prepared and tested as growth substrates for microbial enzymes production such as protease, lipase, chitinolytic and ligninolytic enzymes. This new approach described in this review can reduce environmental problems associated with waste disposal and, simultaneously, lower the cost of microbial enzyme production.

In the present study concentration of protease and its activity have been evaluated in the visceral organs of four marine food fishes. Visceral wastes of different fish species such as mackerel scad (*Decapterus macarellus*), tunas (*Euthynnus affinis*), sea catfish (*Nemapteryx nenga*) and Sardines (*Sardinella longiceps*) were used. These visceral wastes were collected from the local fish markets (Kollam) in sterile polythene bags and stored at  $-20^{\circ}\text{C}$ . These fish visceral wastes were washed thoroughly with distilled water and homogenized with 0.02M Tris- HCl, pH 8.0. The homogenate was centrifuged at 6000 rpm for 15 min and the supernatant referred to as "crude extract". The protease activity of crude extract was determined spectrophotometrically with casein as the substrate (Chong et al., 2008). The crude extract (0.25 ml) was added to a tube containing 0.5 ml of 1% (w/v) casein (dissolved in 0.02M Tris-HCl buffer, pH 8.0) and incubated at  $37^{\circ}\text{C}$  for 30 min. To this, 3 ml of a 5% (w/v) tri-chloroacetic acid (TCA) was added to stop the proteolysis. The mixture was incubated at  $4^{\circ}\text{C}$  for 5 min. After incubation, the reaction mixture was filtered, and TCA soluble peptides in the filtrate were measured at 660 nm using using Multiscan GO 1510-02575C. One unit of proteolytic activity (U) was defined as  $\mu\text{g}$  tyrosine liberated per ml per min of the enzyme extract. Standard curve was prepared by using tyrosine as standard (10-100 $\mu\text{g}$ ).

The crude enzyme was precipitated from the supernatant by the addition of ammonium sulphate, with gentle stirring until 80% saturation, followed by centrifugation at 10,000 rpm for 15 min. The pellet was dissolved in 0.02 M Tris-HCl buffer (pH 8.0) and dialyzed. Then the sample was passed through a Sephadex G-100 column equilibrated with 0.02 M of Tris-HCl buffer (pH 8.0)15. The fractions were collected at the flow rate of 0.5ml/min and analysed for protease activity.

The study revealed that the visceral waste of *Euthynnus affinis* and *Decapterus macarellus* showed high protease concentration ( $481 \pm 1.8 \mu\text{g/ml}$ ;  $451 \pm 2.7 \mu\text{g/ml}$ ) and proteolytic activity ( $908.5 \pm 2.1 \text{ U/ml}$ ;  $851 \pm 1.9 \text{ U/ml}$ ) when compared with that of *Sardinella longiceps* and *Nemapteryx nenga* ( $342 \pm 2.4 \mu\text{g/ml}$ ;  $551.55 \pm 2.6 \mu\text{g/ml}$ ) and its proteolytic activity is  $646 \pm 2.2 \text{ U/ml}$ ;  $551.55 \pm 2.6 \text{ U/ml}$  respectively. Standard curve was prepared by using tyrosine as standard (10-100 $\mu\text{g}$ ). This study highlights the recent research in marine proteases and the trends and prospects for the future, with special emphasis on nutraceutical and pharmaceutical development into marketed products. Taking into importance of the crucial role played by marine fishes in healthcare, the present project focuses on isolation of proteases and their enzymatic activity from marine fish waste which is as a major source for bioactive compounds and thereby introducing an important waste reduction strategy to the industry by utilizing these fish wastes in pharmaceutical and nutraceutical marke

## NATURAL DYE FROM *THOTTEA DUCHARTREI* SIVAR., BABU & INDU: A PROMISING WINDOW IN GREEN CHEMISTRY

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### **ABSTRACT**

The focus on environmental concerns is increasingly causing the textile industry to explore natural sources of dyes as opposed to synthetic dyes. The aim of the study was to evaluate the performance of dyes extracted from root, leaves and flower of the plant *Thottea dutchartrei* belongs to family Aristolochiaceae. Most of the members in *Thottea* are aromatic and have medicinal values. In the present study, the dyeing pigments present in flowers, root and leaves of *T.duchartrei* were extracted. The UV, visible, and near infrared spectroscopic analysis of dyes yielded characteristic peaks corresponding to the colouring compound. The presence of flavonoids was indicated by chemical characterization of dye. Three types of mordants were used to set isolated dye on cotton fabric by forming a co-ordination complex and also studied the effect of fabric on three different methods of mordanting. Among the three mordanting techniques, pre-mordanting method was good in terms of dyeing. Fastness properties and oil repellence of the dyed cotton were also tested. Here the post-mordanting sample yielded good result. Among the different dyes, dye from flower yielded promising results in terms of colour fastness.

### **Keywords**

*Thottea dutchartrei*, Dye, Mordants, Colour fastness

## LENGTH-WEIGHT RELATIONSHIP AND GROWTH CONDITION OF *MYSTUS GULIO* (HAM.) IN DIFFERENT MONTHS AND SEXES

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### ABSTRACT

*Mystus gulio* belongs to the family Bagridae in the order Cypriniformes. It is an edible fish with therapeutic qualities and is recommended by physicians as diet during convalescence. The body of the fish is elongate, compressed and sub cylindrical, head depressed and subconical, covered with skin and is without ordinary scale, upper surface of head rough and granulated. Despite a paucity of information available about its biology, hence quests have been made to assess length-weight relationship (LWR). It is often believed that the regression coefficient of weight to length for fishes ranges from 2- 4 (Le Cren, 1951 and Rounsefell and Everhart, 1953) and for perch like fish it is often 3 (Mia, 1984). In fisheries research, length-weight relationships are important for the estimation of weight where only length data are available, and as an index of the condition of the fish (Pauly, 1993; Petrakis Stergiou, 1996). The present work was undertaken to observe seasonal effect on both male and female. A total of 383 specimens of *Mystus gulio* were randomly collected from Vattakkayal lake. All morphometric measures were taken with digital calipers on the left side of the fish. The data on length was recorded in mm with an accuracy of 0.5, while weight was noted in milligram using a digital balance. Weights of the fish were recorded to the nearest gram using digital weighing device (Tanita, KD-160) sensitive to 1g. After the measurement of specimens, the fishes were preserved in 10% formalin as quickly as possible.

Comparison of growth pattern of *M. gulio* was calculated using the linear relationship of the form  $Y = bX + a$ , where 'Y' represents the body parameters and 'X' represents the total length for body morphometric parameters, and head length for head morphometric parameters. Results of the growth pattern of female and male *M. gulio* showed a linear pattern of body growth on the morphometric characters like fork length and standard length with respect to total length (X). The length weight relationship was calculated separately for males and females to observe if there are differences in the relationship due to sex and season. In all the cases, the relationship was found to be linear in the logarithmic form conforming to the general formula expressing the relationship between the length and weight of fishes. Total length of *Mystus gulio* was found to be  $18.32 \pm 4.06$  cm in female and  $17.15 \pm 3.99$  cm in male. Statistical analysis showed that significant difference was found between male and female in terms of their total length ( $t(206) = 2.10, p = 0.003$ ). Standard length of female fishes were  $14.45 \pm 3.14$  cm, whereas in male it was  $13.39 \pm 3.15$  cm. Statistical analysis showed that significant difference was found between male and female in terms of their standard length ( $t(206) = 2.42, p = 0.01$ ). The fork length of female and male were found to be  $14.64 \pm 3.12$  cm and  $14.18 \pm 3.24$  cm respectively. Statistical analysis showed that no significant difference was found between male and female in terms of their fork length ( $t(206) = 1.03, p = 0.30$ ).

**KEY WORDS:** Growth condition Length-weight relationship, *Mystus gulio*



## **WE ARE NOT READY TO REPRODUCE IN A POLLUTED ENVIRONMENT- MYSTUS GULIO**

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### **ABSTRACT**

The present study is the pioneer one giving detailed information of the effect of pollution load on the reproductive aspects of *Mystus gulio* in Vattakkayal, a part of Ashtamudi lake, Kerala, South India. Twenty four physico-chemical parameters of water quality were analysed. The range of values of the parameters recorded in Vattakkayal is as follows. Temperature - 27°C to 33.8°C, pH - 6.95 to 8.8, conductivity - 1.35 µS/cm to 49.39 µS/cm, hardness - 1300 to 4300 mg/l as CaCO<sub>3</sub>, calcium hardness - 320.64 to 841.68 mg/l as CaCO<sub>3</sub>, magnesium hardness - 97.45 to 804 mg/l as CaCO<sub>3</sub>, TS to 100 mg/l to 40000 mg/l, TDS - 885 mg/l to 31000 mg/l, TSS - 114.4 mg/l to 8700 mg/l, total alkalinity - 200 to 1020 mg/l as CaCO<sub>3</sub>, salinity - 0.66 to 33.31 mg/l, DO - 1.16 mg/l to 10.6 mg/l, sodium - 342.7 mg/l to 2183 mg/l, potassium - 17.2 to 205.5 mg/l, nitrite - 0.11 to 4.84 mg/l, nitrate - 1.2 mg/l to 30 mg/l, phosphate - 0.51 mg/l to 4.86 mg/l, sulphate - 13.12 to 657.4 mg/l, cadmium - 0.22 to 1.124 mg/l, lead - .01 to 4.64, copper - 0.086 to 0.45 mg/l, iron - 1.17 to 13.84 mg/l and chromium - 1.17 to 13.84 mg/l and the results showed that the lake is heavily polluted. Of the 469 fishes examined in the present study, the numbers of female fishes were 405 (86.35%), whereas the numbers of male fishes were 64 (13.64%). Present study showed that most of the female fishes during spawning season showed skipped spawning behaviour. Here the ripe ovary of female fishes is directly passed into resting stage thereby skipping its spawning. Experiment conducted on *Mystus gulio* showed that fish in non polluted environment undergo natural breeding while in polluted environment it showed skipped spawning behaviour. Due to this skipped spawning behaviour, the number of young ones is highly reduced. If this situation persists *Mystus gulio* species will extinct soon from Vattakkayal. This study is an eye opener for the need protection of Vattakkayal from pollutants. Otherwise it will cause the depletion of the fish diversity of Vattakkayal. To conserve this inherent treasure of Vattakkayal, a part of Ashtamudi lake, the wetland of international importance, a long term management plan should be adopted.

**Key words:** Fish diversity, Spawning, Vattakkayal, Water quality.

# CHEMICAL PROSPECTING OF THE ROOTS OF *THOTTEASILQUOSA* (LAM.) DING HOU, WITH SPECIAL EMPHASIS ON ANTIOXIDANT, ANTICANCEROUS AND DNA DAMAGE INHIBITION PROPERTIES

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## ABSTRACT

Plants are utilized globally as herbal medicine due to their therapeutic values. Identification of phytochemicals from plants gives a gateway for the development of new drugs. The main aim of the present study was to investigate invitro antioxidant potential, DNA damage inhibition and cytotoxicity of phytochemicals extracted from the roots of *Thotteasiliquosa*(Lam) Ding. Hou., the medicinal undershrub from the family Aristolochiaceae. The dried roots of *T. siliquosa* were powdered and extracted with distilled water and chloroform and subjected to phytochemical screening. The extracts were shown the presence phytochemicals like Alkaloids, Glycosides, Saponins, Phenol and Flavonoid compounds. Invitro antioxidant activity was analyzed by using DPPH and H<sub>2</sub>O<sub>2</sub> assays. Both the extracts showed strong DPPH and H<sub>2</sub>O<sub>2</sub> scavenging activities. The root extracts were found protecting the plant DNA from UV irradiation. Distilled water extract of plant root exhibited invitro cytotoxicity on tumor cells at concentration of 200µg/ml. These findings confirms the antioxidant, anticancerous and DNA damaging effects of the root extracts of *T.siliquosa*.

## Keywords

*Thotteasiliquosa*, Phytochemicals, antioxidant, DPPH, H<sub>2</sub>O<sub>2</sub> invitro cytotoxicity

# **COPPER NANOPARTICLES FROM THOTTEA SILIQUOSA (LAM.) DING HOU: THE PROMISING PROSPECTS IN GREEN CHEMISTRY**

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## **ABSTRACT**

*Nanotechnology has created a kind of revolution as this new area encompasses Physics, Chemistry, Material Science, Engineering along with Biology and Medicine. Nanoparticles may be of the same dimension as some biological molecules such as proteins and nucleic acids. They have been developed for use in the area of agriculture, where they can increase the efficiency and productivity of crops. Hence an attempt was made in the present investigation to explore the synthesis of copper nanoparticles both biologically and chemically with the medicinal plant *Thottea siliquosa* and by using sodium borohydride respectively. The study discusses the biologically and chemically synthesised copper nanoparticles from *Thottea siliquosa* and the characterisation using UV-VIS Spectroscopy and SEM; germination study using *Triticum aestivum* and its antibacterial activity. The presence of copper nanoparticles was confirmed by the spectroscopic examination. The diameter of chemically synthesised copper nanoparticle is approximately 50nm and the biologically synthesised one varying from 100nm to 500nm that is about 10 times larger than that of chemically synthesised copper nanoparticle. Both the nanoparticle possess negative impacts on the germination rate and its growth. The result indicated that even though they possessed antibacterial activity, at higher concentrations these nanoparticle have a growth inhibition activity.*

## **KEYWORDS**

*Thottea siliquosa, Copper nanoparticle, Triticum aestivum, Germination, Antibacterial activity*

## **STUDIES ON THE DIVERSITY OF MARINE ALGAE IN KOLLAM COAST: POST OCKHI SCENERIO**

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### **ABSTRACT**

*Seaweeds are marine macroscopic algae which form an important component of marine living Organisms. Seaweed samples were collected from the coast of Kollam district from the regions Thirumullavaram, Thankasseri, Eravipuram, Kovilhottam and Azheekal. The seaweed samples were collected from intertidal regions of different stations for a period of January 2018. Cyclone Ockhi was devastated parts of Kerala coasts at 11 December 2017. Total 22 algal species were collected during the study., they are Dictyota dichotoma, Chealosporium spectabilis, Hypnea muciformis, Coralina officianalis, Gelidium pusillus, Ceramium brevizonatum, Chaetomorpha antennena, Sargassum ilicifolium, Gymnogongrus densus, Valoniopsis pachynema, Jania rubens, Gracilaria edulis, Gracilaria corticata, Ulva fasciata, Sargassum whitti, Padina tetrastomatica, Dictyota divaricata, Ceramium clavatum, Cladophora fascicularis. . Among all the algae analyzed only one species founded in five selected sites that is Chaetomorpha antennena. most abundant seaweed growth in Thirumullavaram and the next site is Thankasseri. All the other three sites shows less growth of seaweeds.*

## **STUDIES ON THE PHYSICO-CHEMICAL PARAMETERS OF THE POLACHIRA WETLAND IN KERALA**

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### **ABSTRACT**

*Health of a wetland ecosystem is dependent on the physico-chemical qualities of water, sediment and also on the biological diversity of the system. Therefore analysis of the physico-chemical characteristics of the wetland is of utmost importance in the conservation of wetlands. The present study attempts to evaluate the water quality of the Polachira wetland, one of the important fresh water wetlands of Kerala coast, located in the Southern part of Kollam district. The study was carried out for a period of two years from October 2012 to September 2014. The parameters estimated were temperature, depth, pH, alkalinity, DO, dissolved CO<sub>2</sub>, Hardness, TDS and the nutrients (nitrate, nitrite, phosphate, silicate and sulphate). Accepted standard methods were followed for the estimations. The observations were statistically interpreted and presented based on correlation analysis and ANOVA. The detailed investigation of the parameters which are well within the desirable limit indicates that the Polachira wetland is a fairly unpolluted, except for high alkalinity and hardness, which can be attributed to natural causes and agricultural runoff.*

**KEYWORDS:** *Physico-chemical, Polachira, Wetland*

### **INTRODUCTION**

Wetlands are unique ecosystems where the physical and chemical characteristics of water and sediments are used to assess the ecological nature of the system. Analysis of physico-chemical properties of any aquatic ecosystem is important, because any fluctuations in the water quality have an influence on the biotic communities. According to Gosselink and Turner (1978), the modifications of the physico-chemical environment, in turn, have a direct impact on the biotic response in the wetland. Therefore analysis of the physico-chemical characteristics of the wetland is necessary for its conservation.

### **MATERIALS AND METHODS**

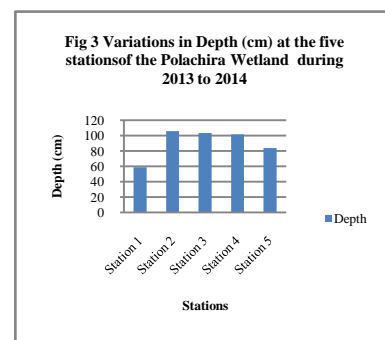
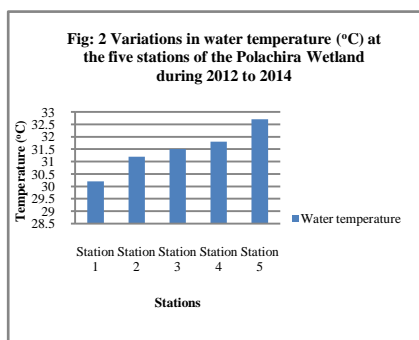
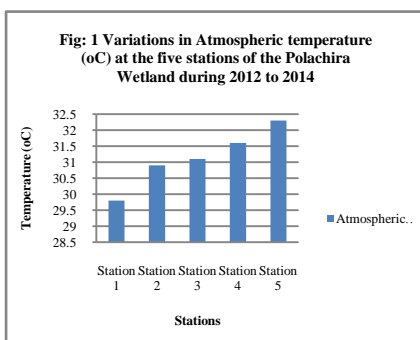
The study was carried out at Polachira, one of the important fresh water wetlands of Kerala coast, located in the Southern part of Kollam district. It lies between 8°50'0''N to 8°51'0''N Latitudes and 76°41'0''E to 76°42'30''E Longitudes. The wetland formed in the estuaries of the Ithikkara River and Paravur backwaters is encircled by small rivulets and is thickly vegetated. It spreads over 650 hectares of sprawling land at a depth of 5 m above sea level. The study was carried out for a period of two years from October 2012 to September 2014. Five stations were selected randomly for the collection of samples. The physico-chemical parameters of water samples were carried out as per the methods of Trivedy and Goel (1986) and APHA (2005). The observations were statistically interpreted and presented based on correlation analysis and ANOVA. The statistical analyses of data were made by using the software SPSS 17.01.

## RESULTS AND CONCLUSIONS

Results of the physico-chemical parameters of the five stations of the Polachira wetland ecosystem are presented in the Table 1; Figs. 1-10.

The physico-chemical analysis of the study revealed that water temperature was slightly higher than the atmospheric temperature. This may be due to the property of water of slow release of heat that it has absorbed, when compared to that of air. The water level of the wetland was rarely stable; it varied from station to station and with seasons. The fluctuation in water level is mainly due to climatic factors e.g., evaporation of water due to increased atmospheric temperature during the day time, wind velocity, rainfall and humidity (Welch, 1952). Throughout the period of study water pH remain slightly acidic to alkaline in nature. Total alkalinity was greater than  $100 \text{ mg l}^{-1}$  which is an indication of the highly productive nature of the system. Average value of dissolved oxygen ranged from  $5.1 \text{ mg l}^{-1}$  to  $7.4 \text{ mg l}^{-1}$ . The concentrations of dissolved oxygen in unpolluted waters are usually about  $8\text{-}10 \text{ mg l}^{-1}$  (Joseph and Jacob, 2010). Compared to other fresh water wetlands, the average amount of DO in the present study indicates the healthy nature of the water body. Average value of dissolved  $\text{CO}_2$  content was quite low and it did not show wide fluctuations. Positive correlation of hardness to TS, TDS and TSS indicates the role of solids in increasing hardness of the wetland. The shallowness of the system promoted a short nutrient turnover resulting in high productivity.

In Polachira, a typical tropical climate was prevalent during the entire period, that favoured both primary and secondary production. Physico-chemical parameters often help to relate the abiotic and biotic interactions and integrity in aquatic ecosystems. The detailed investigation of the parameters which were well within the desirable limit indicate that the Polachira wetland is fairly unpolluted, except for high alkalinity and hardness, which can be attributed to natural causes and agricultural runoff.



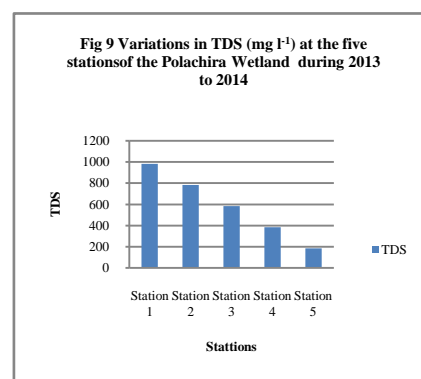
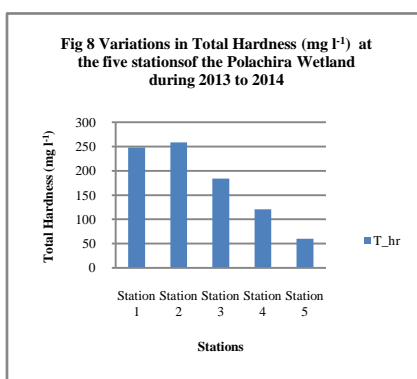
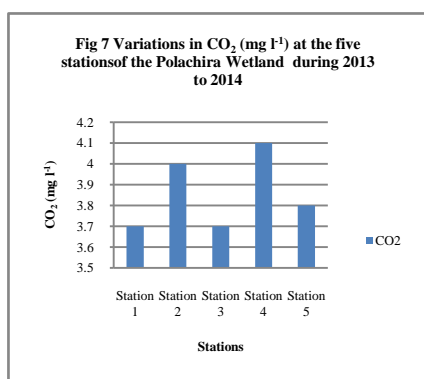
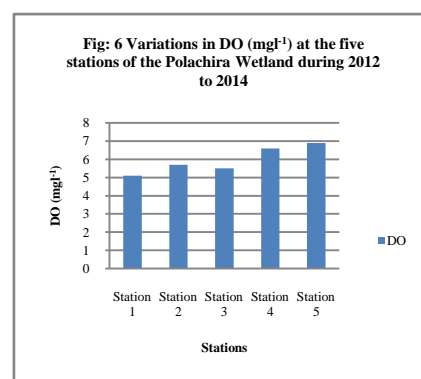
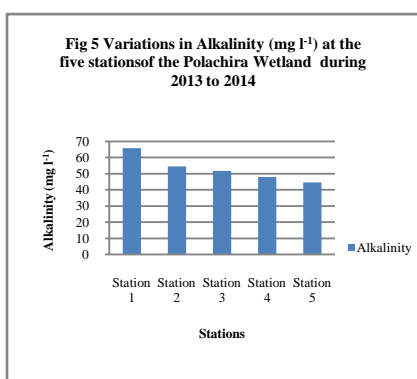
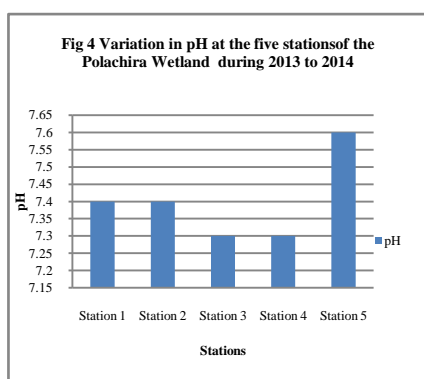


TABLE 1 Variations in the nutrient concentrations of the five stations of the Polachira wetland during 2012-2014

	Station 1	Station 2	Station 3	Station 4	Station 5
Nitrate	1.2 ± 0.6	1.3 ± 0.7	1.3 ± 0.6	1.5 ± 0.6	1.4 ± 0.6
Nitrite	0.6 ± 0.3	0.6 ± 0.3	0.6 ± 0.3	0.7 ± 0.3	0.7 ± 0.3
Phosphate	12.8 ± 2.2	13.2 ± 2.3	13.5 ± 2.3	13.2 ± 2.2	12.4 ± 2
Silicate	85.5 ± 23.2	89.6 ± 21.6	95.6 ± 18.1	93 ± 24.2	83 ± 18.1
Sulphate	2.8 ± 2	2.5 ± 1.7	1.8 ± 1.7	2 ± 2	1.6 ± 2.1

## REFERENCES

- Gosselink, J.G. and Turner, R.E. (1978) The role of hydrobiology in freshwater wetland ecosystems. *In*, Fresh Water Wetlands: Ecological Process and Management Potential, (R.E. Good, D.F. Whigham and R.L. Simpson, eds.), Academic Press, Inc. New York.
- Trivedy, R. K. and Goel, P.K. (1986) *Chemical and Biological Methods for Water Pollution Studies*. Environmental Publications, Karad (India), 320.
- APHA (2005) *Standard Methods for the Examination of Water and Wastewater*. 21<sup>st</sup> ed., Am. Public Hlth. Ass., Washington, DC, USA.
- Welch, T.S. (1952) *Limnology*. 2<sup>nd</sup> ed. McGraw Hill Book Co., New York, 538.
- Joseph, P. V. & Jacob, C. (2010) Physico chemical characteristics of Pennar river, A fresh water wetland in Kerala, India. *E-J. Chem.*, 7: 1266-1273

# **THE CONTROLLED RELEASE STUDY OF THE ANTI-CANCEROUS DRUG 5-FLUOROURACIL FROM MESOPOROUS SILICA BASED DRUG DELIVERY SYSTEM.**

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## **ABSTRACT**

*The influence of a drug in disease treatment is highly dependent on the ability of the therapeutic to selectively and effectively treat targeted cells and tissues while leaving other healthy parts of the body untouched. Relatively few of these drugs are used clinically due to low therapeutic windows for drug efficacy compared to drug related side effects. Drug delivery systems has therefore attracted wide attention in biomedical research due to their potential to significantly reduce the side effects of therapeutics, while making it possible to control the concentration and location of active drugs released in the body over long periods of time. The scope of the present study was the synthesis and characterisation of a drug delivery system based on the natural mesoporous clay bentonite for the controlled delivery of the anti- cancerous drug 5-Fluorouracil. The materials used for the synthesis of drug delivery system are natural clay and beta cyclodextrin. The characterisation of drug delivery system was carried out using FT-IR, XRD and SEM. The in vitro release study was done as a function of pH. The maximum release of 5-Fluorouracil was found to be at pH 7.4. The in vitro biocompatibility study was performed by MTT assay. Drug delivery of the composite proved that 5-Fluorouracil could be successfully release in a controlled manner in the colon without much degradation.*

**Key words** –Bentonite, Controlled Drug Delivery, 5-Fluorouracil, In-vitroRelease, Mesoporous Silica.

## **INTRODUCTION**

Cancer is a group of disease involving abnormal cell growth with the potential to spread to other part of the body. 5-Fluorouracil is widely used in the treatment of colorectal cancer. 5-FU with the chemical name 2,4-dihydroxy-5-fluoropyrimidine is an antimetabolite of the pyrimidine analogue type, with a broad spectrum of activity against solid tumours [2]. Due to its structure, 5-FU interferes with nucleic acid synthesis and inhibits DNA synthesis which leads to cytotoxicity and cell death. 5-FU is widely used in the treatment of colorectal cancer [4]. On the same time, it suffers from some major draw backs like incomplete and erratic oral bioavailability. The conventional free dosage of drug is not a better way for the release of ant cancerous drugs. These kinds of side drawbacks can be overcome to an extent by using the technology of controlled drug delivery system.

The controlled drug delivery systems offer a novel pathway to carry the drugs to the targeted site at a chosen rate and in a desired dosage [1]. As a result, it increases the utilization of the drugs by the diseased part and also it provides a steady state level in serum and plasma line without making remarkable fluctuations. In the last few years, so many researches were going on in the synthesis of biodegradable and biocompatible drug carrier vehicles. Among these, the mesoporous silica



materials like can be used as a potential drug carrier system for the controlled and targeted drug delivery [3]. Mesoporous materials have tuneable pore size; it can change its pore size from 2-50 nm. So these materials can be used as a better drug carrier system for different kinds of bioactive materials of with variable size [5]. In the present study, a novel pH sensitive composite was prepared by intercalation of modified bentonite and acrylamide-cyclodextrin polymer.

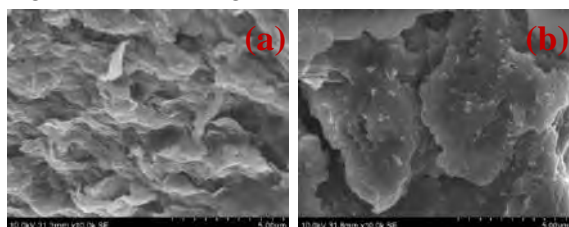
## MATERIALS AND METHODS

All the chemicals were purchased from Alfa Aesar (England). Distilled water with specific conductivity less than  $1 \mu \text{Scm}^{-1}$  was used throughout the study. The DDS was synthesised according to the following procedure. In a three neck RB flask was equipped with a magnetic stirrer and a reflux condenser, a calculated amount of modified bentonite, acrylamide-cyclodextrin polymer, ethylene glycol dimethacrylate and AIBN was taken.. To the above mixture added 25 ml methanol. the mixture was heated in weak magnetically stirred at  $70^{\circ}\text{C}$  for 4 hrs. The product was filtered, washed, dried and grounded. For the encapsulation of 5-FU, about 0.1 g of powdered composite was added to 100ml of 5-FU solution (50 mg/L) was stirred using a water bath shaker for 8hrs. The concentration of drug loaded was measured using UV at 266 nm. The *in-vitro* release study was carried out at pH 7.4 (phosphate buffer) at  $37 \pm 1^{\circ}\text{C}$ . The MTT assay was carried out in HeLa cell line to understand the cell viability of the DDS

## RESULT AND DISCUSSION

The drug delivery system is a grafted composite hydrogel. 5-FU molecules can enter into the clay through the cation exchange with  $\text{Na}^{+}$  or may through the weak intermolecular force of attraction. The acrylamide-cyclodextrin polymer can act as a 'gate keeper' molecule in which it can be introduced to tuning the pore size of the clay for the effective loading and the controlled release of drug. The swelling property of DDS has a role in the release of the drug. Both the swelling and release of drug were found to be at pH 7.4. The FT-IR analysis was carried out for both the DDS and 5-FU loaded DDS. The drug loaded composite shows major bands in the composite as well as the drug. From this it is clear that, there is no chemical bond formed between the DDS and the drug. From the XRD of DDS and 5-FU loaded DDS, it is clear that the XRD pattern of the composite and the drug loaded composite has no remarkable changes shown; this provides a good evidence for the weak physical interaction between host and the guest. The surface of DDS appears to be irregular due to the presence of a large number of pore cavities. But the surface of the 5-FU loaded DDS appears to be different due to the loading of 5-FU in those pores. SEM images are shown in (Figure.1).

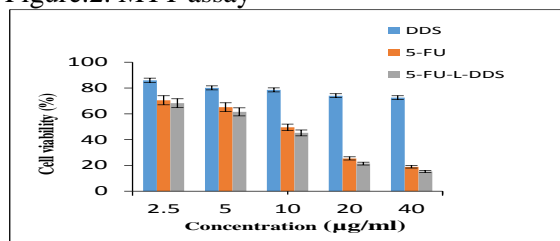
Figure.1. SEM images of DDS and 5-FU-loaded DDS



About 68.3% of drug was released; the release of drug takes place in a normal rate. The release kinetics follows Ritger-Peppas equation with  $n = 0.567$ , means non-Fickian type of release. In non-Fickian mechanism, the release of drug is mainly due to both diffusion and

swelling of the polymer. The cell viability at different dosage range of 2.5 to 40  $\mu\text{g/mL}$  was analysed. From the result it is clear that, % of cell viability decreases with increase in concentration of the drug. It means that the cell biocompatibility is strongly influenced by the concentration of the drug. The results of MTT assay shown in (Figure. 2).

Figure.2. MTT assay



The % cell viability decreases with increase in the concentration of DDS. In the case of drug loaded DDS, the % of cell toxicity was increased by the factor 22.4%, when the concentration was doubled.

## CONCLUSION

In the present work, we synthesised a novel pH responsive drug delivery system. The DDS was characterized by FTIR, XRD and SEM. The maximum drug release occurs at pH 7.4. The 5-FU release from the DDS followed non-Fickian mechanism. The release of drug depends on both the diffusion and the swelling of the composite. The *in vitro* MTT assay on HeLa cell line confirmed the biocompatibility of the drug delivery system. The DDS was more potent for the controlled release of 5-FU colorectal cancer with better bioavailability.

## Acknowledgement

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## REFERENCES

- Anirudhan, TS., Binusreejayan., Jayan, PP. (2016). Development of functionalized chitosan-coated carboxylated mesoporous silica: A dual drug carrier. *Designed Monomers and Polymers*, **5**, 381-393.
- Chen, X., Lai, M., Zhang, Y., Huang, Q. (2002). Less cytotoxicity to combination therapy of 5-Fluorouracil and Cisplatin than 5-Fluorouracil alone in human colon cancer cell line. *World Journal of Gastroenterology*, **8**, 841-846.
- Hu, I., Yu, Z., Zheng, J., Wang, Y., Liu, Y., Jiang, G., Tong, Y., Zhou, X. (2015). Tannin as a gatekeeper of pH-responsive mesoporous silica nanoparticles for drug delivery. *RSC Advance*, **5**, 85436-85441.
- Paula, M., John, E., John, F., Thomas, R. (1982). Time-Dose relationship for 5-Fluorouracil cytotoxicity against human epithelial cancer cells in *in vitro*. *Cancer Research*, **42**, 4413-4420.
- Su, Q., Tao, H., He, J., Zhu, P., Yuan. (2012). A novel insight in the silylation of montmorillonite surfaces. *Materials Chemistry and Physics*, **136**, 292-295.

## ANTIMICROBIAL PROPERTIES OF NANOCERIA

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### ABSTRACT

*Cerium oxide is a technologically important rare earth oxide material. It is unique in that it can exist in both +3 and +4 oxidation states. Nanoceria or cerium oxide nano particles have shown promising applications due to its ability to adjust or switch over its oxidation states easily. In the present work, we have synthesized nanoceria via chemical co precipitation method using Ethylene Diamine Tetra Acetic acid (EDTA). The carbonate precursor obtained is calcined on the basis of thermo gravimetric analysis to get the oxide nanoparticle. The antimicrobial activities of nanoceria are studied in microorganisms like Salmonella typhimurium and Candida albicans.*

Keywords: Nanoceria, DNA, Antimicrobial activity

### INTRODUCTION

Cerium (Ce) is the most abundant rare earth element (atomic number 58) in the lanthanide series of the periodic table. Cerium oxide is a promising material which has multiple applications like gas sensors, catalysis, electrolyte material for solid oxide fuel cell, sunscreen for ultraviolet absorbents, etc. However to enhance the properties of nano materials to meet the need for different applications, it is very essential to decrease the size and thus to increase the active surface area of nanoparticles. In recent years much effort has been focused on the development of environmental friendly routes for preparing nano cerium oxide to decrease the hazardous and toxic effect of chemicals.

The aim of this study is to synthesis nano ceria and to study its antimicrobial activities. Among the processes of synthesis, chemical co precipitation is simple and low cost in comparison with other techniques and moreover it can be realized in our own lab set up. The antimicrobial study was carried out by well diffusion method.

### EXPERIMENT DETAILS

#### Materials

Cerium(III) nitrate hexa hydrate, ammonium carbonate and EDTA were purchased from Merck and were of analytical grade. These chemicals were used without further purification.

#### Preparation of Cerium oxide nano particles

Cerium oxide nano particles were synthesized by chemical co precipitation method by taking aqueous solution of cerium nitrate hexa hydrate and ammonium carbonate under constant stirring. Upon adding the solutions, precipitation of cerium carbonate occurred. The capping agents were used to control the size of the nanoparticles. The whole mixture was then stirred for five hours. After stirring, it was filtered and washed several times with deionized water. Then the dried

precipitate (the carbonate precursor) was calcined at 400<sup>0</sup>C. The synthesized nanoceria were pale yellow in color.

In a typical experiment, petriplates containing 20 mL Muller Hinton medium are seeded with 24 hr culture of bacterial strains *Salmonella typhimurium* and *Candida albicans*. Well of approximately 10 mm are bored using a well cutter and 25  $\mu$ L, 50  $\mu$ L and 100  $\mu$ L of samples are added to the well from a stock concentration of 0.1 g/mL. The plate is then incubated at 37  $^{\circ}$ C for 24 hr. The antimicrobial activity is assayed by measuring the diameter of the inhibition zone formed around the well. Gentamycin is used as a positive control.

## **RESULT AND DISCUSSION**

### **Antimicrobial Activity**

The antimicrobial activity of the synthesized nano ceria was examined by well diffusion method. It was performed against water pathogens like *Salmonella typhimurium* and antifungal activity against *Candida albicans*. All the pathogens exhibited a moderate inhibition of 6mm with nanoceria. Generally the antibacterial activity is due to the interaction of nanoparticles on to the bacterial cell wall by the electrostatic interaction [8].



Fig 1. Antimicrobial activity of nanoceria

## **CONCLUSIONS**

Cerium oxide nano particles were synthesized using chemical co precipitation method using EDTA as the capping agent. The nanoceria exhibited inhibition to bacteria as well as fungus.

## **ACKNOWLEDGMENTS**

The authors are thankful to SICCC, University of Kerala and CEPCI Kollam for providing facility for characterization.

## REFERENCES

- [1] Zhang P., Ma .Y., Zhang, Z., He, X., Zhang, J., Guo, Z., Tai, R., Zhao, Y., Chai, Z., ACS Nano No. 11 pp.9943-9950. 2012
- [2] O Thill., Zeyons Spalla, O., Chauvat,, F., Rose, J. Auffan, M., Flank ,A. M., Environ. Sci Technol. No.40 pp.6151-6156. 2006
- [3]. Zhang, F., Chan ,S. W., Spanier, J.E., Apak, E., Q. Jin, R.D. Robinson, I.P. Herman, Appl. Phys. Lett. No.80 pp.127-129, 2002
- [4] Hu, J, Li, Y. Zhou ,X., Cai ,M., Mater. Lett. No.61 (2007) pp.4989-4992.
- [5] H. Wang, J.J. Zhu, J.M. Zhu, X.H. Liao, S. Xu, T. Ding, H.Y. Chen, Phys. Chem. Chem. Phys., No.4 pp. 3794-3799, 2002
- [6]. Liao, X.H., Zhu .J.M., Zhu ,J.J., Xu .J.Z., Chem. Commun, pp. 937-938, 2001
- [7] Kumar A, Das S, Munusamy P, et al. Behavior of nanoceria in biologically relevant environments. Environ Sci Nano. 2014;1:516–532
- [8] Munusamy S, Bhakyaraj K, Vijayalakshmi L, Stephen A, Narayanan V. Synthesis and characterization of cerium oxide nanoparticles using *Curvularia lunata* and their antibacterial properties. Int J Innovative Res Sci Eng. 2014;2(1):318–323.
- [9]. Thill A, Zeyons O, Spalla O, et al. Cytotoxicity of CeO<sub>2</sub> nanoparticles for *Escherichia coli*. Physico-chemical insight of the cytotoxicity mechanism. Environ Sci Technol. 2006;40(19):6151–615
- [10]. Zeyons O, Thill A, Chauvat F, et al. Direct and indirect CeO<sub>2</sub> nanoparticles toxicity for *Escherichia coli* and *Synechocystis*. Nanotoxicology. 2009;3(4):284–295.

## STIMULATORY ROLE OF TRIIODOTHYRONINE IN HYDROMINERAL REGULATION IN FRESHWATER AND SALINITY ACCLIMATED CLIMBING PERCH, *ANABAS TESTUDINEUS*

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### ABSTRACT

*In fishes, the osmoregulatory organs such as gills, kidneys and intestine are involved in creating ionic and osmotic gradients between the body fluid and external environments. It is well known that gill mitochondria-rich cells, or chloride cells (CCs), are responsible for salt secretion in seawater-adapted fish. Euryhalinity helps the fish to tolerate a wide range of salinity because of possessing abundant CCs.*

**Key words:** Chloride cells,  $\text{Na}^+$ ,  $\text{K}^+$ -ATPase, Osmoregulation,  $\text{T}_3$ ,  $\text{T}_4$

### INTRODUCTION

In freshwater adapted teleosts, by contrast, active ion absorption from a hyposmotic environment is necessary to compensate for the constant diffusional loss of ions through the gill epithelia (Evans, 2005). Gills of marine stenohaline teleosts possess a greater amount of  $\text{Na}^+$ ,  $\text{K}^+$ -ATPase activity than freshwater stenohaline species. Seawater acclimation results in many changes in gill function including increases in the activity of  $\text{Na}^+$ ,  $\text{K}^+$ -ATPase and the number of chloride cells (CCs) (Mancera and McCormick, 2000) and the appearance of accessory cells on the gill. The dynamics of endocrine support such as thyroid hormones (THs), growth hormone and cortisol has been studied in salmonid migration which further modify the structural and chemical features of gill, leading to transition to a hyper-osmotic environment (McCormick, 2002).

### MATERIALS AND METHODS

Air breathing perch *Anabas testudineus* of approximate 50g body mass were collected from a local supplier and kept in large glass tanks. They were acclimated in well water at  $28 \pm 2^\circ\text{C}$  under natural photoperiod (12L/12D) for three weeks prior to experiment. Two weeks prior to experiment, fish were arranged in four subsets of six each and kept in 100L glass tanks. The first subsets (1 and 2) were freshwater-adapted (FW) fish and subsets 3 and 4 fish were acclimated to dilute seawater (SA). Artificial sea water of 20ppt salinity was prepared by dissolving natural sea salt. Consequently, fish subsets 3 and 4 were transferred to this salinity after keeping at 5, 10, 15 ppt for over 12h at each stage. These freshwater adapted and seawater-acclimated fish subsets were acclimated for two more days. After acclimation, subsets 2 and 4 fish were made hyperthyroid by administering i.p. injection of  $100 \text{ ng}\cdot\text{g}^{-1} \text{ T}_3$  for 24h. This dose of  $\text{T}_3$  has been shown to raise the endogenous  $\text{T}_3$  concentration within the physiological range after 24 h. Subsets 1 and 3 were given equal amount (100 $\mu\text{l}$ ) of isotonic saline. All subsets were sampled after 24h.

The levels of plasma  $\text{T}_3$  and  $\text{T}_4$  were measured by enzyme immunoassay (EIA) technique based on the magnetic solid phase separation (Serozyme, Guidonia Montecelio, Italy). The ouabain-sensitive  $\text{Na}^+$ ,  $\text{K}^+$ ATPase enzyme specific activity (ESA) was measured in tissue homogenates ( $\text{H}_0$ ) as described by Flik *et al.*, (1989) and modified by Peter *et al.*, (2000).

### RESULTS

Plasma  $\text{T}_3$  and  $\text{T}_4$  As expected, plasma  $\text{T}_3$  level showed a significant ( $P < 0.05$ ) elevation in both FW and SA fish after  $\text{T}_3$  injection (Fig. 1). On the contrary,  $\text{T}_4$  level declined significantly in both FW and SA fish (Fig. 2)

The specific activity of  $\text{Na}^+$ ,  $\text{K}^+$ -ATPase in gill showed significant increase in both FW ( $P < 0.05$ ) fish and in SA ( $P < 0.01$ ) fish following  $\text{T}_3$  administration (Fig. 3). Conversely, the  $\text{Na}^+$ ,  $\text{K}^+$ -ATPase activity in renal tissue of FW fish decreased significantly ( $P < 0.05$ ), but did not alter its activity in SA fish (Fig. 4).

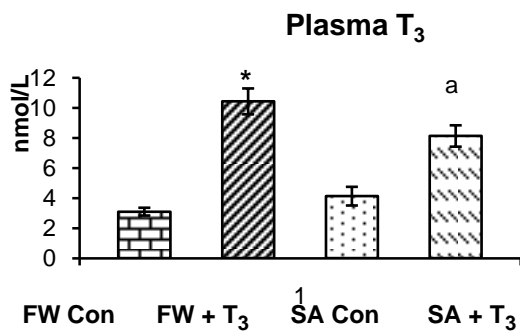


Fig. 1

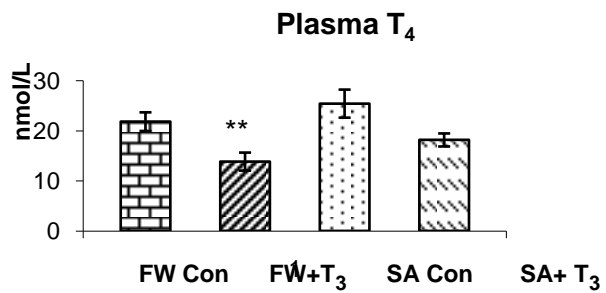


Fig. 2

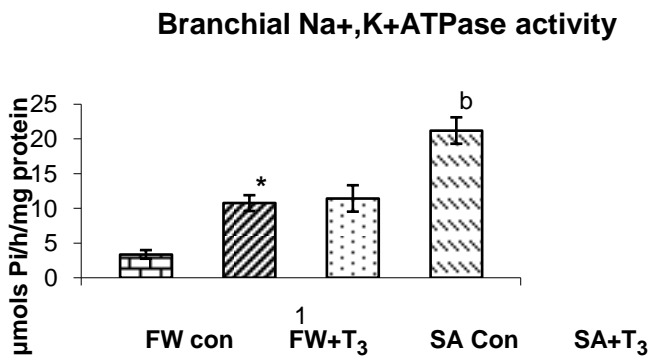


Fig. 3

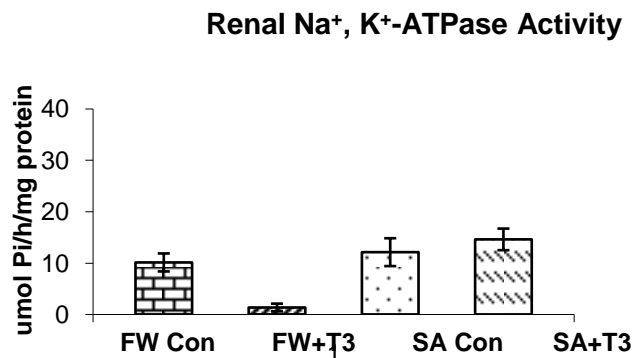


Fig. 4

## DISCUSSION

We demonstrated that  $\text{Na}^+$ ,  $\text{K}^+$ -ATPase activity is approximately one fold higher in the gills of dilute seawater-acclimated perch than in the freshwater fish gill. The sensitivity of thyroid axis to salinity has also been recorded in this study, thereby providing evidence for the remarkable ability of THs to osmoregulate both in hyper and hyposmotic media. Evidence for an osmoregulatory role of  $\text{T}_3$  in SA perch is presented.

Up-regulation of branchial  $\text{Na}^+$ ,  $\text{K}^+$ -ATPase activity in both FW and SA fish points to the definite role of  $\text{T}_3$  in the regulation of sodium pump activity and thus the handling of sodium. It appears that the chloride cells which are involved with active  $\text{Na}^+$  transport are under the  $\text{T}_3$  action. The levels of  $\text{Na}^+$ ,  $\text{K}^+$ -ATPase have been used extensively as an index of transport capacity in fish exposed to a variety of conditions including seawater transfer (Mancera and McCormick, 2000).

## CONCLUSION

It seems that T<sub>3</sub> promotes the activity of branchial sodium pump in FW perch as has been evident from the stimulated Na<sup>+</sup>, K<sup>+</sup>-ATPase activity but not the CC density. THs increase Na<sup>+</sup>, K<sup>+</sup>-ATPase activity in many organs and this enhancement has been related to the augmentation of energy consumption coupled with active Na<sup>+</sup> and K<sup>+</sup> transport. It is, therefore, suggested that in FW T<sub>3</sub> may favour uptake of ions from the extracellular medium driven by increased Na<sup>+</sup> pump activity. On the contrary, T<sub>3</sub> appears to secrete Na ions by stimulating Na pump activity in perch acclimatized to salinity.

#### **REFERENCES**

- Flik, G., Rentier-Delrue, F. and Wendelaar Bonga, S. E. (1994). Calcitropic effects of recombinant prolactins in *Oreochromis mossambicus*. *Am. J. Physiol.* **266**: R1302-R1308
- Mancera, J. M. and McCormick, S. D. (2000). Rapid activation of gill Na<sup>+</sup>,K<sup>+</sup>-ATPase in the euryhaline teleost *Fundulus heteroclitus*. *J. Exp. Zool.* **287**, 263-274.
- McCormick S. D. (2002). Endocrine control of osmoregulation in teleost fish. *Am Zoologist* **41**:781–794.
- Peter, M.C.S., Lock, R.A.C and Bonga, S.E.W. (2000). Evidence for an osmoregulatory role of thyroid hormones in the freshwater Mozambique tilapia, *Oreochromis mossambicus*. *Gen Comp Endocrinol* **120**:15



## **MICROBIAL QUALITY ASSESSMENT OF BAIGAI, BABYLONIA ZEYLANICA (BRUGUIÈRE, 1789) LANDED IN KOLLAM, KERALA AT DIFFERENT STAGES OF PROCESSING**

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### **ABSTRACT**

*Babylonia is a marine gastropod mollusc of the family Babyloniidae, commonly referred to as whelks. Significant quantities of Indian babylon (B. zeylanica) is landed along the coast of Kerala in the months of April – May and forms part of the seafood export from the state under the trade name baigai in frozen form. The present study investigates the bacterial load (Total Plate Count) and the presence of human microbial pathogens (E. coli, Staphylococci, V. cholera and V. parahemolyticus) in B. zeylanica during different stages of processing. Raw material was sampled randomly from Sakhikulangara fishing harbor, samples after depuration and end product were collected from a HACCP approved processing facility in Kollam. Standard microbiological procedures (BAM method) were followed for the enumeration and identification of bacteria. TPC was highest at the raw material stage and lowest in the end product. All pathogens except V. parahemolyticus were detected in the raw material. Staphylococci detected within permissible limits (<10 CFU/gm) was the only pathogen present in the end product. The detailed microbial quality at different stages of processing will be presented in the seminar. The study is a proof of the high quality frozen baigai exported from Kerala.*

*Key words: Edible gastropods, whelk, seafood microbes.*

## WATER QUALITY DYNAMICS IN AQUAPONICS

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### ABSTRACT

*Maintenance of water quality in aquaculture is one of the major challenges in the sector. Around 75% of the feed nitrogen and phosphorus is unutilized and remain as waste in water. Depending on the species and culture technique, up to 85% of phosphorus, 80–88% of carbon and 52–95% of nitrogen input into a fish culture system may be lost to the environment through feed wastage, fish excretion, faecal production and respiration. Aquaponics is one of the solutions to this problem. Aquaponics is the symbiotic farming of fish and terrestrial plants in an integrated recirculating aquaculture and hydroponics system. Plants act as an additional crop by utilizing the nutrient generated from the fish excreta and excess feed.*

*In this Study, we are trying to analyze the utilization of nutrients by different plants for standardizing the better plant combination which is suitable for aquaponics with efficient nutrient regulation as well as production without any supplement nutrition. Nile tilapia (*Oreochromis niloticus*) and Pacu (*Piaractus brachypomus*) were reared in the system. Water quality was monitored continuously to analyze the nutrient dynamics (Ammonia, nitrite, nitrate and phosphate) in each plant hydroponics for the comparison of nutrient uptake by each plant. Cowpea (*Vigna unguiculata*), Cauliflower (*Brassica oleracea* var. *botrytis*), Brinjal (*Solanum melongena*), Chilli (*Capsicum annuum*) and Tomato (*Solanum lycopersicum*) were studied.*

*In the current study, water quality of fish tank water was maintained by the plants without any other filtration system. Studies on the analysis of plants with better nutrient absorption are in progress.*

**Keywords:** water quality, nutrients, aquaponics

## EPIBIONT BACTERIA OF THE MARINE ALGAE *SARGASSUM WIGHTII* AGAINST THE FUNGAL PATHOGEN *ALTERNARIA ALTERNATA*

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**Abstract:** Marine seaweeds and their associated bacteria produce bioactive compounds which have been found to be important for health promotion and disease prevention. The present study, focused on the isolation, characterization and screening of the antibiotic producing bacteria associated with *Sargassum wightii* from the coast of Thirumullavaram, Kollam, Kerala. Ethyl acetate extracts of bacterial supernatant were screened for antibacterial activity. From the 10 isolates 6 revealed antibacterial potential against the plant pathogen *Alternaria alternata*. *A. alternata* is a fungus which has been recorded causing leaf spot and other diseases on over 380 host species of plant. Identification of the active isolate upto genus level were carried out by morphological and biochemical analysis of the isolates. The most active isolates were identified upto species level by Phylogenetic analysis based on 16S rRNA gene sequencing, which showed that the strains belongs to the genus with the maximum similarity to Proteobacteria and Firmicutes. Microbial communities associated with algae remain underexplored, despite their wide biodiversity and the fact that they differ markedly from those living freely in seawater.

**Keywords:** Antimicrobial potential, *Alternaria alternata*, epibiont, Firmicutes, Proteobacteria, *Sargassum wightii*

### INTRODUCTION

The surfaces of marine eukaryotes provide a unique habitat for colonizing microorganisms where competition between members of these communities and chemically mediated interactions with their host are thought to influence both microbial diversity and function. With the increasing need for novel drug discovery, marine epibiotic bacteria may thus represent a largely underexplored source of new antimicrobial compounds. The use of chemical pesticides, many pathogenic strains have developed an enhanced level of resistance to existing pesticides. Marine and terrestrial bacteria have many similarities, but the adaptations required by organisms to live in a marine environment, where chemical and physical conditions differ significantly from terrestrial environment, have resulted in production of novel compounds to aid in their survival. Considering the above importance, the present study was undertaken to determine the antimicrobial potential of the secondary metabolites of epiphytic bacteria of the seaweed *Sargassum wightii* collected from Thirumullavaram, against the fungal pathogen *Alternaria alternata*. *A. alternata* causes black spot in many fruits and vegetables around the world. It is a latent fungus that develops during the cold storage of fruits, becoming visible during the marketing period thereby causing large postharvest losses.

### MATERIALS AND METHODS

Isolated epiphytic bacteria from the seaweed samples collected from Thirumullavaram (8° 54'N and 76°38'E). Prepared crude extract of the samples and was used for bioassay against *A. alternata*. Antimicrobial activity was analysed by agar well diffusion method. The culture of pathogen was collected from National Chemical Laboratory, Pune. The isolated bacteria with antimicrobial activity were first identified to the genus level by observing their morphology and biochemical characteristics as IMVIC test, glucose fermentation test, urease production test, catalase and oxidase test according to the schemes [7,8]. The bacteria with wide antimicrobial spectrum were identified upto species level by PCR amplification of the 16S rRNA gene, BLAST analysis.

## RESULTS AND DISCUSSIONS

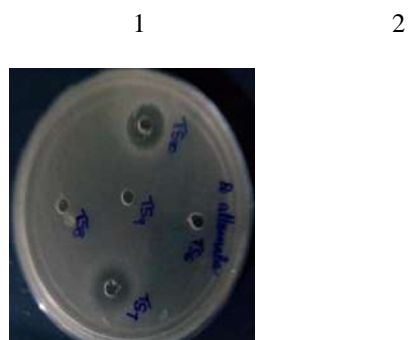
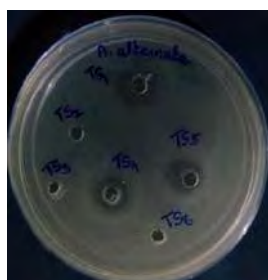
The ten isolates obtained from *Sargassum wightii* from Thrumullavaram coast are represented as TS1, TS2, TS3, TS4, TS5, TS6, TS7, TS8, TS9 and TS10 respectively. The pure culture of the bacterial epibionts were maintained in agar slants and subsequently tested for their antimicrobial potential against the plant pathogen *A alternata* by agar well diffusion method. The inhibition zone obtained is shown in TABLE 1 and PLATES 1&2

Among the ten isolates of epibionts of *S wightii* obtained from Thirumullavaram, ethyl acetate extract of TS1, TS4, TS5, TS7 and TS10 showed considerable antibacterial activity against *A alternata*. The maximum zone of inhibition was (13mm) shown by TS1, the minimum zone (6mm) was observed in TS5. The isolates with antimicrobial potential were identified using morphology, Gram staining and Biochemical tests. Results of gram staining and biochemical tests were shown in TABLE 3. The bacteria with wide antimicrobial spectrum were identified to the species level by PCR amplification of the 16S rRNA gene, BLAST analysis, and comparison with sequences in the Gene Bank nucleotide database. 16SrRNA sequence analysis reveals that the strain TS1 is *Bacillus velezensis*. Phylogenetic tree of *B velezensis* is given in FIGURE 4.

**Table 1 : Zones of Inhibition Formed by Epiphytic Bacteria Against *A alternata***

Pa th og en	Isolated Epiphytic Bacteria(mm)									
	T S 1	T S 2	T S 3	T S 4	T S 5	T S 6	T S 7	T S 8	T S 9	T S 10
<i>A alt er na ta</i>	13	-	-	7	6	-	8	-	-	6

**Plates 1&2: Screening of Antimicrobial by Agar Well Diffusion Method**



In the present study Gram-positive bacilli from seaweed were obtained. Gram-positive bacteria are known to generate spores under adverse conditions, such as those encountered in marine ecosystems, and this is thought to ensure their survival within the host tissue. Interestingly, spore formation is co-regulated with antibiotic production [5]. In the present study active strains belong to proteobacteria and firmicutes. The bacterial diversity observed in the study may be only a fraction of the total diversity of associated bacteria. *B velezensis* has been investigated and applied more and more widely recently because it can inhibit fungi and bacteria and become a potential biocontrol agent. Because of its ability to produce a large number of antimicrobial peptide, the genus *Bacillus* is becoming an interesting source to search for inhibitory substance [3].

**Table 3: Gram Staining and Biochemical Properties of the Active Isolates**

Properties of bacterial isolates	Epibiont bacteria with antimicrobial potential				
	TS1	TS4	TS5	TS7	TS10
Gram staining	+	+	+	-	-
Morphology	Rods	rods	rods	cocci	rods
Indole	-	-	-	-	-
Methyl red	-	-	-	-	+
Voges-Proskauer	+	-	+	-	-
Citrate	-	-	+	+	+
Catalase	-	+	+	+	
Oxidase	+	+	-	-	+
sucrose	+	-	+	-	+
Lactose	-	-	-	-	-
Urease	-	+	-	-	-

**Fig 4 :Phylogenetic Tree of *Bacillus velezensis* based on 16srRNA sequencing**



The genus *Bacillus* includes aerobic endospore-forming bacteria and is one of the largest sources of bioactive natural products [4]. The information about the

metabolic profile, antimicrobial activity and cytotoxicity of the selected *Bacillus* strains could be valuable in the search for new antibiotics and commercially useful therapeutic agents[8]. Apart from their association with seaweeds *Bacillus* were previously isolated from sediments and seaweeds with antimicrobial properties. As observed in the present study the most potential isolate identified as *Bacillus* sp. showed remarkable activity against the tested pathogen, *A. alternata*.

## CONCLUSION

It can be concluded that isolation of marine bacterial samples can offer a numbers of microbial strains for sources of new biomolecules. This study indicated that certain strains of bacteria could be induced to produce antibiotics. From the eighteen isolated epibionts, seven species showed antimicrobial potential against the plant pathogen *A. alternata* and two of the species under genus *Bacillus* was the most active. Because of emerging and re-emerging infections to important economic crops, further studies are required for the documentation of different bioactive compounds from seaweed associated bacteria against plant pathogens.

## REFERENCES

1. Armstrong, E., Yan, L., Boyd, K.G., Wright, P.C. and Burgess, J.G. (2001). The symbiotic role of marine microbes on living surfaces. *Hydrobiologia* 461: 37–40.
2. Bonar, D.B., Weiner, R.M., and Colwell, R.R. (1986). Microbial–invertebrate interactions and potential for biotechnology. *Microb Ecol* 12: 101–110.
3. Croft, M. T., Lawrence, A. D., Raux-Deery, E., Warren, M. J., and Smith, A. G. (2005). Algae acquire vitamin B12 through a symbiotic relationship with bacteria. *Nature* 438, 90–93. doi: 10.1038/nature04056.
4. Davies, J. (1996). Medicine – bacteria on the rampage. *Nature* 383:219–220.
5. Goecke, F., Thiel, V., Wiese, J., Labes, A., and Imhoff, J. (2013). Algae as an important environment for bacteria – phylogenetic relationships among new bacterial species isolated from algae. *Phycologia* 52, 14–24. doi: 10.2216/12-24.1
6. Mearns-Spragg, A., Bregu, M., Boyd, K.G., Burgess J.G. (1998). Cross-species induction and enhancement of antimicrobial activity produced by epibiotic bacteria from marine algae and invertebrates, after exposure to terrestrial bacteria. *Lett. Appl. Microbiol.*, 1998; 27: 142-146.
7. Schwartzmann, G., Rocha, A.B., Berlinck, R.G.S., Jimeno, J. (2001). Marine organisms as a source of new anticancer agents. *Lancet Oncol.*;2: 221-225.

# **HEAVY METAL POLLUTION IN WATERS OF LAKE VATTAKAYAL, CHAVARA, KOLLAM, KERALA.**

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## **Abstract**

In the last few decades many areas of India have been undergone intensive industrial progress and urban development. Most of the lakes tropical region of India face severe effect of heavy metal pollution, as a consequence of industrial revolution and urban agglomeration, all have serious detrimental impact on people and ecosystems those who rely on such bodies of water. Vattakayal lake system was one of the most productive ecosystems of Kerala, now became heavily polluted due to the effluents from KMML Titanium dioxide pigment plant at Sankaramangalm which pose grave environmental problems, affecting the biota directly or indirectly. In this study both surface and bottom water samples have been seasonally analyzed for determining the concentration of metals such as zinc, copper, cadmium, lead, manganese and nickel. The result showed that the sites of the lake, near the industrial area was more contaminated with the metals than the sites of non industrial area. An increasing trend of metal concentration towards the bottom water than surface water was also observed. The physicochemical parameters such as temperature, pH and salinity were also analyzed to understand the metal accumulation in water body. The prevailing conditions of temperature, pH and salinity in Vattakayal lake waters have indicated the enhanced rate of accumulation of metals.

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## **Key words**

bio accumulation, Itaiitai disease ,metal toxicity, Minamata disease, Vattakayal lake.

## **Introduction**

Lakes are complex and dynamic ecosystems that are constantly influenced the environment. Both chemical and biological components of the lake system changes continuously, these changes cause re equilibration, creating a new steady state (Reddy et. al., 2004). If the ecology of the lake changes drastically, it will harmfully affect both human beings and resources. Substances such as heavy metals, metalloids, petroleum hydrocarbons, chlorinated organic and polycyclic aromatic hydrocarbons, which might be released in to the lake system, cause great threat (Panda et.al. 2006). Due to the nonbio degradable, persistent and toxic nature of heavy metals, it is of great concern about distribution and behavior of heavy metals in the aquatic environment (Shirlin, et.al. 2014). Tragedies such as Minamata incident and Itaiitai disease have occurred due to the heavy metals pollution by the irrational discharge of industrial effluents. Therefore in the modern era, metal toxicity is one of the hottest topic (El- Hassan and Jiries 2001).

Of the six heavy metals studied, metals like zinc, copper and nickel serve as essential micro nutrients, since its availability affect the physiological and biochemical activity of aquatic organism. Metals like manganese is very significant in controlling biogeochemical processes and non essential metals like cadmium and lead have no known biochemical, nutritional and physiological functions in organisms. Since these metals are non bio degradable it became highly toxic at elevated concentrations (Ashraf et. al., 2008). Presences of heavy metals in waters of lake

system are of extreme importance due to their impact on ecosystem. (Forstner and Wittmann, 1982).

Extensive studies have been conducted on heavy metal contamination and toxicity in water (Bryan, 1984, Viarengo, 1985, Nriagu and Pacyana., 1988; Mattivertta, 1989; George Thomas and Fernandez 1996, Mohan and Omana 2004, Suneela et. al., 2007, Panday et. al.,2008, Wang et.al., 2011, Ondarza et. al.,2012, Karim et.al.,2015). Only very limited studies are reported about heavy metal pollution of Vattakayal lake system, which is the nursery ground for vast resources of several fishes and molluscans and many people are depending on the lake for their livelihood. Hence the present study was undertaken with an aim of analyzing heavy metal concentration in water and its relation with physico chemical features such as pH, salinity and temperature.

## Materials and Methods

### **Study area.**

Vattakayal lake, a big brackish water lake about 5km away from KMML (Kerala minerals and Metals limited) company, Chavara, Kollam District, Kerala, India lies between 8°51'N and 8°45' N latitude and 76°32'E and 76°34' longitude having a circumference of 90 acres. A part of T S canal the national water way starting from Shornur and ending in Thiruvananthapuram stretching from Vattakayal lake to Ashtamudy lake. Vattakayal lake system was one of the most productive ecosystems of Kerala now became heavily polluted, clay deposition observed as thick layer so the depth of the water body became every much reduced and living organisms were almost absent in some regions of this lake.

### Sample collection and preservation

Water samples were collected from four locations in Vattakayal during premonsoon, monsoon and postmonsoon seasons. Each sample was kept in good quality polyethylene bottles and placed in an ice box. Both surface water samples and bottom water samples were collected by using Von Dorn water sampler. Each sample was a combination of four or five sub samples. After collection each samples were immediately brought to the laboratory for analysis.

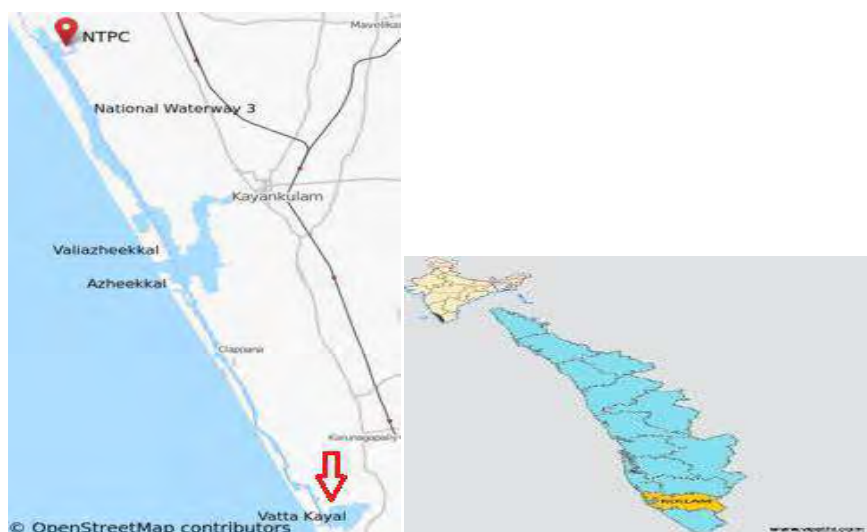


Fig I. Map showing the Vattakayal Lake and sample locations.

Sample analysis.

#### Physicochemical analysis of water

Water quality parameters such as pH, salinity and temperature for water samples were done as per standard producers of APHA (APHA, 1998).

Hydrogen ion concentration of water samples was measured at the site itself with a portable pH meter of  $\pm 0.1$  accuracy (model, pH Tester 1, 2, Eutech instruments UK). The temperature of water was recorded with the help of a centigrade thermometer. Salinity of the water samples was estimated by Mohr-Knudsen method (Muller, 1999).

#### Heavy metal analysis of water

Filter papers loaded with suspended particulate matter were digested using concentrated  $\text{HClO}_4$  and  $\text{HNO}_3$  in the ratio 1:3, which is then evaporated to dryness. The obtained residue was then dissolved in 0.1 N  $\text{HNO}_3$  and made up to a definite volume (APHA, 1998).

Water samples preserved in acids were pre concentrated using 1% solution (1 ml) of chelating agents APDC (ammonium-1-pyrrolidine dithiocarbamate), DDDC (diethyl ammonium diethyl dithiocarbamate) and 30ml chloroform in several steps (APHA 1998). From the above mixture extraction of solvent was done after adjusting the pH of the acidified sample to 4 to 5 by the addition of ammonium hydroxide. By using sub boiling distilled concentrated  $\text{HNO}_3$ (2ml) the chloroform layer was acidified and metals were brought into the aqueous phase by equilibration with Milli- Q water. This aqueous layer was then transferred to a standard flask, boiled off the excess chloroform and made up to a definite volume. Metal determinations were carried out on the concentrates by graphite furnace atomic absorption spectrometry (Perkin Elmer model 3110, with HGA 600) calibrated using standard solutions prepared by dilution of 1000mg/l standard solutions (Merck). Analytical blanks were prepared using same procedures and reagents.



## Statistical Analysis

Statistical analysis was performed using statistical package for social science (SPSS) version 16.0. Pearson correlation analysis was performed to identify the relationship of various hydrographical and physico chemical parameter. Spatial and temporal variations of hydrographical and heavy metals (Zn, Cu, Cd, Pb, Mn, and Ni) were assessed by two way analysis of variance (ANOVA) without replication with season and stations as sources of variations.

## Result and discussion

### Physico chemical parameters

Water quality parameters such as pH, temperature and salinity were analysed and the summary of the result is given in the table 1. Station wise variations of physico chemical variations is graphically represented in the figure.1a. Hydrogen ion concentration in station I and II was acidic, the average pH of station I and station II are  $2.53 \pm 0.57$  and  $2.87 \pm 0.51$  respectively. While in non industrialized areas pH average is  $7.33 \pm 0.37$  (station III) and  $7.47 \pm 0.46$  (station IV). pH value showed minimum in pre monsoon season while maximum in monsoon season. Acidic effluents released from the industry might be the reason for low pH in the water body.

Temperature is an important physical factor of any habitat and temperature plays a vital role in biochemical reactions and self purification of aquatic systems. The water temperature in station I range from  $27.5^{\circ}$  to  $30.8^{\circ}\text{C}$  in surface water and  $27.3^{\circ}$  to  $30.5^{\circ}$  in bottom water. Pre monsoon temperature shows highest values is  $30.8^{\circ}\text{C}$ , monsoon temperature is the minimum which is  $27.3^{\circ}\text{C}$ . In station II temperature ranges between  $27.1^{\circ}\text{C}$  to  $29.9^{\circ}\text{C}$  in the case of surface water and  $27$  to  $29.8^{\circ}\text{C}$  in bottom water, here also highest values observed in pre monsoon and minimum temperature value in monsoon season. In station III  $27.1^{\circ}\text{C}$  to  $28.5^{\circ}\text{C}$  is the temperature range of surface water, while in the case of bottom water, range between  $27^{\circ}$  to  $28.5^{\circ}\text{C}$ . in station IV  $27^{\circ}\text{C}$  to  $29.7^{\circ}\text{C}$  is the range of temperature surface water and  $27.1^{\circ}$  to  $29.6^{\circ}\text{C}$  in the case of bottom water.

Pre monsoon season showed maximum temperature followed by post monsoon and monsoon in the present investigation. This may be due to the reason that heavy solar radiation, low rain fall, stagnant water condition during pre monsoon season. Similar observations were previously done by Joseph et al., 1984 in Periyar estuary, Geetha Bhadrans (1997) from Ashtamudy lake, Meera and Nandan (2010) from Cochin back waters. Usually exothermic reactions take place in waste materials due to the presence of different chemicals and micro organisms in the waste.

Salinity of aquatic environment is a major controlling factor for various physical chemical and biological processes that occurs in the surroundings. The average of salinity in station I is  $26.08 \pm 2.2$ . Highest salinity observed in pre monsoon season while the lowest in monsoon season. In station II salinity range is  $23.35 \pm 1.48$ . In station III average range is between  $11.24 \pm 0.79$ . In station IV salinity range is between  $21.83 \pm 1.42$ . Maximum salinity observed in station I and II which is nearest to the industrial area. Salinity in the industrial area was higher than other stations, the same observation were previously recorded by Ciji and Bijoy Nandan (2014). Elevated salinity observed at pre monsoon season this might be due to high rate of evaporation and might be due to discharge of high chloride content from the industry. Minimum value observed in monsoon season which might be due to heavy influx of rain water (Sankaranarayanan and Qasim 1969, Mani Kannan et al., 2011) there is a positive correlation observed between salinity and

temperature. Station IV also shows elevated salinity, this station is near to the sea, so tidal actions may occurs, (Pillai et al., 1975 and Geetha Bhadran (1997).

STATION S	TEMPERATURE	pH	SALINITY
Station I	29.3±0.2	2.53±0.5 7	26.08±2.2
Station II	28.5±0.13	2.87±0.5 7	23.35±1.4 8
Station III	27.9±0.1	7.33±0.3 7	11.24±.70
Station IV	27.5±0.30	7.47±0.4 6	21.83±1.4 2

**Table I. Means of physico chemical factors at different stations.**

### **Distribution of Heavy metals in water**

The seasonal and spatial variation of total heavy metal concentrations were analyzed both in surface and bottom waters collected from four different stations during premonsoon, monsoon and post monsoon periods from June 2014 to May 2015.

Zinc is the most abundant essential trace element in the human body and it is a constituent of several enzymes. Zinc deficiency cause impairment of physical growth and development. The mean concentration zinc in surface waters of station I, II, III, and IV were 7.4±1.89 4.32±0.65, 0.02±0.009, 1.20±0.66 respectively. While in bottom water the concentration mean value were 8.18 ± 1.4, 4.62 ± 0.9, 0.05 ± 0.01, 1.42 ± 0.63. Zinc concentration varied from a minimum of 0.01 mg-l to a maximum of 10.11mgL<sup>-1</sup> in surface water and from 0.07mgL<sup>-1</sup> to 10.26mgL<sup>-1</sup> in bottom waters. Much concentration of heavy metals occurred in bottom water than the upper water layers, similar observation by Shylesh Chandran, 2016 in Vembanad Lake. This might be because zinc can be recycled from the sediment to the water column by the oxidation of labile organic compound at the sediment water interface. (Selvam et. al., 2012). Maximum zinc concentration observed at station I (10.26mgL<sup>-1</sup>) may be due to industrial effluents from KMML factory, directly released into this site. Station II also showed a higher concentration because this station is near to the station I. while station III and station IV showed lowest concentration these two stations are interior part of the lake and fresh water supply occurred in this area.

Copper is also an essential element in metabolism and it is very essential for many enzymes in our body. By large concentration of copper become toxic and leads to liver damage. Average values of copper at four stations I, II, III and IV was in the order 1.24±0.23, 0.50±0.3; 0.007±0.002, 0.196±0.11 in surface water and in bottom water 1.38±0.18, 0.58±0.3, 0.010±.003, 0.32±0.14. Elevated concentration observed in station I and II in bottom water layers than surface waters. According to USEPA (2011) copper concentration ranges between 18.0-35.3 ppb is tolerable limit. Based on EU standards copper level 2.0mgL<sup>-1</sup> become upper limit. Copper content stations I and II was above the range of USEPA but within the EU standards. Concentration of copper greater than 1ppm considered to be toxic to aquatic life.

Cadmium is very toxic and poisonous traces of it may cause adverse effect on environment and living things. Cadmium enters in to water exclusively through industrial wastes and land leachates (Paulson et. al., 1993). Cadmium content in the surface water of four stations was 0.016±0.009, 0.009±0.01 0.004±0.003 and 0.004 ±0.002. While the bottom water

concentration was  $0.018 \pm 0.006$ ,  $0.01 \pm 0.004$ ,  $0.003 \pm 0.001$  and  $0.005 \pm 0.002$ . Station I showed higher cadmium content than other stations this may be due to the reason that this station receives directly the effluents from KMML factory. World average concentration of cadmium is  $0.01 \text{mgL}^{-1}$ , station I and II showed higher values than the world average. Continued exposure of cadmium may cause renal arterial hypertension. Significant elevated concentration may cause kidney and liver damage or anemia and may even cause death.

Lead is a most abundant toxic contaminant because it is continuously released into air, water and soil in significant amount. (Branica, 1980). As per USEPA the contamination level of lead is  $0.15 \text{mgm}^3$ . Above this level, lead causes brain damage, behavioral problems and mental deficiency, continuous exposure of lead causes nephritis. The mean concentration of lead in surface waters of station I, II, III and IV are  $1.6 \pm 0.5$ ,  $0.12 \pm 0.01$ ,  $0.007 \pm 0.001$ ,  $0.01 \pm 0.005$  while in bottom waters the concentration ranged as  $1.71 \pm 0.8$ ,  $0.11 \pm 0.01$ ,  $0.007 \pm 0.001$ ,  $0.01 \pm 0.005$ . The level of lead had crossed the stipulated limit at station I and station II, which is about  $0.01 \text{mgL}^{-1}$

Manganese is an essential element needed for normal functioning of the body of the organism but it become toxic when the concentration exceeds in the human body. Manganese poisoning cause bronchitis, lung embolism and Parkinson disease. Average concentration of manganese in surface waters of station I, II, III and IV were in the order  $1.13 \pm 0.3$ ,  $1.004 \pm 0.1$ ,  $0.06 \pm 0.04$ ,  $0.07 \pm 0.01$ , and while in bottom water concentrations were in the order  $1.17 \pm 0.3$ ,  $1.03 \pm 0.02$ ,  $0.046 \pm 0.01$ ,  $0.072 \pm 0.02$ . Station I and II showed comparatively higher concentration of manganese, which may be due to the discharge of effluents containing manganese from nearby industry. WHO limit of manganese in water is  $0.5 \text{mgL}^{-1}$  (WHO 1991), station I and II manganese concentrations crosses this limit.

Nickel is essential in small quantities when the content increases it become a danger to human life, excess amount of nickel is carcinogenic to human beings. The waste water released from smelting and refining industries are the sources of nickel. Nickel concentration in surface water at all the four station were in the order  $0.55 \pm 0.19$ ,  $0.41 \pm 0.18$ ,  $0.21 \pm 0.04$ ,  $0.26 \pm 0.13$  while bottom water average  $0.56 \pm 0.20$ ,  $0.42 \pm 0.18$ ,  $0.00 \pm 0.08$ ,  $0.37 \pm 0.2$ . Higher concentration of nickel occurs in all stations but the station I and II values were above the world average nickel content, which is about  $0.49 \text{mg L}^{-1}$ . (Taylor et al., 1995).

METALS	STATION I	STATION II	STATION III	STATION IV
ZINC	$7.4 \pm 1.89$	$4.32 \pm 0.65$	$0.02 \pm 0.009$	$1.20 \pm 0.6$
COPPER	$1.24 \pm 0.23$	$0.50 \pm 0.3$	$0.007 \pm 0.002$	$0.196 \pm 0.11$
CADMIUM	$0.016 \pm 0.009$	$0.009 \pm 0.01$	$0.004 \pm 0.003$	$0.004 \pm 0.002$
LEAD	$1.6 \pm 0.5$	$0.12 \pm 0.001$	$0.007 \pm 0.001$	$0.01 \pm 0.055$
MANGANESE	$1.13 \pm 0.3$	$1.004 \pm 0.1$	$0.06 \pm 0.04$	$0.07 \pm 0.01$
NICKEL	$0.55 \pm 0.19$	$0.42 \pm 0.18$	$0.021 \pm 0.04$	$0.026 \pm 0.13$

Table 1, Average Metal Concentration of Surface waters of different stations.

METALS	STATION I	STATION II	STATION III	STATION IV
ZINC	$8.18 \pm 1.4$	$4.62 \pm 0.9$	$0.05 \pm 0.01$	$1.420 \pm 0.6$
COPPER	$1.38 \pm 0.18$	$0.58 \pm 0.3$	$0.010 \pm 0.003$	$0.32 \pm 0.14$
CADMIUM	$0.018 \pm 0.006$	$0.01 \pm 0.04$	$0.004 \pm 0.001$	$0.005 \pm 0.002$
LEAD	$1.71 \pm 0.8$	$0.11 \pm 0.001$	$0.007 \pm 0.01$	$0.01 \pm 0.02$

MANGANESE	1.17±0.3	1.03±0.62	0.046±0.01	0.072±0.01
NICKEL	0.56±0.2	0.42±0.18	1.00±0.08	0.037±0.13

Table 2. Average Metal Concentration of Bottom waters of different stations

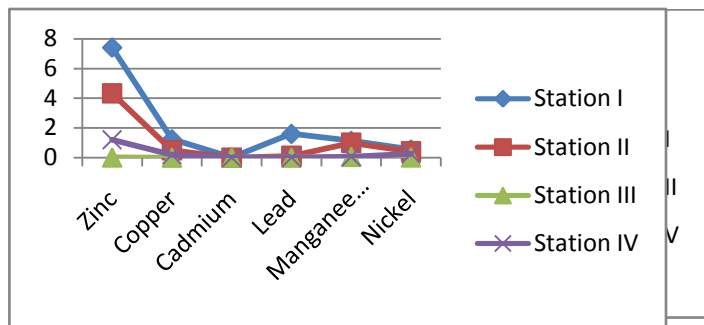


Fig. II Metal concentrations of surface water. bottom water.

Fig III. Metal concentrations of bottom water.

**Influence of physico chemical factors on Heavy metal distribution in water column**

Using Pearson Correlation, correlation between various water quality parameters such as temperature, pH, and salinity and metals like zinc, copper, cadmium, lead, manganese and nickel were done. pH is negatively correlated with all the studied metal concentration at 0.05 level of significance, while temperature and salinity is positively correlated with concentration of metal. There exist a positive correlation between metals, which indicate the presence of a common source of metal. The metal content present at four stations studied showed a significant variation in Two Way ANOVA.

	pH	Salinity	Temp	Zinc	Copper	Cadmium	Lead	Manganese	Nickel
pH	1								
Salinity	-.721**	1							
Temp	-.458**	.571**	1						
Zinc	-.909**	.820**	.622*	1					
Copper	-.807**	.785**	.687*	.958*	1				
Cadmium	-.709**	.672**	.750*	.860*	.858*	1			
Lead	-.660**	.588**	.544*	.874*	.892*	.800**	1		
Manganese	-.985**	.738**	.445*	.926*	.833*	.756**	.695*	1	
Nickel	-.633**	.525**	.842*	.724*	.766*	.857**	.644*	.630**	1

Table III. Correlation matrix of heavy metals, pH, salinity and temperature of all the samples

## REFERENCES

- [1] El Hasan.,T and Jiries A. 2001. Heavy metal distribution in valley sediments in Wadi Al Karak catchment, South Jordan. *Environmental Geochemistry and Health*, 23(2).105-116.
- [2] Panda U C, Rath P, Sahu K C, Majumdar S and Sundaray S K, 2006. Study of geochemical association of some trace metals in the sediments of Chilka Lake. *Environ. Monitoring Assessment*. ,123, 125-15
- [3] Shirlin J M, Sophiya J N,Devi M R, Raj L P, Suresh M and Kalaiarasi J M V., Evaluation of heavy metal contamination in the estuaries of Chennai. *Biolife*, 2014,2(4), 1090-1093.
- [4] Ashraf M P, Edwin L and Meenakumari B. 2008. Trace metal pollution in estuaries of South India. *Asian Journal of Water Environment and Pollution*, 5(2).63-69.
- [5] Forstner U and Wittmann GTM (eds).1982. *Metal pollution in the aquatic environment*. Springer Verlag, Berlin.486.
- [6] Shylesh Chandran M S, 2015. Distribution of Heavy metals in Vembanad Lake with special reference to hydrology and geochemistry. Ph D Thesis, School of Environmental science.
7. Suneela. M, Krishna G R, Krishna K V, Sai V M, Bharagav V, Reddy K S S, Srinivas D S S, Srinivas J.S, 2008. Proceedings of Taal, 2007. The 12<sup>th</sup> world lake conference. 304-306.
- [8] Matti Verta, 1989, History of heavy metal pollution in Finland as recorded by lake sediments. *Science of the Total environment*. Vol. 87-88 . 1-18 .
- [9] Nriagu J O and Pacyana J M, 1988. Quantitative assessment of worldwide contamination of air, water and soil by trace metals. *Nature*, 333. 134-139.
- [10] Karim L R, Wliams E S, 2015. Accumulation of heavy metals in surface water of Ashtamudy Lake, Kollam, Kerala. *Nat. Environment Pollution Techno*. 14. 431-434.
- [11] Ciji P P and Nandan, S B 2014, Toxicity of copper and zinc to *Puntius parrach* (Day, 865). *Marine environmental research*. 93. 38-46.
- [12] Bryan G W, 1984. Pollution due to heavy metals and their compounds. In. *Marine Ecology*,5 Kinne,O(ed),John Wiely&sons Ltd. New York.1311-1393.
- [13] Wang Y, Yang Z, Shen Z, Tang Z, Niu J, Gao F (2011).Assessment of heavy metals in sediments of the Yangtze River, China. *Environ.Mon. and Assessment*, Vol. 172, No. 1-4, 2011, 407-417.
- [14] APHA 1998. *Standard methods for water and waste water*. United book Press, Inc, Baltimore, Mary land, USA.
- [15] Sankaranarayanan V N and Qasim S Z. 1969. Nutrients of Cochin back waters in relation of environmental characteristics. *Marine Biology*.,2;236-247.
- [16] Geetha Bhadrán, 1997. Heavy metal pollution in Ashtamudy estuarine system. Ph. D Thesis, University of Kerala.
- [17] Manikannan R, Ashokan S and Ali A H M S, 2011. Seasonal variation of physico chemical properties of the Great Vedaranyam Swamp, Point Calimere Wilde life Sanctuary, South east coast of India. *African Journal of Environmental Science and Technology*.,5(9): 673-681.
- [18] Pillai V K, K J Joseph and A K K Nair, 1975. The plankton production in the Vembanad lake and adjacent waters in relation to the environmental parameters. *Bull. Dept. Mar. Sci. Univer. Cochin*. 7:137-150.
- [19] Ciji P P and Nandan, S B 2014, Toxicity of copper and zinc to *Puntius parrach* (Day, 865). *Marine environmental research*. 93. 38-46.
- [20] Meera and Bijoy Nandan S. 2010. *Water Quality status and primary*

- productivity of Valanthakad Back waters in Kerala. *Ind.J. of Marin. Science.* 39(1): 105-113.
- [21] WHO, 1991. Nickel, Environmental health criteria-World Health Organization. Finland. 101-117.
- [22] Paulson A J, Curl H, C and Feely R A., 1993. The biogeochemistry of nutrients and trace metals in Hood Canal, a Pudget Sound fjord. *Marine Chemistry.* 43, 157-173.
- [23] Branica M, 1980. In: Branica M and Konrad Z, (eds). *Lead in the Marine Environment.* Pergamon Press, New York. 353-388.
- [24] Viarengo A, 1985. Biochemical effects of Trace metals, *Mar. Pollu. Bull.* 16:153-158.
- [25] Panday S S , Parvez R, Ahammed Ansari M, Ali , M Kaur, F Hayat, F Ahma, S H Raisuddin. 2008. Effects of exposure to multiple trace metals on biochemical, histological and ultra structural features of gills of a fresh water fish, *Channa punctata* Bloch. *Chemico-Biological Interactions.* 174 (3): 183-192.
- [26] Ondarza P M, M G Karina, S B Miglioranza, 2012, Increasing levels of persistent organic pollutants in rainbow trout *Oncorhynchus mykiss* in Negro River basin. *Science of The Total Environment,* 419: 233-239.
- [27] Selvam A P., Priya S L, Banerjee K, Hariharan G, Purvaja R and Ramesh R , 2012. Heavy metal assessment using geochemical and statistical tools in the surface sediments of Vembanad Lake, South west Coast of India. *Environmental monitoring and assessment,* 184(10).5899-5915.

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# ISOLATION AND IDENTIFICATION OF POLY AROMATIC HYDROCARBON DEGRADING BACTERIA FROM OIL CONTAMINATED ENVIRONMENT.

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## ABSTRACT

*Poly aromatic hydrocarbons (PAHs) are widely distributed environmental contaminants that have detrimental biological effects, toxicity, mutagenicity and carcinogenicity. Conventional methods for the removal of these pollutants are expensive, and the rate of contamination is quite high. In view of this situation bioremediation gives a better solution compared to the currently existing methods. It provides efficacy, cost and simplicity of administration with promising opportunity for creating better environment. Bioremediation is the tool to transform the compounds to less hazardous or non-hazardous forms with less input of chemicals, energy, and time. It is an approach to degrade pollutants in an eco-friendly manner. We have isolated and identified polycyclic aromatic hydrocarbon degrading bacteria from marine ecosystems of Ernakulam and Vizhinjam. This was done by culturing bacteria in media containing different substrates such as naphthalene, fluorene and carbazole and identified using a PCR based strategy. In this we designed primers specific to the genes which encode 16 S rRNA and used for amplification and sequencing. The sequence obtained was analysed by NCBI BLAST to identify these bacterial strains. The results showed homology to Rhodococcus, Staphylococcus, Micrococcus and Bacillus. The bacteria Rhodococcus is most the efficient one and an ideal strain for bioremediation in oil contaminated field.*

## Keywords

*PAH, bioremediation, bacteria, 16srRNA, PCR, sequencing*

## INTRODUCTION

Petroleum-based products are the derivatives of crude oil and is the major source of energy for industries. Polycyclic aromatic **hydrocarbons** (PAHs) occur in nature extensively as pollutants and are important environmental contaminants because of their recalcitrance and carcinogenic properties. Hydrocarbon-degrading bacteria are widely distributed in different habitats and their ability for bioremediation has been established as an efficient, economical, versatile and environmentally sound treatment [5]. They allow for the conversion of hazardous substances into forms that are less or non-toxic substances [1].

The aim of the present study is to isolate and identify bacteria from polluted marine ecosystems of Vizhinjam, Thiruvananthapuram and Marine drive, Ernakulam and test potential of isolated bacteria in degradation of poly aromatic hydrocarbons.

## **MATERIALS AND METHODS**

- **Study site**

We have taken Marine Drive, Ernakulam as site A and Vizhinjam, Trivandrum as site B.

- **Sample collection and culture methods**

Wastewater samples were collected from five sites from both locations during the month of January 2017. The sterilized plastic bottles were used to collect water samples, serially diluted and stored at +4°C. For strains isolation and identification, enriched cultures were prepared. For this, 1 mL stock solution and selected hydrocarbons such as naphthalene, fluorene and carbazole were dissolved in a suitable solvent and added into nutrient agar plates with pour plating method. The agar plates prepared from different concentrations of stock solution were used as control. It was incubated at 37°C for 24 hours. From the culture plates, morphologically distinguishable colonies were selected and transferred into nutrient broth. It was again subjected to incubation at 37°C for 24 hours on a shaking incubator.

- **DNA Extraction and Identification using 16SrRNA Genes**

Total DNA extraction of bacterial strains was performed by the Master Pure Complete DNA&RNA Purification Kit (Epicenter, Biotechnologies, Madison, WI) in accordance with manufacture's protocol. The 16S rDNA loci were amplified using 1 primer pair: the 27F (5'-AGAGTTTGATCCTGGCTCAG-3', Lane, 1991) primer and the 1492R (5' TACGGYTACCTTGTACGACT-3') [4] universal primer. The PCR reaction mixture containing 50 mM KCl, 10 mM TrisHCl pH 8.3, 1.5 mM MgCl<sub>2</sub>; 2.2 µl dNTP, 1.1 µL of primers, 0.5 µL of Taq DNA polymerase, and 1 µl of DNA were subjected to an initial denaturation at 94 °C for 2 min followed by 30 cycles of denaturation at 94 °C for 30 seconds, annealing at 58 °C for 45 seconds and extension at 72°C for 10 minutes using a Gene Amp® PCR System 9700 (Applied Biosystems) and the samples were subjected to agarose gel electrophoresis. Sequencing reaction was performed by using the Big Dye Terminator v3.1 cycle sequencing kit. Dye terminated products were run in a ABI 3700 48 capillary automated DNA sequencer. These sequences were then analyzed by using NCBI nucleotide-nucleotide BLAST to reveal its identity.

## **RESULTS AND DISCUSSIONS**

- **Isolation of Bacteria**

From the enrichment cultures, a total of four morphologically distinct isolates which are able to metabolize hydrocarbons in oil as carbon and energy source were obtained. They were marked as C1

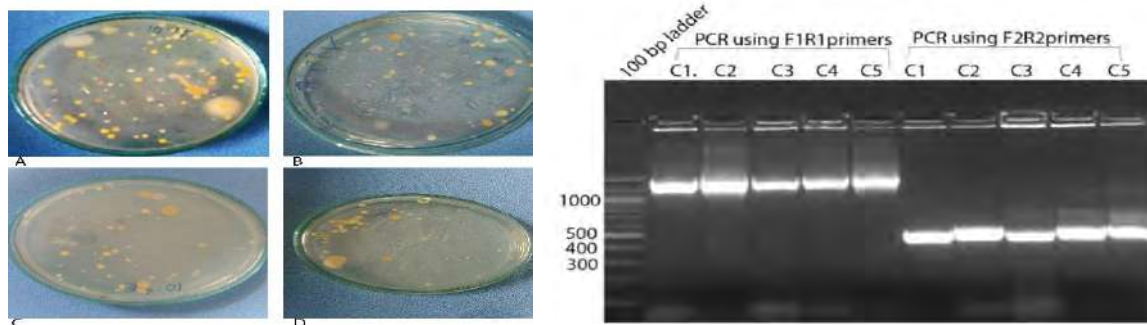


(colony 1), C2 (colony 2), C3 (colony 3) and C4 (colony 4). They showed different colony characteristics such as colour, shape, size, texture etc. Among the isolates, two colonies namely colony1 and colony2 showed best growth. The bacteria grown in nutrient agar plates coated with different substrates were shown in Figure 1.

In our study it was found that bacterial population is high in Site B than Site A which indicates that the site B is more polluted than site A. The diversity of the species in two sites were almost the same. Among all the colonies, colony 3 showed the the best growth when compared to other three colonies. C1 showed maximum growth at site 1. Whereas C2 showed maximum growth rate at site 2. This was done by culturing bacteria in media containing different substrates such as naphthalene, fluorene and carbazole. Some of the bacteria were present in all the culture plates coated with different substrates.

- Identification of Bacteria

The bacteria grown in these media were identified using 16s rDNA PCR and sequencing. The result is shown in Figure 2. We have used two different primers namely F1R1 and F2R2 for this purpose. Based on 16sRNA, we could identify C1(colony 1), C2(colony 2), C3(colony 3) and C4(colony 4) as *Rhodococcus*, *Staphylococcus*, *Micrococcus* and *Bacillus* respectively. The sequence obtained after PCR from the C1 was submitted to NCBI BLAST (nucleotide sequencing). The C1 showed homology to *Rhodococcus*. The same procedure was repeated for the remaining three colonies. The most abundant species at both sites were *Micrococcus*.



**Fig 1:** Bacterial strains isolated grown on A: Fluorine, **Fig 2:** Colony PCR amplification using 16s rRNA

specific primers from isolated bacterial strains

B: Carbazole, C: Naphthalene and D: Nutrient agar

Silmilar results were also reported by Margesin R, Schinner F (1997); Jahir Alam Khan and Syed Hasan Abbas Rizvi (2011); Whyte LG, Bourbonnière L, Greer CW (1997) and Qing X. Li (2009). [5, 3, 7 and 6].

## **CONCLUSION**

Bioremediation is advantageous due to its time and cost saving than physical and chemical method. This would enable us to study the differential ability of the bacteria isolated in this study to degrade polycyclic aromatic hydrocarbons, and which could be used as a bioremedial measure in future. Above all there is a need to reduce the rate of oil pollution in order to effectively protect the flora and fauna of the ecosystems. So future research should be focus on isolation of more microorganisms to degrade pollutants and the technology to develop biofilm from these microbes to protect the aquatic ecosystems.

## **REFERENCES**

- Arpitagupte, sheetalsonawdekar (2015). Study of oil degrading bacteria isolated from oil contaminated sites. *International journal for research in applied science and engineering* vol 3 issue 2, 345-349
- Atlas R.M (1981). Microbial degradation of petroleum hydrocarbons: an environmental perspective. *Microbiological Reviews*. 45 (1):180-209.
- Jahir Alam Khan and Syed Hasan Abbas Rizvi (2011). Isolation and characterization of micro-organism from oil contaminated sites. 2011. *Advances in Applied Science Research*, 2 (3), 455-460.
- Lane D J (1991). 16/23S rRNA sequencing. In *nucleic acid techniques in bacterial systematic*. Wiley; New York, 115–175.
- Margesin R, Schinner F (1997). Efficiency of indigenous and inoculated cold adapted soil microorganisms for biodegradation of diesel oil in Alpine soils. *Applied Environmental Microbiology* 63, 2660-2664.
- Qing X. Li , Jong-Su Seo and Young-SooKeum (2009). Bacterial Degradation of Aromatic Compounds. *Int. J. Environ. Res. Public Health*, 6, 278- 309.
- Whyte LG, Bourbonnière L, Greer CW (1997). Biodegradation of petroleum hydrocarbons by psychrotrophic *Pseudomonas* strains possessing both aAlkane (alk) and naphthalene (nah) catabolic pathways. *Applied Environmental Microbiology* 63, 3719-3723.



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Epidemiological statistics of the past decade reveals high incidental prevalence of the malady of cancer. Rippling effect of this unchartered presence of this illness has evoked mass anxiety of species survival. Traversing the Medical frontiers in the treatment protocol still has not mitigated the pervasiveness of its arbitrary random occurrence. Forewarned is forearmed is the motto that offers stability in "can survive" ethics. Bridging the scientific evidences with literature through a platform of discussion will widen the horizons of awareness and optimism among the populace.

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## CONTENTS

1	EFFECTS OF FAMILY CAREGIVING ON HEALTH AND WELLNESS Grace Paul
2	MERCURY POLLUTION IN INDIA: A REVIEW Dr. T. Geetha
3	STUDIES ON THE TRENDS IN BODY MASS INDEX AMONG TEENAGE GIRLS OF THE SAME AGE GROUP OVER YEARS Dr. Thanuja A Mathew
4	CANCER A SERIOUS TREAT TO MANKIND Freny Jacob
5	A STUDY ON THE THERAPEUTIC BENEFITS OF READING IN RELATION TO DEPRESSION AND WELL BEING Jisna Jose
6	EFFECTS OF SUNSCREEN ON SKIN Litty Irimpan
7	SYNTHESIS AND PHARMACOKINETIC STUDIES ON COORDINATION COMPOUNDS OF CO(II), NI(II), CU(II), ZN(II), CD(II), HG(II), PT(IV) AND PD(II) WITH A HETEROCYCLIC SCHIFF BASE Bincy Joseph
8	MEDICINAL PLANTS FOR BETTER LIVING Dr. Regi Raphael K,
9	CAESALPINIASAPPAN (PATHUMUGHAM) – THE NEUTRACEUTICAL THIRST QUENCHER FOR A HEALTHY SOCIETY DR SR, Meena K Cheruvathur
10	DOMINANCY OF BIOGENIC NANOPARTICLES OVER ITS SYNTHETIC COUNTERPARTS, Kaveen Vadakkan
11	ROLE OF POLYPHENOLS & FLAVONOIDS IN CANCER PREVENTION. Shafna Jose
12	DEFYING SILENCE: A STUDY ON SELECTED VERBAL AND VISUAL NARRATIVES OF CANCER Rehna Mol.S, Dr. Clara B. Reshma
13	SMALL INDIGENOUS FISHES OF RIVERS – ROLE IN FOOD AND NUTRITION SECURITY FOR HEALTHY LIVING, Dalie Dominic A. <sup>A</sup> , Swapna Johny <sup>B</sup>
14	MATHEMATICS IN CANCER RESEARCH Alphy Jose
15	Bamboo – The Natural Healer Dr. Lakshmi C.J.
16	BIOMEDICAL APPLICATIONS OF NANOFLUIDS Rose Paul
17	REDEFINING THE TRAUMATIC ENIGMA OF SELF: A GLIMPSE OF 'MANICHITRATHAZHU' Ms. Rasmi Prahlan
18	CARPE DIEM AS A LIFE FORCE: EXPLORING <i>THE FAULT IN OUR STARS</i> Parvathy C S
19	STEPHEN HAWKING AND ALS: EXPLORING THE PLACEBO EFFECT OF A HOPEFUL PSYCHE IN <i>MY BRIEF HISTORY</i> Nair Anushri Rajasekharan
20	BEYOND THE ONSCREEN ROLE, A ROLE FOR LIFE: AN ANALYSIS OF THE EXPERIENCE AND SURVIVAL OF MANISHA KOIRALA Sherin Kuriakose. V
21	REVIEW ON DISEASES CAUSED ON CLIMATE CHANGE Nimmy M V



## DEFYING SILENCE: A STUDY ON SELECTED VERBAL AND VISUAL NARRATIVES OF CANCER

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In her book, *The Body in Pain*, Elaine Scarry makes the following assertion: "Because the person in pain is ordinarily so bereft of the resources of speech, it is not surprising that the language for pain should sometimes be brought into being by those who are not themselves in pain but who speak on behalf of those who are." (Scarry,4) Needless to say, there is a clear distinction between incipient pain and its last stages, where one's language as well as one's body's stamina are devoid of power and significance, rendered almost, if not completely, unspeakable. While Scarry endeavor is to bring into discussion instances of those who are in pain either in torture or at war, my paper examines the fundamental birth into embodiment through the pain of cancer as experienced by two women: Vivian Bearing in Margaret Edson's play *Wit*, Audre Lorde in *The Cancer Journal*.

What is the connection between medicine and art? As Thomas G. Couser asserts, "The word 'pathography' first caught my attention not in its clinical context, in which it simply refers to writing about illness, but in the context of 'autopathography,' i.e., autobiographical narratives of illness or disability." (Couser,65) For Ellis, during the process of autoethnography, one reveals one's vulnerability, and that is a courageous act because, once we reveal our vulnerability, we cannot "[t]ake back what [we]'ve written," just as we cannot have "[a]ny control over how readers interpret it." (Ellis,738). Finally, since an autoethnography "[i]s an autobiographical genre of writing and research that displays multiple layers of consciousness, connecting the personal to the cultural," (Ellis,739). It helps me to keep focus my motivations and concerns in writing this paper; in order to feel that the other as being part of the community, we should listen to his/her story as experienced in a rather isolated environment, i.e., the hospital. If we do not listen to such stories, then we risk facing the consequences of what I call "cultural loss".

### **Margaret Edson's *Wit***

In *The Body in Pain: The Making and Unmaking of the World*, Elaine Scarry argues, "[w]ork and its artifacts are names that are given to the phenomena of pain and the imagination as they begin to move from being a self-contained loop within the body to becoming the equivalent loop now projected into the external world." (Scarry 170) In Margaret Edson's play *Wit*, the stage is empty, bare. Vivian Bearing--the protagonist--has advanced ovarian cancer. The emptiness of the stage parallels the baldness of the patient, as well as the simplicity of her hospital gowns. They are now parts of who she has become: a stranger to/in her own body. Vivian is completely dependent on the machines (IV poles and others), and on chemically induced treatments. These are the outside markers of her new identity. Her inside identity is challenged, too. According to Sontag, "In cancer, non-intelligent cells are multiplying, and you are being replaced by the non you." (Sontag,66) Can these "non-intelligent cell" completely replace/erase one person's/patient's identity?



The first part puts into spotlight the last days of a woman whose former individuality comes to her through flashbacks, and the protagonist's reactions to her cancer, hospitalization, and the loss of contact with the outside world. Tom Chambers writes that "Ellipses usually occur [...] between periods of entrance into the medical setting. [...] The farther the character goes from the medical world, the greater the chance of ellipses." (Chambers,179) In Vivian's case, the protagonist is not going to get out of the hospital. Her ellipses occur only at the level of her mind when she recollects fragments of her former identity.

who is Vivian? She is a professor specialized in the 17th century poetry, particularly in John Donne's metaphysical poems. Because of her cancer, she is now a student in illness. Furthermore, because her ovarian cancer is in an advanced stage, the doctors propose to her a very drastic

treatment, of which they do not know much, if anything at all. As Vivian sadly admits, "Shrinking in metastatic tumors has not been documented." (Edson,37) Therefore, incapable to still have control over her body, unable to teach her students the beauty and difficulty of Donne's poems, Vivian performs one final role: that of a patient who has been isolated in a cold and mechanized environment, practically forgotten by everybody.

On her deathbed, Vivian says, "I am like a student and this is the final exam and I don't know what to put down because I don't understand the question and I am running out of time." (70) The unwritten, unspoken, yet understood meanings of Vivian's degenerating body, raise the following questions: What is cancer? Does cancer have a meaning? Could we understand cancer other than through the physicality of the one in pain? According to Barbara Rosenblum, *When you have cancer, you are bombarded by sensations from within that are not anchored in meaning. They float in a world without words, without meanings. You do not know from moment to moment whether to call a particular sensation a 'symptom' or 'side effect' or a 'sign.' [...] Words and their referents are uncoupled, uncongealed, no longer connected.* (22)

Cancer almost makes language meaningless. Words like cancerous cells that spread all over one's body are eaten up by silences, interrupted by short sentences, and then continued by some more unbearable silences. I read Vivian's pain and her inevitable death through the signs inscribed on her body: she is bald, "has a central catheter over her left breast, so that the IV tubing goes there, not in her arm," (23) vomits constantly, and has lost considerable weight.

*VIVIAN. In everything I have done, I have been steadfast, resolute-some would say in the extreme. Now, as you can see, I am distinguishing myself in illness. I have survived eight treatments of Hexamethosphacil and Vinplain at the full dose ... I have broken the record. I think Kelekian and Jason [his intern] foresee celebrity status for themselves upon the appearance of the journal article they will no doubt write about me. But I flatter myself. The article will not be about me, it will be about my ovaries.* (24)

What we could infer from this passage is that the one in pain not only succumbs to pain itself eventually (when the body does not have resources to fight against the illness anymore), but also that the body of the ill person is unjustly claimed by the medical staff. After all, Kelekian and his interns will most likely write an article about Vivian's ovaries. Consequently, Vivian is not treated as a whole body. The focus of the doctors' research has switched to her ovaries, thus treating Vivian metonymically.

I think that while medicine tries to find a norm for our bodies, ironically or not, our bodies constantly prove the endeavor futile. We are bodies within bodies. Not one body, but multiple bodiments that change their morphology constantly accompanied by multifarious sense and myriad of reactions. To diagnose someone means to put that person's/patient's illness in one category. However, to treat one him/her means to find a cure for his/her special case. The role of the doctor is to attentively collect and interpret the information received from his/her person/patient. (This information comes to him/her through routine and/or



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sticated clinical tests, dialogues with the persons/patients, and collaborations between a doctor and his/her staff) As it has often been argued, doctors play the role of historians. But, when the events did not happen in the more or less remote past, but are present, then, in a shift of reflexivity, the person/patient becomes a historian. Narrating his/her "presentpast," the person/patient may be willing to do it succinctly or with abundant details, may be able to recollect in depth the events "as they happened," or may not be willing to share too much of his/her sudden invaded intimacy. From history textbooks, we have learned that, if an event has at least two interpretations, then each one claims supremacy over the other. Put differently, when one's body is analyzed by the doctor as

historian and by oneself historian, then inevitably there occurs conflicts in interpreting the events "as they happened." I believe that these conflicts are a pertinent example to show that there are limitations in medicine and the way it views its patients, just as there are limitations in any other science of the humanities. In Edson's Vivian's case, having been diagnosed late in her life, the doctors knew that they would not be able to save her life. Their mistake, however, was to treat Vivian just as a case, and not as a human being. As Leonardo Cassuto points out, "The case study relies on this continuing tension between the abstract (and general) and the concrete (and individual)." (123) But Vivian sadly admits, "Medical terms are less evocative [i.e., than John Donne's metaphysical conceits]. Still, I want to know what the doctors mean when they ... anatomize me. [...] My only defense is the acquisition of vocabulary." (Edson44) Unlike her former fascinating acquisition of Donne's terms such as "ratiocination," "concatenation," "coruscation" which have taken her a lifetime to taste the flavor of their multiple connotations, now Vivian feels not only is she running out of time, but also she is refused a genuine dialogue with her doctors. As she says, "In isolation, I am isolated. For once I can use a term literally." (47) Instead, she regrets the fact of not having been given the opportunity to communicate effectively with the medical staff, and, thus, to understand more things about her cancer. She realizes that there is a more perverse dimension to isolation. She is isolated because her immune system is so low, defenseless, that it may actually attack her body. When she is put in that isolated room, she is literally left alone with her body, which she finally sees more clearly. It is not her body anymore, but something accompanied, surrounded and sustained by an orchestrated set of machines. Ironically, she justifies the existence and meaning of those machines. In other words, the machines could function without Vivian; they could be plugged and unplugged effortlessly, with a simple touch of a button. Sadly, it is Vivian who cannot function without them. This is the ultimate definition of isolation which comes as a shock to her.

Through Vivian's nakedness, Edson may propose a way in which persons/patients could reclaim their personhood. Vivian enters, if not becomes, the invisible yet pervasive light. I could be totally wrong, but for me Vivian's tearing of her hospital gown at the end of the play has positive meanings. Only when she tears them apart, only when she is naked again, can she finally break off the cocoon of her hospitalized identity.

#### **Audre Lorde's *The Cancer Journals***

If Margaret Edson introduced a fictitious character diagnosed with cancer to us, as an example of the enactment of cancer, Audre Lorde's *The Cancer Journals* documents this woman's struggle with cancer. Moreover, if having ovarian cancer is biased on the implication of a total internal affliction, and consequently it is less "effective" for the public eye, breast cancer raises all sorts of questions. The fetishism of the female breast has been construed socioculturally, and should definitely be scrutinized and reflected upon.

Having one breast surgically removed, Lorde finds herself lost, but, at the same time, tries to find persuasive means to communicate her most intimate feelings: "I want to write rage, but all that come is sadness. [...] I am not supposed to exist. I carry death around in my body like a condemnation. But I do live. There must be some way to integrate death into living, neither ignoring it, nor giving in to it." (13) Losing a breast to mastectomy provides an opportunity to dem-



justify the myth that a woman is whole only if she is symmetrical, narrowly understood as having two breasts. As Lorde recollects,

*In September 1978, I went into the hospital for a breast biopsy for the second time. [...] I knew it was malignant. [...] The gong in my brain of 'malignant,' 'malignant,' and the icy sensations of that frigid room, cut through the remnants of anesthesia like a fine hose trained on my brain. (27)*

Prior to finding out whether or not her tumor was malignant, Lorde sensed fear all over her body. Actually, the adjective malignant seems to have spread all over her being, obsessively adding psychical pain to a physical one. According to Scarry, "[t]o have pain is to have certainty; to hear that another person has pain is to have doubt." (Scarry,7) Could we honestly agree with Scarry's point of view? Doesn't it deny our capacity to empathize with the other? All her life, and particularly after discovering her cancer, Lorde tried to express her anxieties and stop these tyrannies of silence." (Lorde,58) As she writes reflecting upon her cancer,

*What I most regretted were my silences. [...] Death is the final silence. And that might be coming quickly, now, without regard whether I had ever spoken what I needed to be said, or had only betrayed myself into small silences, while I planned someday to speak, or waited for someone else to say the words for me. (57)*

Her life took a dramatic turn when she discovered that it could have been saved only if her breast was to be surgically removed. After the surgery, she remembers, "My breast which was no longer there would hurt as if it were squeezed in a vise. [...] The euphoria and the numbing effects of the anesthesia were beginning to subside." (38)

Although after the mastectomy Lorde tried to lift her spirits by making the rather unusual comparison between her situation and that of the Amazon those famous mythological female archers whose one breast was cut to allegedly make them more combative/precise in fights nevertheless she knew she was more than an Amazon. She was a carnal, vibrant, real woman, and not a mythological creature. Furthermore, to her bitter disappointment, she found out that there were few documents related to other women who had lost a breast because of cancer. What happens when women are convinced to wear a prosthesis, and thus fit into a "norm"? In this instance of "normalization," does the hyphenated space of doctor/person/patient bear the marks of scarification and pressure of those aberrant rules that say a woman is a woman only if she has two breasts? As Lorde admits, "To imply to a woman that yes, she can be the 'same' as before surgery, with the skillful application of a little puff of lambswool, and/or silicone gel, is to place an emphasis upon prosthesis which encourages her not to deal with herself as physically and emotionally real, even though altered and traumatized." (39) In addition, "[a]rtificial limbs perform specific tasks, allowing us to manipulate or to walk. Dentures allow us to chew our food. Only false breasts are designed for appearance only." (40) Furthermore, according to Thatcher Carter, "Normalization is the key component in prosthetic breast sales; there is no medical reason to have a prosthetic breast, and the breast is shaped to fit the norms of our society." (71) There are two key words in this succinct, yet powerful passage: "(breast) sales" and "to fit." When women are convinced, after mastectomy, that they should return to "normal," this normality implies not only an integration into consumer society, but also an artificial reconstruction performed on the site of a female body. But how could such a "breast" be considered healthy, when it is artificial?

Finally, as Ellis remarks, "Arthur Frank says in *The Wounded Storyteller* that it is important to think with a story, not just about a story. Thinking with a story means allowing yourself to resonate with the story, reflect on it, become part of it." (66) In other words, thinking with allows us simultaneously to become the author, the character, and the critic of that story viewing ourselves from multiple perspectives, accepting our strengths, and facing our weaknesses. To be human is to cry, laugh, and make time for us and our dear ones. To be human is also to make time to listen to what others have to say/share to/with us. This is the very



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time I let my wounds be printed in an academic journal. I hope my paper becomes inspirational to other women and men "out there," who, most likely, have a story to tell.

#### Works Cited

- Carson, Roland A. "The Hyphenated Space: Liminality in the Doctor/Patient Relationship." *Stories Matter: The Role of Narrative in Medical Ethics*. Ed. Rita Charon. Routledge, 2002. Pp.171-181.
- Chambers, Tom. "What to Expect from an Ethics Case." *Stories and their Limits: Narrative Approaches to Bioethics*. Ed. Hilde Lindemann Nelson. New York: Routledge, 1997: 171-184.
- Couser, Thomas G. "Autobiography: Women, Illness, and Lifewriting." *Auto/biography Studies*, Vol.6,no.1 ,1991,pp 65-75.
- Edson, Margaret. *WIL*. Faber and Faber, 2000
- Ellis, Carolyn and Arthur P. Bochner. "Autoethnography, Personal Narrative, Reflexivity: Researcher as Subject". *Handbook of Qualitative Research*. Eds. N. K. Denzin & Y. S. Lincoln. Thousand Oaks, Sage Publications, Inc., 2000,pp. 733-768.
- Kimmich, Allison. "Writing the Body: From Abject to Subject." *Auto/biography Studies*.vol.13, no.2, 1998,pp. 223-234.
- Lorde, Audre. *The Cancer Journals*. Aunt Lute Books, 1992.
- Scarry, Elaine. *The Body in Pain: The Making and Unmaking of the World*. Oxford UP, 1985.
- Sontag, Susan. *Illness as Metaphor*. Farrar, Straus and Giroux, 1978.



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M. K. SANOO



# Dr PALPU

The Champion of Justice

# **Dr PALPU**

**The Champion of Justice**

**M. K. Sanoo**

Supported by

**Gokulam Gopalan**

Translation

**Radhika P. Menon**



[www.opendoormedia.in](http://www.opendoormedia.in)



Radhika P. Menon retired as Head, Dept of English, Fatima Mata National College, Kollam in 2018.

Her *TALES of ATHIRANIPPADAM* (translation of S. K. Pottekkatt's *Oru DESHATHINTE KATHA*, along with fellow-translator Sreedevi K. Nair) won the prestigious ICWT Award from the University of California, Irvine in 2011. Besides, she has translated Devaki Nilayamgode's *ANTHARJANAM* (OUP, 2011), K. Madhavan's *On the BANKS of the TEJASWINI* (NBT, 2011), S. K. Pottekkatt's *In the LAND of the KAPPIRIS* (CUP, 2015), Moyarath Sankaran's *AUTOBIOGRAPHY of A Freedom Fighter AND MARTYR* (Chinta, 2016), K. Bhaskaran's *A CELEBRATION of Life* (Folio, 2018) and so on. Her translation of N. N. Pillai's *Yours Truly* is forthcoming.

# Contents

Preface

“Palpu’s Vision”

1. A Warrior against Death	11	
2. Unfazed in Crises	20	
3. Pathways to Freedom	34	
4. “We too are Humans”	47	
5. The Ezhava Memorial	58	
6. Efforts to Win Rights Gain Strength	81	
7. Spirituality and Organized Power	96	
8. A Friend of the Humiliated and the Oppressed		106
9. Fresh Air of Freedom in the Family	114	
10. Jail and Field of Service	124	
11. Unbounded Interest	137	
12. The Creative Style of Service	144	
13. Ahead of His Times	161	
14. The Power of the Solitary Man	176	
15. The Last Days	187	
16. Self-sacrifice for the sake of Principles	196	

His intelligence, powers of empathy and visionary zeal were so extraordinary that he stood head and shoulders over most of his contemporaries. But so deep-rooted was his piety that his towering self-confidence was always tempered by respect for fellow-humans. Dr Palpu was a colossus who bestrode the narrow world of his times, without being affected by its pettiness or overwhelmed by self-pride. Spiritual poise was second nature to him, as he went about his life, drawing inspiration from his sattvik mentors, and shouldering responsibilities unbidden, as much to alleviate the misery of others as to elevate the condition of the oppressed.

Prof. M. K. Sanoo's authoritative biography *Dr PALPU The Champion of Justice* is most likely to make the readers remark thus about Dr Palpu: "How noble in reason, how infinite in faculty! In form and moving how express and admirable! In action how like an angel".

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# പ്രവാസ സാഹിത്യം

സമ്പാദനം പഠനം  
ഡോ. എ.എസ്. പ്രതീഷ്

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# പ്രവാസസാഹിത്യം

ഡോ. എ.എസ്. പ്രതീഷ്

സമ്പാദനം പഠനം



കേരള ഭാഷാ ഇൻസ്റ്റിറ്റ്യൂട്ട്  
തിരുവനന്തപുരം

## ഉള്ളടക്കം

അവതാരിക	പേജ് നമ്പർ
പ്രവാസമെന്ന ബഹുവചനം കെ. ജയകുമാർ ഐ.എ.എസ്	xv
ആമുഖപഠനം - 1 പ്രവാസസാഹിത്യം ഡോ. എ.എസ്. പ്രതീഷ്	xix
ആമുഖപഠനം - 2 പ്രവാസരേഖകൾ ഡോ. പി.കെ. രാജശേഖരൻ	xxiv
ആമുഖപഠനം - 3 പ്രവാസത്തിന്റെ പൊരുൾ വി. രാജകൃഷ്ണൻ	xli

## ഭാഗം ഒന്ന് നോവൽ

1. മുറിഞ്ഞുവീണ ഗൗളിവാലുകൾ ഡോ. ആർ. ചന്ദ്രബോസ്	3
2. അവസാനിക്കാത്ത ആടുജീവിതം ഡോ. ജോർജ്ജ് ഓണക്കൂർ	10
3. അപമാനവീകരണത്തിന്റെ ആഖ്യാനാനുഭവം ഡോ. സുനീത ബാബു. വി.എസ്	13
4. ഇരുപത്തിയൊന്നാം നൂറ്റാണ്ടിലെ പ്രവാസം ഡോ. ഡി.വി. അനിൽകുമാർ	21
5. ചട്ടക്കൂടുകൾക്കുള്ളിലെ ഹമാമുകൾ അശ്വനി. എ.പി	29
6. പുത്തുമലരുന്ന നിലയിടങ്ങൾ ദേവിശ്രീ. ജി	39

7.	തക്കാളിത്തോട്ടത്തിലെ ജീവിതയാതനകൾ ഡോ. നീലിമ ജയദേവൻ	47
8.	തലമുറകളുടെ പ്രവാസം അലക്സ് ബാബു	55
9.	കണ്ണനീർ വീണാനന്തര മണൽപ്പുരപ്പുകൾ റീജ. പി	73
10.	കടിയേറ്റജീവിതത്തിന്റെ സ്വത്വസംഘർഷങ്ങൾ സുര്യ ഭാളി. എസ്	80
11.	ദേശങ്ങളിൽ നിന്ന് സ്ഥാനഭ്രഷ്ടരായവർ അശ്വതി. റ്റി.ജി	85
12.	പ്രവാസവും പ്രയാണവും പിന്നെ, അതിജീവനവും ആര്യാരാജ്. ആർ	90
13.	നീതിതേടിയുള്ള യാത്രകൾ സുജ സാവിധി	94
14.	കരിക്കോട്ടക്കരി എന്ന കനാൻദേശം ഹരിത ജി. മോഹൻ	99
15.	വേരുകൾ തേടി ഗ്രാമത്തിലെത്തുന്നവർ ശാജ. ആർ	112
16.	തലമുറകൾ തമ്മിലുള്ള സംഘർഷം ഡോ. ജി.ജി. പി	121
17.	കാലത്തിനു മുന്നിൽ വേഷപ്പകർച്ചയാടുന്നവർ രഞ്ജിനി. എസ്	124
18.	പ്രവാസത്തിന്റെ ജീവപരിസരം ദീപ. എസ്	131

**ഭാഗം രണ്ട്  
ചെറുകഥ**

1.	പ്രവാസാനുഭവവും മലയാളകഥാഭാവനയും ഡോ. ടി. മധു	143
2.	പ്രവാസിയുടെ രാഷ്ട്രീയം ഡോ. ഇ. ബാനർജി	152
3.	ഉയിർന്നൊന്ന് ഉടുവസ്ത്രം തേടുന്നവർ ഡോ. എസ്. അജയലോഷ്	162

4.	നഗരകാനനത്തിലെ പ്രവാസകാലം ഡോ. എസ്. ജയൻ	169
5.	അന്നംതേടുന്ന തൊഴിൽപ്രവാസങ്ങൾ ഡോ. എസ്. ഹേമലാൽ	174
6.	പ്രവാസത്തിന്റെ ജീവിതവ്യാഖ്യാനങ്ങൾ ആർ. രമ്യ	181
7.	കബീറിന്റെ ചിരിയിലെ മൃകഭാഷ്യങ്ങൾ ഡോ. ദീപ്തി. വി.എസ്	186
8.	നിശബ്ദതയാൽ മുറിവേൽപ്പിക്കപ്പെട്ടവർ മൈത മോഹൻ	194
9.	അഹ്റാജിലെ ബഹുസ്വരത സുരാതി മോഹൻ. ജെ	200
10.	മരുഭൂമിയുടെ ഊഷ്മരയിൽ നിന്നും ഇടവപ്പാതിയുടെ കളിരിലേക്ക് സുര്യ ശ്രീധരൻ	206
11.	ചരിത്രത്തിൽ ഇടനിഷേധിക്കപ്പെട്ടവർ സിബി. വി	211
12.	കടൽ കടന്നുപോകുന്നവർ പെരലൻ. എം	215

**ഭാഗം മൂന്ന്  
കവിത**

1.	പ്രവാസികവിത മലയാളത്തിൽ ഡോ. ശിവദാസ് കെ.കെ.	221
2.	ഒടിച്ചുകത്തിച്ചെടിയുടെ വിഹലതകൾ ഡോ. എം.എസ്. സുചിത്ര	234
3.	വീട്ടിലേക്കു പോകുന്നവർ ഐശ്വര്യ മാധവൻ	239
4.	പ്രവാസവും സ്വത്വനഷ്ടവും ഗീതു. പി.ജി	246
5.	കവിതയിലെ പ്രവാസകാലം രോഷ്ണി. എം	253



**ഭാഗം നാല്  
തിരക്കഥ**

1. മലയാളസിനിമയും പ്രവാസസ്വതന്ത്രപ്രതിസന്ധിയും രേഖ. എസ്	265
2. പ്രവാസജീവിതത്തിന്റെ നേർക്കാഴ്ചകൾ കിരൺ മോഹൻ. എം	272
3. പെൺപ്രവാസം മലയാളസിനിമയിൽ കവിത. സി.കെ	277
4. പ്രവാസി തൊഴിൽസംസ്കാരം അജി. ഡി	284
5. സ്വപ്നങ്ങൾ വിൽക്കുന്നവർ ഐശ്വര്യ. എ	289
6. പ്രവാസജീവിതം പത്തേഴായിൽ പെടീഷ്യ ജോൺ	295
7. മലയാളിയുടെ ഗൾഫ്കടിയേറ്റം രാജേഷ്. ആർ	299

**ഭാഗം അഞ്ച്  
ചലച്ചിത്രഗാനങ്ങൾ**

1. പ്രവാസജീവിതവിഷ്കാരം മലയാളചലച്ചിത്രഗാനങ്ങളിൽ കൃഷ്ണപ്രിയ. ആർ.വി	307
--	-----

**ഭാഗം ആറ്  
നാടകം**

1. സ്വത്വം നഷ്ടപ്പെടുന്നവർ സതീഷ് ജി. നായർ	315
--	-----

**ഭാഗം ഏഴ്  
ഓർമ്മക്കുറിപ്പുകൾ**

1. ജീവിതഗന്ധിയായ സൊറകൾ ആഷിത എസ്. ഷാബു	323
--	-----

2. പ്രവാസിയുടെ ഓർമ്മക്കുറിപ്പുകൾ അശ്വതി. എം.സി	327
3. വേരുകളില്ലാത്ത പാഴ്വരങ്ങൾ ലീയ. ജെ	333
4. പ്രവാസമെന്ന ദുരിതദ്രമിക അരുൺ. ജെ.ജി	336

**ഭാഗം എട്ട്  
സഞ്ചാരസാഹിത്യം**

1. കാപ്പിരികളുടെ നാട്ടിലെ ഇന്ത്യാക്കാർ ജി.എസ്	347
2. മലയാളികളുടെ അറബ്ജീവിതം ഷിഹാബി. കെ.എസ്	351

**ഭാഗം ഒൻപത്  
സംസ്കാരം**

1. സംസ്കാരം പ്രവാസി രചനകളിൽ ഡോ. സീമാ ജെറോം	361
2. ദേശം ഒരു കഥയെഴുതുന്നു ശ്രീല. എസ്	373

**ഭാഗം പത്ത്  
ഇതിഹാസങ്ങൾ**

1. ഇതിഹാസകൃതികളിലെ പ്രവാസം ഡോ. സുഷമകുമാരി. എസ്	381
2. ബൈബിൾ: പ്രവാസജീവിതവിഷ്കാരങ്ങളുടെ അക്ഷയഖനി എബി എം. അലക്സ്	388

**ഭാഗം പതിനൊന്ന്  
ഫെയ്സ്ബുക്ക്/ബ്ലോഗ്**

1. പ്രവാസം ഫെയ്സ്ബുക്ക് സാഹിത്യത്തിൽ സംഗീത് മാത്യു	399
2. ബ്ലോഗെഴുത്തിലെ പ്രവാസം അന ജെയിംസ്	409

# മുറിഞ്ഞുവീണ ഗൗളിവാലുകൾ പ്രവാസത്തിന്റെ അനുഭൂതിചരിത്രം

ഡോ. ആർ. ചന്ദ്രബോസ്

## പ്രവാസവും ആധുനികതയും

മലയാളികളുടെ അനുഭൂതിചരിത്രത്തിൽ പ്രവാസം മുറിഞ്ഞുപോയ ഗൗളിവാൽപോലെ പിടഞ്ഞു നിശ്ചലമായ ഓർമകളാണ്. ആ ഓർമകളെക്കൂടി രേഖപ്പെടുത്തിയാലേ നമ്മുടെ സാംസ്കാരികചരിത്രം പൂർണ്ണമാവുകയുള്ളൂ. പ്രവാസത്തിന്റെയും അത് സൃഷ്ടിച്ച സങ്കീർണ്ണങ്ങളായ വൈകാരിക പ്രശ്നങ്ങളുടെയും നൂറ്റാണ്ടായിരുന്നു ഇരുപതാംനൂറ്റാണ്ട്. വിവരസാങ്കേതിക സംവിധാനങ്ങളുടെ വർത്തമാനകാലത്ത് പ്രതീതിയാമാർദ്ദങ്ങളുടെ പ്രതലങ്ങളിൽ പ്രവാസം അതിന്റെ വൈകാരികഭാവങ്ങൾ ഇറക്കിവെച്ച് ഇളവേല്ക്കുന്നുണ്ട്. എന്നാൽ കഴിഞ്ഞ നൂറ്റാണ്ടിൽ പ്രവാസത്തിലേക്ക് റെയിലേറിപ്പോയവരും കപ്പലേറിപ്പോയവരുമായ നമ്മുടെ മുൻതലമുറകൾക്ക് അത് അനിശ്ചിതത്വങ്ങളിലേക്കുള്ള യാത്രകളായിരുന്നു.

നമ്മുടെ സമൂഹത്തെ പരിഷ്കാരത്തിലേക്കും ആധുനികതയിലേക്കും വളർത്തിയതിൽ നവോത്ഥാനമുന്നേറ്റങ്ങളും പുരോഗമനപ്രസ്ഥാനങ്ങളും വഹിച്ച പങ്കുപോലെതന്നെ പ്രധാനമാണ് പ്രവാസികളുടെ ഭൗതികവും ബൗദ്ധികവുമായ നീക്ഷേപങ്ങൾക്കുമുള്ളത്. കോളോണിയൽ ആധുനികത കൊണ്ടുവന്ന ഗതാഗതസൗകര്യങ്ങളും നഗരകേന്ദ്രിത വിദ്യാഭ്യാസ സൗകര്യങ്ങളും പത്തൊൻപതാം നൂറ്റാണ്ടിന്റെ അവസാനദശകങ്ങളിൽ ഫ്യൂഡൽ കുടുംബങ്ങളിലെ ചില ധിഷണശാലികളെ വിലക്കുകളുടെ 'കോരപ്പുകൾ' മുറിച്ചുകടന്ന് വിജ്ഞാനനഗരങ്ങളിലേക്ക് പോകാൻ പ്രേരിപ്പിച്ചിരുന്നു. മലബാറിൽ നിന്ന് സൈദാപേട്ട കാർഷികകോളേജിൽ കൃഷിശാസ്ത്രം പഠിക്കാൻ വേങ്ങയിൽ കുഞ്ഞിരാമൻ നായനാർ എന്ന ജന്മിത്തമ്പുരാൻപോയത് ചരിത്രമാണ്. മലബാർ കളക്ടറായിരുന്ന ലോഗൻസായ്യാണ് ആധുനികമായ അറിവിന്റെ ലോകത്തേക്ക് നായനാറെ പറഞ്ഞെച്ചതത്രേ. ഏതായാലും വിദ്യാർജ്ജനത്തിനായുള്ള പ്രവാസശേഷം തിരികെ വന്ന നായനാർ മലബാറിൽ പുത്തൻ കാർഷികസംസ്കാരത്തിനും മലയാളസാഹിത്യത്തിൽ ചെറുകഥയ്ക്കും വിതയൊരുക്കി. അങ്ങനെ ആധുനികതയിലേക്കുള്ള മലയാളി

# പ്രവാസമെന്ന ദൂരിതദ്രമിക

അരുൺ ജെ.ജി.

അനന്യതാ തുടരുന്ന ജീവിതപ്രക്രിയയും അർഥപരിവർത്തനം സാധ്യമായ ജീവിതാവസ്ഥയുമാണ് പ്രവാസം. അതിന് പ്രയാണം, പ്രവർത്തനം, പരിവർത്തനം എന്നിങ്ങനെ മൂന്നവസ്ഥകളുണ്ട്. സ്വന്തം ദേശം വിട്ടുപാകുന്നതിനായോ തൊഴിലിനായോ നാടുകടത്തപ്പെട്ടോ മറ്റൊരു നാട്ടിലേയ്ക്കു തുണയായാണ് പ്രയാണം. അവിടെ ജീവിതം കരപിടിപ്പിക്കുന്നതിനായി അയാൾ നടത്തുന്ന യത്നമാണ് പ്രവർത്തനം. ആ പ്രവർത്തനത്തിലൂടെ അയാൾക്കും ചുറ്റുപാടുകൾക്കുമുണ്ടാകുന്ന മാറ്റമാണ് പരിവർത്തനം. പ്രവാസിയുടെ ഈ മൂന്നവസ്ഥകളിലൂടെയുള്ള സഞ്ചാരമാണ് പ്രവാസരചനകൾ.

രാഷ്ട്രീയമായി നാടുകടത്തപ്പെടുന്നവരുടെ ജീവചരിത്രവും രാഷ്ട്രീയമായി ചരിത്രവുമായിരുന്നു ആദ്യകാല പ്രവാസരചനകളെങ്കിൽ ഇപ്പോഴത് എല്ലാത്തരത്തിലുമുള്ള മാനുഷികപ്രവർത്തനങ്ങളുടേയും താല്പര്യങ്ങളുടേതുമായി മാറിയിട്ടുണ്ട്. ഉപജീവനാർത്ഥമുള്ള കടിയേറ്റം സ്വമേധയാലോ നിർബന്ധിതത്വത്തിനാലോ ഉണ്ടായ ദേശാന്തരണമാണ്.

പ്രവാസസാഹിത്യമെന്നാൽ ലിറ്ററേച്ചർ ഇൻ എക്സ്പാട്രിയേഷൻ. ഡയസ്പോറാലിറ്ററേച്ചർ എന്നും ഇതിന് പേരുണ്ട്. ലിറ്ററേച്ചർ ഇൻ എക്സ്പാട്രിയേഷൻ പറയുന്നത് രാഷ്ട്രീയരചനകളാണ്. രാഷ്ട്രീയ കാരണങ്ങളാൽ നാടുകടത്തപ്പെട്ടവരോ ജന്മനാടുപേക്ഷിച്ച് അന്യരാജ്യങ്ങളിൽ അഭയാർത്ഥികളായവരോ എഴുതുന്ന സാഹിത്യമാണ് ഇത്. സൽമാൻ റുഷ്ദി, തസ്ലീമ നസ്രിൻ, ദലൈലാമ, സോൾഷേനിറ്റ്സ് തുടങ്ങിയവരെക്കൊഴിവാക്കി എഴുതുന്ന അനഭവ സാഹിത്യം ലിറ്ററേച്ചർ ഇൻ എക്സ്പാട്രിയേഷൻ. ഇവർക്കൊക്കെ ഉണ്ടായ പീഡാനുഭവങ്ങളെ ദൂരിതപരിവർത്തനങ്ങളോ ഇന്ത്യൻ എഴുത്തുകാർക്ക് പ്രത്യേകിച്ച് മലയാളി എഴുത്തുകാർക്കുണ്ടായിട്ടില്ല. അന്ധമായ മതവിശ്വാസമോ കക്ഷിരാഷ്ട്രീയവിശ്വാസമോ ഉയർത്തുന്ന ഏതാനും ചില ഭീഷണികൾ ഉണ്ടെന്നതൊഴിച്ചാൽ ഇന്ത്യൻ സാഹചര്യങ്ങളിൽ എഴുത്തുകാർ ആവിഷ്കാര സ്വാതന്ത്ര്യമുള്ളവരാണ്. അതുകൊണ്ടുതന്നെ ലിറ്ററേച്ചർ ഇൻ എക്സ്പാട്രിയേഷൻ ഇന്ത്യൻ സാഹചര്യങ്ങളിൽ കുറവെന്നു പറയാം. ഇന്ത്യയിലുള്ളത് ലിറ്ററേച്ചർ ഇൻ എക്സ്പാട്രിയേഷൻ (Literature in expatriation) ആണ്. എക്സ്പാട്രിയേഷൻ എന്നതിനർത്ഥം ദേശബഹിഷ്കരണം, അന്യനാട്ടിൽ പോയി വസിക്കൽ അന്യനാട്ടിൽ പോയി താമസിക്കൽ എന്നൊക്കെയാണ്. എക്സ്പാട്രിയേഷൻ പ്രവാസമെന്നും അന്യനാട്ടിൽ പോയി താമസിക്കലെന്നും ദേശബഹിഷ്കരണമെന്നും അർത്ഥമുണ്ട്. തൊഴിലിനായോ മെച്ചപ്പെട്ട ജീവിതസാഹചര്യങ്ങൾ തേടിയോ വിദേശങ്ങളിൽ പോയവരാണ് ഇത്തരം എഴുത്തുകൾ നടത്തുന്നത്.

ദേശപൗരത്വം എന്ന ക്ലാസ്സിക്ക് ആശയത്തെ പ്രശ്നവല്പരമാക്കി നാടും വിട്ടുമാറ്റിയെടുത്ത അലയുന്ന ജനവിഭാഗത്തിന്റെ വിഹവലതകളും യേശുദാ കളും അവതരിപ്പിച്ചവരാണ് വി.എസ്. നൈപാൾ, സൽമാൻ റുഷ്ദി, തസ്ലീമ നസ്രിൻ തുടങ്ങിയവർ. അതുകൊണ്ടു തന്നെ ഇവരുടെ പ്രവാസ എഴുത്തുകൾ ദേശാന്തർത്തിയില്ലാത്ത ലോകപൗരത്വം എന്ന ആശയത്തെ പ്രതിനിധീകരിക്കുന്നു. എന്നാൽ ഈ വക പ്രശ്നങ്ങളൊന്നും ഇന്ത്യൻ പ്രവാസ എഴുത്തുകാരിൽ കാണാനാകില്ല. പുതിയ ഇന്ത്യൻ സാഹചര്യങ്ങളിൽ ഇവിടുത്തെ പ്രവാസ എഴുത്തുകാരിൽ രണ്ടുതരം ഭാവനാവിഷ്കാരങ്ങൾ കാണാനാകും.

അതിൽ ആദ്യത്തേത് ജീവിതത്തിന്റെ കറച്ചുകാലം ഇന്ത്യയിൽ ജീവിച്ച ശേഷം പിന്നീട് പുറം നാടുകളിൽ ചേക്കേറിയവർ എഴുതിയ സാഹിത്യമാണ്. ഗ്രഹാന്തരസഞ്ചാരങ്ങളും അനുഭവങ്ങളും പ്രവാസജീവിതകാലത്തെ ദൂരിതങ്ങളും കൊണ്ട് സമ്പന്നമാണ് ഇത്തരം രചനകൾ. ഒറ്റപ്പെട്ടലിൽ വേദനിക്കുന്നവരുടെ അവസ്ഥകളോ അനുഭവങ്ങളോ പ്രവാസജീവിതകാലത്ത് നേരിടുന്ന പൗരത്വപ്രശ്നങ്ങളോ ഒക്കെയായിരിക്കും ഇത്തരം എഴുത്തിൽ കാണുക. ഗൾഫ്നാടുകളിലെയും യൂറോപ്യൻ നാടുകളിലെയും പ്രവാസികളുടെ എഴുത്താവിഷ്കാരങ്ങൾ ഈ ഗണത്തിൽപ്പെടുന്നവയാണ്. രണ്ടാമത്തേത് വിദേശത്തു തന്നെ ജനിച്ചവർക്ക് ആത്മദേശത്തിന്റെ നാഡിസ്പന്ദനങ്ങളറിയാതെ സർഗ്ഗാവിഷ്കാരങ്ങളിൽ ഇടപെടുന്നവരുടേതാണ്. അമ്മഭാഷയും തായ്നാടും എന്നെന്നേക്കുമായ വേദന വെളിപാടുമായില്ലാത്തവന്റെ ഇരട്ട മനോഭാവം ഇത്തരം രചനകളിൽ കാണാം.

മലയാളികളുടെ പ്രവാസജീവിതത്തിന് ഏകദേശം ഒരു നൂറ്റാണ്ടുകാലത്തെ പഴക്കമുണ്ട്. എന്നാൽ സിലോണിലോ ബർമയിലോ സിംഗപ്പൂരിലോ എത്തപ്പെട്ട ആദ്യകാല പ്രവാസികളൊന്നും തന്നെ തങ്ങളുടേതായ അനുഭവങ്ങളോ സാഹിത്യങ്ങളോ എഴുതിയില്ല. ജന്മനാട്ടിൽ വസിച്ച മലയാളികളും അവരെപ്പറ്റി എഴുതിയില്ല. വിദേശാനുഭവങ്ങളെയും ജീവിതത്തെയും മലയാളിയു മുന്നിൽ ആദ്യമായി എത്തിച്ചത് യാത്രാവിവരണഗ്രന്ഥങ്ങളായിരുന്നു. എന്നാൽ അവയൊന്നും പൂർണ്ണമായ അർത്ഥത്തിൽ പ്രവാസസാഹിത്യമാണെന്നു പറയുവാൻ സാധിക്കില്ല. പ്രവാസത്തെ നാഗരിക യാഥാർത്ഥ്യവുമായി കൂട്ടിയോജിപ്പിച്ചുകൊണ്ട് അവതരിപ്പിച്ച ആനന്ദിന്റെ 'അപഹരിക്കപ്പെട്ട ദൈവങ്ങൾ' (2001), മലയാളികളുടെ തൊഴിൽ തേടിയുള്ള പ്രയാണങ്ങളെ ദൃശ്യവൽക്കരിച്ച എ. മുക്തന്റെ 'പ്രവാസം' (2008) എണ്ണപ്പെടാത്ത നാക

യാഥാർത്ഥ്യങ്ങളെ പച്ചയായി അവതരിപ്പിച്ച ബെന്യാമിന്റെ 'ആട്ടജീവിതം' എന്നിവയൊക്കെ ശ്രദ്ധേയമായ പ്രവാസരചനകളാണ്. അമ്മട്ടത്തിൽ ഉൾപ്പെടുത്താവുന്ന ഒന്നാണ് പത്രപ്രവർത്തകനും എഴുത്തുകാരനുമായ കൃഷ്ണദാസ്സിന്റെ 'ദുബായ്പ്പഴ'. മരുഭൂമികൾ എങ്ങനെയാണ് ഉണ്ടാകുന്നതെന്ന് എഴുത്തുകാർ പലതരത്തിലും പറഞ്ഞിട്ടുണ്ട്. എന്നാൽ മരുഭൂമി മനുഷ്യനോട് എന്തൊക്കെ ചെയ്യുന്നു എന്ന് അധികം പേരും പറഞ്ഞിട്ടില്ല. മരുഭൂമിയിലെ തണുപ്പുപറ്റുന്ന മനുഷ്യനോട് അവിടം എങ്ങനെയാണ് സംവദിക്കുന്നതെന്ന് പറയുകയാണ് 'ദുബായ്പ്പഴ'യിലൂടെ കൃഷ്ണദാസ് ചെയ്യുന്നത്.

**ഗൃഹാതുരസ്മരണകൾക്ക് ആശ്വാസമാകുന്ന പ്രവാസം**

മെമ്മറിസ് ഓഫ് എക്സ്പാടിയേഷൻ എന്ന വിഭാഗത്തിലാണ് 'ദുബായ്പ്പഴ'യെ കൃഷ്ണദാസ് ഉൾപ്പെടുത്തിയിരിക്കുന്നത്. ഈ കൃതി ആരംഭിക്കുന്നത് ഒരു വഞ്ചിയിലിരുന്ന് ഗോപുരങ്ങളെ നോക്കിക്കാണുന്ന രണ്ടു മനുഷ്യരുടെ ചിത്രവുമായിട്ടാണ്. അവിടെ എഴുത്തുകാരൻ കുറിച്ചിട്ടുന്നത് ഇങ്ങനെ: 'പ്രവാസത്തിന്റെ അനാഥത്വം തികച്ചിരുന്നപ്പോഴൊക്കെ സാത്ത്യാനമേകാൻ ദുബായ്പ്പഴ ഉണ്ടായിരുന്നു.' ഗൃഹാതുരാനുഭവങ്ങൾ നിറഞ്ഞ ജീവിതത്തിന്റെ ഓർമ്മകളിലേക്കാണ് ഈ പഴ അവരെകൊണ്ടു പോകുന്നത്. മനുഷ്യരുടെ ശബ്ദങ്ങളും പറവുകളുടെ കരച്ചിലും പഴയുടെ കോലാഹലങ്ങളുമൊക്കെ തന്നെ കേൾക്കുന്ന ജീവിതത്തിന്റെ ചലനാത്മക താളങ്ങളിലേക്കാണ് അവരെ നയിക്കുന്നത്. അകലങ്ങളിലിരിക്കുന്ന നാടും നാട്ടാരും ബന്ധങ്ങളും പ്രവാസിയെ സംബന്ധിച്ച് കളിത്തളള ഓർമ്മകളാണ്. ആ ഓർമ്മകളിലാണ് പ്രവാസജീവിതത്തിലെ നൊമ്പരങ്ങൾ അവൻ മറക്കുന്നത്. നാടും നാട്ടുകാരും നാട്ടുവർത്തമാനങ്ങളും ചായക്കടകളിലെ സൊറപറച്ചിലുകളും ഉത്സവഘോഷങ്ങളും പഴയും കടലുമെല്ലാം മറ്റാരുടെയും ജീവിതത്തിലുള്ളതിനേക്കാൾ നിറഞ്ഞു നിൽക്കുന്നത് പ്രവാസിയുടെ ഓർമ്മകളിലാണ്.

വർഷങ്ങൾക്കുശേഷം ദുബായിൽ വീണ്ടുമെത്തുന്ന എഴുത്തുകാരന്റെ ഓർമ്മകളിലൂടെയാണ് 'ദുബായ്പ്പഴ' മുന്നോട്ടുപോകുന്നത്. 'എല്ലാം ഇന്ന് ഓർമ്മകളുടെ കലവറകളിലെ സംഭരണികൾ മാത്രം' എന്നു കൃഷ്ണദാസ് കുറിച്ചിട്ടുണ്ട്. ദുബായ്ക്ക് സംഭവിച്ച മാറ്റം എഴുത്തുകാരനെ അത്ഭുതപ്പെടുത്തുന്നു. നാടിന്റെ സൂതികൾക്കൊപ്പം പഴയകാല ദുബായ് ജീവിതത്തിന്റെ തന്നെ ഗൃഹാതുരസ്മരണകൾ ഉണർത്തുന്നു. ഇന്ത്യ, പാകിസ്ഥാൻ, അഫ്ഗാനിസ്ഥാൻ, ഇറാൻ തുടങ്ങിയ ദേശങ്ങളിൽ നിന്നും പത്തേമാരികളിൽ കയറി എണ്ണഖനികൾ തേടി ദുബായിൽ എത്തിയവരായിരുന്നു ആദ്യകാല പ്രവാസികളെന്ന് എഴുത്തുകാരൻ സ്മരിക്കുന്നു. അങ്ങനെയെത്തിയ അഭയാർഥികളോട് ദയാദാക്ഷിണ്യങ്ങളോടെയാണ് അക്കാലത്തെ തദ്ദേശവാസികളും അധികാരികളും പെരുമാറിയത്. കൃഷ്ണദാസ് എഴുതുന്നു. 'പട്ടണത്തിന്റെ തെരുവുകളിൽ ദിശാ

ബോധമില്ലാതെ അലയുന്ന ഭാഗ്യാന്വേഷികളോട് അധികാരികളെന്നും അനുകമ്പയോടു മാത്രം പെരുമാറി അക്കാലത്തെ അധികാരികളും ഗൾഫ് നിവാസികളും കാട്ടിയ കാരുണ്യം പ്രവാസികളെ സംബന്ധിച്ച് രക്ഷമാർഗ്ഗമായിരുന്നു. ഇന്നത്തെപ്പോലെ വിമാനസർവീസുകളോ സൗകര്യങ്ങളോ ഒന്നും അക്കാലത്ത് യാത്രാസൗകര്യമായി ഉണ്ടായിരുന്നില്ല. പത്തേമാരികളിൽ കയറി പട്ടണിയും പരിവട്ടവുമായി ദുബായ് തിരത്ത് ഇറങ്ങുമ്പോൾ തങ്ങൾക്ക് പരിചിതമില്ലാത്ത ജനപദങ്ങളിൽ കൂടി നടക്കുമ്പോൾ പുതിയ മണ്ണും ഭാഷയും ഗന്ധവും പരിചയിക്കുമ്പോൾ അവരുടെ ലക്ഷ്യം കൊടുംപട്ടിണിയിൽ നിന്നും ദാരിദ്ര്യത്തിൽ നിന്നും കടുംബത്തെ കരകയറ്റുക എന്നതായിരുന്നു. അവിടെ അവർക്കു കൂട്ടം കൂടുമായിരുന്നത് നാടിനെപ്പറ്റിയുള്ള ഓർമ്മകളും തദ്ദേശവാസികളുടെ സഹായഹസ്തങ്ങളുമായിരുന്നു. മെച്ചപ്പെട്ട ജീവിതസാഹചര്യങ്ങളുണ്ടാക്കുവാൻ ഗൾഫ്നാടുകളിൽ എത്തുന്ന സമകാലിക മലയാളിയുടെ ജീവിതസാഹചര്യമായിരുന്നില്ല അന്നുണ്ടായിരുന്നത്. ജീവിതത്തിന്റെ അവസ്ഥയും അവസ്ഥാന്തരങ്ങളും കൊണ്ട് പരിക്കിണിത്തം അവശമായിരുന്ന അഭയാർഥികൾക്ക് ആശ്വഹൃത്യ ഒരു രക്ഷയാണെന്നു പോലും തോന്നിയിരുന്നു. പട്ടണിയാൽ വലഞ്ഞ അവർക്ക് കൂട്ടായി ഇരുന്നത് റംസാൻ മാസത്തിന്റെ കാരുണ്യമായിരുന്നെന്ന് കൃഷ്ണദാസ് പറയുമ്പോഴാണ് ദാരിദ്ര്യവും അലച്ചിലും പിടിച്ചുറങ്ങിയ പ്രവാസിയുടെ നൊമ്പരം മനസ്സിലാക്കാൻ സാധിക്കുക.

കൃത്യമായി ജോലിയോ വിസയോ ഇല്ലാതിരുന്നവരെ തദ്ദേശവാസികൾക്കൊപ്പം അവിടെ എത്തിയ പ്രവാസികളും സഹായിച്ചു. കൃഷ്ണദാസിന്റെ ഗൃഹാതുരസ്മരണകളിൽ അതുണ്ട്. 'ഇന്ന് തിരിഞ്ഞുനോക്കുമ്പോൾ ജീവിതത്തിന്റെ നിശ്ചലമായ പാതകളിൽ കണ്ടെത്തുകയും തിരോടവിക്കുകയും ചെയ്ത അജ്ഞാതരായ മനുഷ്യരെ ഓർത്ത് ശിരസ്സു കുനിയുന്നു. പലവ്യഞ്ജനങ്ങളും അരിയും ദുബായിലേക്കുള്ള ട്രാക്റ്റിങ്ങിലും തന്ന് സഹായിച്ച ഹംസ, കൽബയിലെ ഇരുട്ടിൻ അയാളെ കൈപിടിച്ചു കൊണ്ടുപോയ ചന്ദ്രേട്ടൻ, ഏതോ ലോകത്തിൽ നിന്നും കരുണയുടെ കനിവുമായിവന്ന ഒരു ഹാജിയാദ് പ്രവാസജീവിതത്തിനിടയിൽ താങ്ങും തണലുമായി ഇത്തരത്തിൽ പലമുണ്ടായിരുന്നു. അത്തരം പരസ്പരാശ്രിത തലമായിരുന്ന പ്രവാസിയുടെ കരുത്ത്. നാട്ടിലേക്കു പോകുമ്പോഴും തിരികെ വരുമ്പോഴും കടം വാങ്ങുകയും കൊടുക്കുകയും ചെയ്തു കൊണ്ട് ഓരോ പ്രവാസിയും പരസ്പരം ഉറന്നുവെക്കുകയായി. ഇത്തരം തുണയ്ക്കലുകൾ ഒരു പ്രവാസിയെ സംബന്ധിച്ചിടത്തോളം ശക്തമായ ഗൃഹാതുരസ്മരണതന്നെയാണ്.

കൃഷ്ണദാസിന്റെ ഗൃഹാതുരസ്മരണകളിൽ പഴയകാലഗൾഫ് ജീവിതവും നാടിനെപ്പറ്റിയുള്ള ഓർമ്മകളും പത്തുമാറ്റ് തിളക്കത്തോടെ ശോഭിക്കുന്നു. അതു വായനക്കാരനെ ജീവിതമെന്ന മഹാസമസ്തയിലേക്ക് കൂട്ടിക്കൊണ്ടു പോകുന്നു.

### പ്രവാസജീവിതമെന്ന ദുരിതഭൂമി

ഗൃഹാതുരസ്മരണകൾക്കൊപ്പം തന്നെ പ്രവാസജീവിതത്തിന്റെ ദുരിതങ്ങളെയും കഷ്ടപ്പാടുകളെയും 'ദബായ്'പ്പുഴയിൽ കാണാനാകും. നല്ലൊരു നൂതനലേക്ക് യാത്രചെയ്യുമ്പോൾ പലപ്പോഴും കൂട്ടായിരുന്നത് പട്ടിണിയും ദാരിദ്ര്യവും രോഗങ്ങളുമൊക്കെയായിരുന്നു. ദിശതെറ്റിയ പത്തേമാരിയിൽ ദിവസങ്ങളോളം പട്ടിണികിടന്നവന്റെ നൊമ്പരത്തെപ്പറ്റിയും ദൈന്യതയെപ്പറ്റിയും കൃഷ്ണദാസ് പറയുന്നതിങ്ങനെ: 'ദാഹവും വിശപ്പും ദാരിദ്ര്യവും അയാൾ ലേക്കും ആർത്തിയിൽ നിന്ന് പൈശാചികതയിലേക്കുമുള്ള നാഴികകളെപ്പോലെ വിദൂരമല്ലെന്ന് അയാൾ തിരിച്ചറിഞ്ഞു. നിസ്സഹായനായ മനുഷ്യന്റെ മരണവെപ്രാളവും അയാൾ ആ യാത്രയിൽ കണ്ടു. ദേവന്മാർക്കും പ്രവാചകന്മാർക്കും കാണിക്കുകൾ നേർന്നുകൊണ്ട് അവർ വാവിട്ടു കരഞ്ഞു. തിരങ്ങളിലിരുന്ന് പലതവണ ആസ്വദിച്ച അറബിക്കടലിന്റെ സൗന്ദര്യം അപ്പോൾ അയാൾ മറന്നുകഴിഞ്ഞിരുന്നു. കടൽ അയാൾക്ക് ഒരു പേടിസ്വപ്നമായി. പിൽക്കാലത്ത് കടൽ ഒരു ആരണ്യകമാണെന്ന് അയാൾ സ്മൃതയുടെ കൈയ്യിൽ. പ്രവാസജീവിതം നൽകുന്ന ദുരിതവും ദുരന്തവും എത്രമാത്രം മനുഷ്യനെ പീഡിതനാക്കുന്നുവെന്നതിന് ഇതിൽപ്പരം സാക്ഷ്യമില്ല. ജോലിയോ ജീവിതമോ കിട്ടാതെയലഞ്ഞ, ഗൃഹാതുരസ്മരണകളുടെ സാന്ത്വനം നഷ്ടപ്പെട്ട പ്രവാസിയുടെ നൊമ്പരവും നിസ്സഹായതയും നിലവിലിയുമാണിവിടെയുള്ളത്. തൊഴിലും പണവുമായിരുന്നു അവർ നേരിട്ട പ്രധാനപ്രശ്നം. അതില്ലാതെവന്നപ്പോൾ ജീവിതം ഒരു ബാധ്യതയാണെന്ന് അവർക്ക് തോന്നി. അതിനെ അതിജീവിക്കാനാവാതെ വന്ന രവിന്ദ്രനെപ്പോലുള്ളവർ ആത്മഹത്യയ്ക്ക് ശ്രമിച്ചു. ചിലർ നാടുവിട്ടു, ചിലർ നാട്ടിലേക്കു തന്നെ മടങ്ങിപ്പോയി എന്ന് കൃഷ്ണദാസ് കുറിച്ചിട്ടുണ്ട് ചോരകൊണ്ടെഴുതിയ അനുഭവങ്ങളാലാണ്. പ്രവാസമെന്ന ദുരിതഭൂമിയുടെ സാക്ഷ്യപത്രങ്ങളാണിവ.

പ്രവാസം തീക്ഷ്ണമായ ഒരു സാംസ്കാരികാനുഭവമാണ്. അത് ഒരു സ്വത്വപ്രശ്നം തന്നെയാണ് 'ഭൂപടത്തിൽ എവിടെയാണെന്നു തിട്ടമില്ലാത്ത സ്വപ്നദേശങ്ങളിലേക്ക് ഒരു നിശ്ചയവുമില്ലാതിരുന്നിട്ടും പുറപ്പെട്ടവരാണ് ആദ്യകാല ഗൾഫ് കടിയേറ്റത്തിന് മുതിർന്ന മലയാളികൾ, 1950കളുടെ ഒടുവിലും 60-കളിലും ഗൾഫ് നഗരങ്ങളിൽ എത്തിച്ചേർന്നവരാണ്. അൻപതുകളിലും അറുപതുകളിലും എഴുപതുകളിലുമൊക്കെ ഗൾഫിൽ എത്തപ്പെട്ടവർ മെച്ചപ്പെട്ട ജീവിതമായിരുന്നു സ്വപ്നം കണ്ടത്. ദുരിതങ്ങളിൽ നിന്നു കിടംബത്തെ കരകയറ്റുകയായിരുന്നു അവരുടെ ലക്ഷ്യം. എന്നാൽ തൊഴിൽ കണ്ടെത്താനാവാതെ വിസയും അക്കാമയുമൊന്നുമില്ലാതെ അവർക്ക് അലഞ്ഞുതിരിയേണ്ടിവന്നു. മുഴുപ്പട്ടിണിയും ജീവിതത്തെപ്പറ്റിയുള്ള ഭയവും അവരെ

വെട്ടയാടി. 'ബദാമരങ്ങളിൽ നിന്നും പൊഴിഞ്ഞ് വിഴുന്ന് പഴുത്ത കായകൾ കിട്ടി ഉപ്പിച്ചും ചെറിയ ഇലകളും മുൾമുനകളും നിറഞ്ഞ എലന്തമരങ്ങൾ പിടിച്ചുകെട്ടിയും അതിലെ ചെറുപഴങ്ങൾ തിന്നും ആ പാതകളിലൂടെ ഞങ്ങൾ അലഞ്ഞു. പ്രവാസജീവിതത്തിന്റെ വിരസത ആട്ടി അകറ്റുകയായിരുന്നു ഞങ്ങൾ.' എന്നു കൃഷ്ണദാസ് കുറിച്ചിട്ടുണ്ടാവാം ഗൃഹാതുര അനുഭവങ്ങൾക്കോ കണ്ട സ്വപ്നങ്ങൾക്കോ പ്രവാസികളുടെ മാനസികവും ശാരീരികവുമായ പീഡകളെ അകറ്റാൻ കഴിഞ്ഞില്ല എന്നു വായിക്കാം.

പ്രശസ്ത അറബ് പ്രവാസി എഴുത്തുകാരനും സാംസ്കാരിക വിമർശകനുമായ എഡ്വേർഡ് സെയ്ദ് പറയുന്നത് 'ഒരു വ്യക്തി അവന്റെ സ്വത്വം തിരയുന്നത് അവൻ സ്വന്തം നാട് വിട്ടു ജീവിതം തുടങ്ങുമ്പോഴാണ്' എന്നാണ്. 'ദബായ്'പ്പുഴയിലെ കഥാനായകനും സംഘവും അനുഭവിച്ച പ്രവാസജീവിതം അത്തരമൊരു സ്വത്വാനുഭവമായിരുന്നു. സ്വയം ഉരുകി ഇല്ലാതാകാത്തതരമൊരു സ്വത്വാനുഭവമായി ജീവിക്കാൻ വിധിക്കപ്പെട്ട പ്രവാസി അവന്റെ നോട്ടം മറ്റുള്ളവർക്കായി ജീവിക്കാൻ വിധിക്കപ്പെട്ട പ്രവാസി അവന്റെ അസ്തിത്വം തന്നെയാണ് ഉപേക്ഷിച്ചത്. അങ്ങനെയൊരു സാഹചര്യത്തിൽ പ്രവാസ ജീവിതം ഒരർത്ഥത്തിൽ നമ്മുടെ ആന്തരികജീവിതത്തിന്റെ സ്വാതന്ത്ര്യപ്രഖ്യാപനങ്ങളാണ്. എന്നാൽ അത് നടുക്കങ്ങളെയും ഭയാനതകളെയും കൂടി പ്രദാനം ചെയ്യുന്നുവെന്ന് 'ദബായ്'പ്പുഴ വായിക്കുന്നവർക്ക് ബോധ്യപ്പെടും.

### പ്രവാസിയുടെ ദേശസ്നേഹവും കിടംബസ്നേഹവും

പല ദേശക്കാർ പ്രവാസികളായി ഗൾഫിൽ ഒതുങ്ങിയിട്ടുണ്ട്. പല സാഹചര്യങ്ങളിൽ ജനിച്ചവർക്കുമാണ് അവർ ഒതുങ്ങിയ കിടംബസ്നേഹം തമ്മിലുള്ള അഭിപ്രായവ്യത്യാസങ്ങൾ മറക്കുകയോ ഒളിച്ചുവെക്കുകയോ ചെയ്യാറുണ്ട്. പ്രത്യേകിച്ച് ഭാരതീയർ. ഗൾഫ് നിവാസികളുടെ സ്നേഹവും സാന്ത്വനവും അനുഭവിക്കുമ്പോൾ ആശ്വാസമാണ് ലഭിക്കുന്നതെങ്കിലും പ്രവാസികളായ ഇതരദേശക്കാരിൽ നിന്ന് സ്വന്തം നാടിനെപ്പറ്റിയുള്ള കുറുപ്പുത്തലുക്കുകളും ഇന്ത്യക്കാരായ പ്രവാസികൾക്ക് കേൾക്കേണ്ടിവന്നിട്ടുണ്ട്. ഇന്ത്യക്കാരനായ കഥാനായകനോട് 'നിങ്ങളുടെ മഹത്തായ നാട്ടിൽ മുസ്ലീങ്ങളെ ഇങ്ങനെ നിർദ്ദയം കൊന്നൊടുക്കുന്നതെന്തുകൊണ്ട് എന്നും മഹാനഗരത്തിലെ ഏറ്റവും തിരക്കേറിയ തെരുവിൽ ഒരു പശു വന്നു നിന്ന് മണിക്കൂറുകളോളം ഗതാഗതം നിലനിർത്തിയപ്പോൾ നിങ്ങളുടെ നാട്ടിലല്ലേ എന്നും ഈജിപ്തുകാരൻ ചോദിക്കുമ്പോൾ പച്ചറണ ഞങ്ങളുടെ നാട്ടിൽ അങ്ങനൊരു കിടംബസ്നേഹം നൽകുന്നില്ല' എന്നാണ് കഥാനായകനും കൂടുകാറും പറയുന്നത്. പ്രവാസിയുടെ ദേശസ്നേഹവും നിശ്ചയദാർഢ്യവുമാണ് ഈ വാക്കുകളിലുള്ളത്. ജാതി മതവർഗ്ഗവർണഭേദങ്ങൾ കൂടാതെ ഞങ്ങൾ ഇന്ത്യക്കാർ എന്നു പറയുവാനുള്ള ചുറ്റും പ്രകടിപ്പിക്കുന്നതിൽ മുൻപന്തിയിൽ നിൽക്കുന്നത് പ്രവാസികൾ

ഇാണ്. മതഭ്രമിയുടെ മനംമടുപ്പിക്കുന്ന അന്തരീക്ഷത്തിൽ ജാതിമതവ്യത്യാസമോ സാമ്പത്തികവ്യത്യാസമോ അവർ പ്രകടിപ്പിക്കുന്നില്ല. കുടുംബത്തിനും അത്താണിയാകുന്നതിനൊപ്പം നാടിന്റെ അടിമാനം കാത്തുസൂക്ഷിക്കുന്നതിനും അവർ പ്രാധാന്യം നൽകുന്നു. എന്നാൽ ഈ കരുതലും സ്നേഹവും ആരും പരിഗണിച്ചില്ല. 'പ്രവാസജീവിതത്തിൽ അത്താണികളാകാൻ വിധിക്കപ്പെട്ട എണ്ണമറ്റ മനുഷ്യർ എന്നിങ്ങനെ ചുറ്റുമുണ്ടായിരുന്നു. അല്ലെങ്കിൽ അവരുടെയെല്ലാം ദൗത്യം അത്താണികളാകുക എന്നതു തന്നെയായിരുന്നു. ഒരിക്കൽ ദൗത്യം നിറവേറ്റിക്കഴിഞ്ഞപ്പോൾ പിന്നെ അവർ വെറും ചണ്ടികളായി മാറി. അവശേഷിച്ച ജീവിതം അവർക്ക് ആത്മസംഘർഷങ്ങളുടെ ചുഴികൾ മാത്രം സമ്മാനിച്ചു.<sup>12</sup> പരസ്പരം അത്താണികളായി താങ്ങും തണലുമായി ജീവിച്ച പ്രവാസിയുടെ മുഖ്യലക്ഷ്യം കുടുംബത്തെ കരകയറ്റുക എന്നതായിരുന്നു. എന്നാൽ അതേ കുടുംബങ്ങളിൽ നിന്നും വലിച്ചെറിയപ്പെട്ട പ്രവാസികളും നമ്മുടെ സമൂഹത്തിലുണ്ടായി ഏതൊരു കുടുംബത്തിനുവേണ്ടിയാണോ പ്രവാസി സ്വന്തം ജീവിതം ഉഴിഞ്ഞുവെച്ചത് അവർ തന്നെ അയാളെ നിർദ്ദയം ഉപേക്ഷിക്കുന്നു. അലിക്സിയും മറ്റും പങ്കുവെക്കുന്ന ഭയം അതിലേക്കാണ് വിരൽ ചൂണ്ടുന്നത്. 'ഞങ്ങൾ പ്രവാസജീവിതത്തിന്റെ അതിർവരമ്പുകളെക്കുറിച്ച് സംസാരിച്ചു കൊണ്ടിരുന്നത്. ഭയപ്പാടുകളുടെയും ഉല്ലാസങ്ങളുടെയും നിരന്തരമായ സമ്മർദ്ദങ്ങൾ; അവഗണനയുടെയും തിരസ്കാരത്തിന്റെയും പിഡനങ്ങൾ; സങ്കീർണമായ കുടുംബബന്ധങ്ങൾ നൽകുന്ന നെരിപ്പോടുകൾ. ഭാര്യഭർത്തൃജീവിതത്തിലെ വിടവുകൾ-ഗൈലിക്രതമായ ഇത്തരം ജീവിതവും പിന്നീടൊരു ശിലമായി മാറുന്ന അവസ്ഥ<sup>13</sup> പ്രവാസജീവിതം അവശേഷിപ്പിക്കുന്നത് മരണസമാനമായ ഒറ്റപ്പെടലിലേക്കുമാണെന്ന സൂചന 'ദുബായ്പ്പൂഴ' എന്ന പ്രവാസക്കുറിപ്പുകൾ നൽകുന്നു.

ജന്മദേശത്തുനിന്നും മറ്റൊരു ദേശത്തേക്ക് പരിഷ്കരിച്ചുവെച്ചവരാണ് പ്രവാസികൾ. പരസ്പരാശ്രയവും സഹായവും കൊണ്ടാണ് ഓരോ ദിവസവും അവർ തള്ളിനീക്കുന്നത്. പട്ടിണിയിലും രോഗാവസ്ഥയിലും അവർ പരസ്പരംസഹായിക്കുകയും സമാശ്വസിപ്പിക്കുകയും ചെയ്യും. അവഗണനയുടെയും തിരസ്കാരത്തിന്റെ പിഡനങ്ങളും സങ്കീർണമായ കുടുംബബന്ധങ്ങൾ നൽകുന്ന നെരിപ്പോടുകളാണ് തങ്ങളെ കാത്തിരിക്കുന്നതെന്ന ഉത്തമബോധ്യമില്ല. ഉള്ളപ്പോഴും പ്രവാസികൾ കുടുംബത്തെ വളരെയേറെ സ്നേഹിക്കാറുണ്ട്. അതിനായി പരസ്പരം കടംവാങ്ങുകയും വിടുകുളിലേക്ക് എത്തിക്കുകയും ചെയ്യും. ആ കടബാധ്യതകൾ പ്രവാസികൾക്കിടയിൽത്തന്നെ ഒരമയുടെ ലോകം സൃഷ്ടിക്കും. ഈ ഒത്തൊരുമയും പരസ്പരാശ്രയ ദേശസ്നേഹവും കുടുംബസ്നേഹവുമൊക്കെയാണ് ഓരോ പ്രവാസിയുടെയും മുതൽക്കൂട്ട്.

മണലാരണ്യത്തിന്റെ മടുപ്പിക്കുന്ന വിരസതകൾക്കിടയിലും ജീവിതമെന്ന മഹാസാഗരം തരണം ചെയ്യാനുള്ള മനുഷ്യന്റെ ഇച്ഛയും ഇച്ഛാശക്തിയും

പ്രവാസികൾക്കുണ്ടെന്നാണ് 'ദുബായ്പ്പൂഴ' പറയുന്നത്. ഗൾഫിൽ നിന്നെത്തുന്ന പണം കൊണ്ട് പരാധീനതകൾ അവസാനിക്കുമ്പോൾ അവിടെ നിന്നെത്തുന്ന സുഗന്ധദ്രവ്യങ്ങൾ ജീവിതത്തിൽ പരിമളം പരത്തുമ്പോൾ അതു നമുക്കു നൽകിയ പ്രവാസജീവിതങ്ങൾക്കു പിന്നിൽ ആത്മപീഡനങ്ങളുടെ ചോരമണമുണ്ടെന്ന് നാമോർക്കണം. ആത്മാവിൽ സ്വയം അന്യരായി തീർന്നവനാണ് അല്ലെങ്കിൽ അന്യരാക്കപ്പെട്ടവനാണ് ഓരോ പ്രവാസിയും. എഴുപതു കളിൽ ജോലി തേടി ഗൾഫിലെത്തുന്ന മനുഷ്യസമൂഹത്തിന്റെ കണ്ണിതം പുഞ്ചിരിയും കലർന്ന കയ്യും ചവർപ്പും നിറഞ്ഞ ജീവചരിത്രമാണ് 'ദുബായ്പ്പൂഴ'. ഉള്ളിലുള്ള സ്വാഭാവത്തിന്റെ ദ്രക്സാക്ഷ്യമാണത്. ഒരു പുസ്തകത്തിന്റെ വായന വ്യക്തിയെ കൂടുതൽ നല്ലവനാക്കുന്നുവെങ്കിൽ മാത്രമേ അത് മഹത്തായ ഒരു കൃതിയായി മാറുന്നുള്ളൂ. 'ദുബായ്പ്പൂഴ' നമ്മുടെ അനേകം ചെറുപുഴകളെ ഹൃദയത്തിലേക്കൊഴുക്കുന്നു. പ്രവാസജീവിതത്തിന്റെ അനുഭവയാഥാർഥ്യങ്ങൾ കൊണ്ട് സമ്പന്നമായ 'ദുബായ്പ്പൂഴ' മനുഷ്യന്റെ സ്വതന്ത്രയും സത്തയെയുമാണ് വെളിവാക്കുന്നതെന്നു പറയാം.

കുറിപ്പുകൾ

1. ശ്രീകണ്ഠേശ്വരം. ജി. പത്മനാഭപിള്ള ഗബുതാരാവലി, നാഷണൽ ബുക്ക് സ്റ്റാൾ, കോട്ടയം, 2000, പുറം-1299.
2. കൃഷ്ണവാരിയർ.എൻ.വി.(എഡി);, ഇംഗ്ലീഷ്-ഇംഗ്ലീഷ്-മലയാളം ഡിക്ഷണറി, ഡി.സി. ബുക്സ്, കോട്ടയം, 1983, പുറം-300.
3. കൃഷ്ണദാസ്, ദുബായ്പ്പൂഴ, ഗ്രീൻബുക്സ്, കോഴിക്കോട്, 2003, പുറം-23.
4. അതേ പുസ്തകം, പുറം 33.
5. അതേ പുസ്തകം, പുറം 40.
6. അതേ പുസ്തകം, പുറം 45.
7. അതേ പുസ്തകം, പുറം 38
8. ഹാഫിസ് മുഹമ്മദ് എൻ.പി., പ്രവാസികളുടെ പുസ്തകം, ഡി.സി. ബുക്സ്, കോട്ടയം, 2016, പുറം 24.
9. കൃഷ്ണദാസ്, ദുബായ്പ്പൂഴ, ഗ്രീൻബുക്സ്, കോഴിക്കോട്, 2003, പുറം -67, 68.
10. www.pravasam.com
11. കൃഷ്ണ, ദുബായ്പ്പൂഴ, ഗ്രീൻബുക്സ്, കോഴിക്കോട്, 2003, പുറം-87.
12. അതേ പുസ്തകം, പുറം 103.
13. അതേ പുസ്തകം, പുറം 107.

സഹായകഗ്രന്ഥങ്ങൾ

1. കൃഷ്ണവാരിയർ എൻ.വി. (എഡി);, ഇംഗ്ലീഷ്-ഇംഗ്ലീഷ് മലയാളം ഡിക്ഷണറി, ഡി.സി. ബുക്സ്, കോട്ടയം, 1983.
2. കൃഷ്ണദാസ്, ദുബായ്പ്പൂഴ, ഗ്രീൻബുക്സ്, കോഴിക്കോട്, 2003.

# പ്രവാസ സാഹിത്യം

സമ്പാദനം പഠനം  
ഡോ. എ.എസ്. പ്രതീഷ്



ചുട്ടുനീറുന്ന ആകുലതകളുടെ കൊടിയടയാളമായി 'പ്രവാസം' എന്ന സംജ്ഞ മാറിക്കഴിഞ്ഞിരിക്കുന്നു. സ്വന്തം നാട്ടിൽനിന്നും അന്യദേശത്ത് ജീവിക്കേണ്ടിവരുന്ന ഏതുമനസ്സുകാരനും അനുഭവിക്കുന്നത് 'പ്രവാസം' തന്നെയാണ്. സഹനത്തിന്റെയും കണ്ണുനീരിന്റെയും പതംപറച്ചിലുകൾക്കപ്പുറം സുഖസമൃദ്ധിയുടെയും ലോകസൗഹൃദങ്ങളുടെയും മറ്റൊരു വിശാലവേദികൂടി പ്രവാസം ചിലർക്ക് നൽകാറുണ്ട്.

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ഡോ. എ.എസ്. പ്രതീഷ്



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ഡോ. എ.എസ്. പ്രതീഷ്

സമ്പാദനം പഠനം



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തിരുവനന്തപുരം

## ഉള്ളടക്കം

അവതാരിക	പേജ് നമ്പർ
പ്രവാസമെന്ന ബഹുവചനം കെ. ജയകുമാർ ഐ.എ.എസ്	xv
ആമുഖപഠനം - 1 പ്രവാസസാഹിത്യം ഡോ. എ.എസ്. പ്രതീഷ്	xix
ആമുഖപഠനം - 2 പ്രവാസരേഖകൾ ഡോ. പി.കെ. രാജശേഖരൻ	xxiv
ആമുഖപഠനം - 3 പ്രവാസത്തിന്റെ പൊരുൾ വി. രാജകൃഷ്ണൻ	xli

## ഭാഗം ഒന്ന് നോവൽ

1. മുറിഞ്ഞുവീണ ഗൗളിവാലുകൾ ഡോ. ആർ. ചന്ദ്രബോസ്	3
2. അവസാനിക്കാത്ത ആടുജീവിതം ഡോ. ജോർജ്ജ് ഓണക്കൂർ	10
3. അപമാനവീകരണത്തിന്റെ ആഖ്യാനാനുഭവം ഡോ. സുനീത ബാബു. വി.എസ്	13
4. ഇരുപത്തിയൊന്നാം നൂറ്റാണ്ടിലെ പ്രവാസം ഡോ. ഡി.വി. അനിൽകുമാർ	21
5. ചട്ടക്കൂടുകൾക്കുള്ളിലെ ഹമാമുകൾ അശ്വനി. എ.പി	29
6. പുത്തുമലരുന്ന നിലയിടങ്ങൾ ദേവിശ്രീ. ജി	39

7.	തക്കാളിത്തോട്ടത്തിലെ ജീവിതയാതനകൾ ഡോ. നീലിമ ജയദേവൻ	47
8.	തലമുറകളുടെ പ്രവാസം അലക്സ് ബാബു	55
9.	കണ്ണനീർ വീണാനന്തര മണൽപ്പുരപ്പുകൾ റീജ. പി	73
10.	കടിയേറ്റജീവിതത്തിന്റെ സ്വത്വസംഘർഷങ്ങൾ സുര്യ ഭാളി. എസ്	80
11.	ദേശങ്ങളിൽ നിന്ന് സ്ഥാനഭ്രഷ്ടരായവർ അശ്വതി. റ്റി.ജി	85
12.	പ്രവാസവും പ്രയാണവും പിന്നെ, അതിജീവനവും ആര്യാരാജ്. ആർ	90
13.	നീതിതേടിയുള്ള യാത്രകൾ സുജ സാവിധി	94
14.	കരിക്കോട്ടക്കരി എന്ന കനാൻദേശം ഹരിത ജി. മോഹൻ	99
15.	വേരുകൾ തേടി ഗ്രാമത്തിലെത്തുന്നവർ ശാജ. ആർ	112
16.	തലമുറകൾ തമ്മിലുള്ള സംഘർഷം ഡോ. ജി.ജി. പി	121
17.	കാലത്തിനു മുന്നിൽ വേഷപ്പകർച്ചയാടുന്നവർ രഞ്ജിനി. എസ്	124
18.	പ്രവാസത്തിന്റെ ജീവപരിസരം ദീപ. എസ്	131

**ഭാഗം രണ്ട്  
ചെറുകഥ**

1.	പ്രവാസാനുഭവവും മലയാളകഥാഭാവനയും ഡോ. ടി. മധു	143
2.	പ്രവാസിയുടെ രാഷ്ട്രീയം ഡോ. ഇ. ബാനർജി	152
3.	ഉയിർന്നൊന്ന് ഉടുവസ്ത്രം തേടുന്നവർ ഡോ. എസ്. അജയലോഷ്	162

4.	നഗരകാനനത്തിലെ പ്രവാസകാലം ഡോ. എസ്. ജയൻ	169
5.	അന്നംതേടുന്ന തൊഴിൽപ്രവാസങ്ങൾ ഡോ. എസ്. ഹേമലാൽ	174
6.	പ്രവാസത്തിന്റെ ജീവിതവ്യാഖ്യാനങ്ങൾ ആർ. രമ്യ	181
7.	കബീറിന്റെ ചിരിയിലെ മൃകഭാഷ്യങ്ങൾ ഡോ. ദീപ്തി. വി.എസ്	186
8.	നിശബ്ദതയാൽ മുറിവേൽപ്പിക്കപ്പെട്ടവർ മൈത മോഹൻ	194
9.	അഹ്റാജിലെ ബഹുസ്വരത സുരതി മോഹൻ. ജെ	200
10.	മരുഭൂമിയുടെ ഊഷ്മരയിൽ നിന്നും ഇടവപ്പാതിയുടെ കളിരിലേക്ക് സുര്യ ശ്രീധരൻ	206
11.	ചരിത്രത്തിൽ ഇടനിഷേധിക്കപ്പെട്ടവർ സിബി. വി	211
12.	കടൽ കടന്നുപോകുന്നവർ ഹെമൽ. എം	215

**ഭാഗം മൂന്ന്  
കവിത**

1.	പ്രവാസികവിത മലയാളത്തിൽ ഡോ. ശിവദാസ് കെ.കെ.	221
2.	ഒടിച്ചുകത്തിച്ചെടിയുടെ വിഹലതകൾ ഡോ. എം.എസ്. സുചിത്ര	234
3.	വീട്ടിലേക്കു പോകുന്നവർ ഐശ്വര്യ മാധവൻ	239
4.	പ്രവാസവും സ്വത്വനഷ്ടവും ഗീതു. പി.ജി	246
5.	കവിതയിലെ പ്രവാസകാലം രോഷ്ണി. എം	253

**ഭാഗം നാല്  
തിരക്കഥ**

1. മലയാളസിനിമയും പ്രവാസസ്വതന്ത്രപ്രതിസന്ധിയും രേഖ. എസ്	265
2. പ്രവാസജീവിതത്തിന്റെ നേർക്കാഴ്ചകൾ കിരൺ മോഹൻ. എം	272
3. പെൺപ്രവാസം മലയാളസിനിമയിൽ കവിത. സി.കെ	277
4. പ്രവാസി തൊഴിൽസംസ്കാരം അജി. ഡി	284
5. സ്വപ്നങ്ങൾ വിൽക്കുന്നവർ ഐശ്വര്യ. എ	289
6. പ്രവാസജീവിതം പത്തേഴായിൽ പെടീഷ്യ ജോൺ	295
7. മലയാളിയുടെ ഗൾഫ്കടിയേറ്റം രാജേഷ്. ആർ	299

**ഭാഗം അഞ്ച്  
ചലച്ചിത്രഗാനങ്ങൾ**

1. പ്രവാസജീവിതവിഷ്കാരം മലയാളചലച്ചിത്രഗാനങ്ങളിൽ കൃഷ്ണപ്രിയ. ആർ.വി	307
--	-----

**ഭാഗം ആറ്  
നാടകം**

1. സ്വത്വം നഷ്ടപ്പെടുന്നവർ സതീഷ് ജി. നായർ	315
--	-----

**ഭാഗം ഏഴ്  
ഓർമ്മക്കുറിപ്പുകൾ**

1. ജീവിതഗന്ധിയായ സൊറകൾ ആഷിത എസ്. ഷാബു	323
--	-----

2. പ്രവാസിയുടെ ഓർമ്മക്കുറിപ്പുകൾ അശ്വതി. എം.സി	327
3. വേരുകളില്ലാത്ത പാഴ്കുരങ്ങൾ ലീയ. ജെ	333
4. പ്രവാസമെന്ന ദുരിതദ്രമിക അരുൺ. ജെ.ജി	336

**ഭാഗം എട്ട്  
സഞ്ചാരസാഹിത്യം**

1. കാപ്പിരികളുടെ നാട്ടിലെ ഇന്ത്യാക്കാർ ജി.എസ്	347
2. മലയാളികളുടെ അറബ്ജീവിതം ഷിഹാബി. കെ.എസ്	351

**ഭാഗം ഒൻപത്  
സംസ്കാരം**

1. സംസ്കാരം പ്രവാസി രചനകളിൽ ഡോ. സീമാ ജെറോം	361
2. ദേശം ഒരു കഥയെഴുതുന്നു ശ്രീല. എസ്	373

**ഭാഗം പത്ത്  
ഇതിഹാസങ്ങൾ**

1. ഇതിഹാസകൃതികളിലെ പ്രവാസം ഡോ. സുഷമകുമാരി. എസ്	381
2. ബൈബിൾ: പ്രവാസജീവിതവിഷ്കാരങ്ങളുടെ അക്ഷയഖനി എബി എം. അലക്സ്	388

**ഭാഗം പതിനൊന്ന്  
ഫെയ്സ്ബുക്ക്/ബ്ലോഗ്**

1. പ്രവാസം ഫെയ്സ്ബുക്ക് സാഹിത്യത്തിൽ സംഗീത് മാത്യു	399
2. ബ്ലോഗെഴുത്തിലെ പ്രവാസം അന ജെയിംസ്	409

# മുറിഞ്ഞുവീണ ഗൗളിവാലുകൾ പ്രവാസത്തിന്റെ അനുഭൂതിചരിത്രം

ഡോ. ആർ. ചന്ദ്രബോസ്

## പ്രവാസവും ആധുനികതയും

മലയാളികളുടെ അനുഭൂതിചരിത്രത്തിൽ പ്രവാസം മുറിഞ്ഞുപോയ ഗൗളിവാൽപോലെ പിടഞ്ഞു നിശ്ചലമായ ഓർമകളാണ്. ആ ഓർമകളെക്കൂടി രേഖപ്പെടുത്തിയാലേ നമ്മുടെ സാംസ്കാരികചരിത്രം പൂർണ്ണമാവുകയുള്ളൂ. പ്രവാസത്തിന്റെയും അത് സൃഷ്ടിച്ച സങ്കീർണ്ണങ്ങളായ വൈകാരിക പ്രശ്നങ്ങളുടെയും നൂറ്റാണ്ടായിരുന്നു ഇരുപതാം നൂറ്റാണ്ട്. വിവരസാങ്കേതിക സംവിധാനങ്ങളുടെ വർത്തമാനകാലത്ത് പ്രതീതിയാമാർദ്ദങ്ങളുടെ പ്രതലങ്ങളിൽ പ്രവാസം അതിന്റെ വൈകാരികഭാവങ്ങൾ ഇറക്കിവെച്ച് ഇളവേല്ക്കുന്നുണ്ട്. എന്നാൽ കഴിഞ്ഞ നൂറ്റാണ്ടിൽ പ്രവാസത്തിലേക്ക് റെയിലേറിപ്പോയവരും കപ്പലേറിപ്പോയവരുമായ നമ്മുടെ മുൻതലമുറകൾക്ക് അത് അനിശ്ചിതത്വങ്ങളിലേക്കുള്ള യാത്രകളായിരുന്നു.

നമ്മുടെ സമൂഹത്തെ പരിഷ്കാരത്തിലേക്കും ആധുനികതയിലേക്കും വളർത്തിയതിൽ നവോത്ഥാനമുന്നേറ്റങ്ങളും പുരോഗമനപ്രസ്ഥാനങ്ങളും വഹിച്ച പങ്കുപോലെതന്നെ പ്രധാനമാണ് പ്രവാസികളുടെ ഭൗതികവും ബൗദ്ധികവുമായ നീക്ഷേപങ്ങൾക്കുമുള്ളത്. കോളോണിയൽ ആധുനികത കൊണ്ടുവന്ന ഗതാഗതസൗകര്യങ്ങളും നഗരകേന്ദ്രിത വിദ്യാഭ്യാസ സൗകര്യങ്ങളും പത്തൊൻപതാം നൂറ്റാണ്ടിന്റെ അവസാനദശകങ്ങളിൽ ഫ്യൂഡൽ കുടുംബങ്ങളിലെ ചില ധിഷണശാലികളെ വിലക്കുകളുടെ 'കോരപ്പുകൾ' മുറിച്ചുകടന്ന് വിജ്ഞാനനഗരങ്ങളിലേക്ക് പോകാൻ പ്രേരിപ്പിച്ചിരുന്നു. മലബാറിൽ നിന്ന് സൈദാപേട്ട കാർഷികകോളേജിൽ കൃഷിശാസ്ത്രം പഠിക്കാൻ വേങ്ങയിൽ കുഞ്ഞിരാമൻ നായനാർ എന്ന ജന്മിത്തമ്പുരാൻപോയത് ചരിത്രമാണ്. മലബാർ കളക്ടറായിരുന്ന ലോഗൻസായ്യാണ് ആധുനികമായ അറിവിന്റെ ലോകത്തേക്ക് നായനാറെ പറഞ്ഞെച്ചതത്രേ. ഏതായാലും വിദ്യാർജ്ജനത്തിനായുള്ള പ്രവാസശേഷം തിരികെ വന്ന നായനാർ മലബാറിൽ പുത്തൻ കാർഷികസംസ്കാരത്തിനും മലയാളസാഹിത്യത്തിൽ ചെറുകഥയ്ക്കും വിതയൊരുക്കി. അങ്ങനെ ആധുനികതയിലേക്കുള്ള മലയാളി

# കവിതയിലെ പ്രവാസകാലം

റോഷ്നി. എം

മനുഷ്യജീവിതത്തിന്റെ ഭാഗധേയത്തെ നിർണ്ണയിക്കുന്ന പ്രവാസത്തെ ഓരോ എഴുത്തുകാരും ഉൾക്കൊള്ളുന്നതും അനുഭവിക്കുന്നതും ഓരോ തരത്തിലാണ്. അനുഭവങ്ങളിൽ നിന്നും അറിവുകളിൽ നിന്നും വാർന്നുവീഴുന്ന അത്തരം തിരിച്ചറിവുകളാണ് ഓരോ പ്രവാസരചനയും. അതുതന്നെയാണ് പ്രവാസകവിതകളുടെ മുഖമുദ്രയും.

## പ്രവാസവും സന്ദേശകാവ്യങ്ങളും

ഭാരതീയസാഹിത്യത്തിന് മാത്രം എടുത്തുകാണിക്കാൻ പറ്റുന്ന ഒരു കാവ്യസരണിയാണ് സന്ദേശകാവ്യപ്രസ്ഥാനം. സന്ദേശകാവ്യം ഉടലെടുത്തത് ഏതെങ്കിലും ഒരു കാരണത്താൽ ദേശനഷ്ടം സംഭവിച്ച നായകനിൽ നിന്നാണ്. ഈ അവസ്ഥ സന്ദേശകാവ്യത്തിൽ നിറഞ്ഞുനിൽക്കുന്നു. ഋഗ്വേദത്തിലെ അർച്ചാനസ് എന്ന ഋഷിയുടെ പുത്രനായ ശ്യാവശ്യന്റെ സന്ദേശത്തിൽ നിന്നാരംഭിക്കുന്ന സന്ദേശകാവ്യം കരുത്താർജിച്ചത് മേഘദൂതിലൂടെയാണ്. രാമഗിരി ആശ്രമത്തിൽ എത്തിപ്പെടുന്ന യക്ഷന്റെ ജീവിതാനുഭവങ്ങൾ പ്രവാസജീവിതത്തിന്റെ വൈകാരികവും തീവ്രവുമായ മുഖമാണ് കാട്ടിത്തന്നത്. പിറന്നനാട് യക്ഷനെ മാസ്മരികമായി മാടിവിളിക്കുന്നുണ്ട്. മേഘത്തിനോട് ഉജ്ജയിനിപട്ടണത്തിലൂടെ സന്ദേശം കൊണ്ടുപോകണം എന്ന് യക്ഷൻ ആവശ്യപ്പെടുന്നു.

'ഉത്തരാശ്വേദം പോകുന്ന നിൻവഴി  
കൈത്രമാത്രം വളഞ്ഞാലുമെൻ സഖേ  
ഉദ്യമിക്കൊലാ വെണ്ടെന്ന് വയ്ക്കാൻ  
ഉജ്ജയിനിതൻ സൗധാഗ്രസൗഹൃദം.'

ഇങ്ങനെ ജന്മദേശത്തോടുള്ള തീവ്രപ്രണയം മേഘസന്ദേശത്തിൽ യക്ഷൻ കാട്ടിത്തന്നു. കാളിദാസനെ അനുസ്മരിച്ചുകൊണ്ട് ഉണ്ടായിട്ടുള്ള സന്ദേശകാവ്യങ്ങളും ഈ പ്രവാസജീവിതം വഴിയാണ് ചിത്രീകരിച്ചിട്ടുള്ളത്. മലയാളത്തിലെ പ്രമുഖ സന്ദേശകാവ്യങ്ങളായ ഉണ്ണൂനീലിസന്ദേശം, കോകസന്ദേശം, മയൂരസന്ദേശം എന്നിവയെല്ലാം പ്രവാസത്തിന്റെ വിരഹാതുരമായ ആവിഷ്കാരങ്ങളാണ്. വിവാഹിതയായി തപോവനം ഉപേക്ഷിച്ചു

പോകുന്ന സിതയും പ്രവാസാനുഭവങ്ങൾ പേറുന്നവളാണ്. സീത ഭർത്തൃഹരണത്തിലേക്ക് പരിചയപ്പെടുന്ന സ്ത്രീയുടെ പ്രതിനിധിയാണ്. ഇത്തരത്തിൽ പരിശോധിക്കുമ്പോൾ സാഹിത്യത്തിന്റെ നാൾവഴികളിൽ പ്രാചീനകാലം മുതൽ തന്നെ പ്രവാസം സജീവവിഷയമായി എഴുത്തുകാർ സ്വീകരിച്ചിട്ടുള്ളതായി കാണാം.

ആദ്യകാലം മുതലുള്ള മലയാളകവിത പരിശോധിച്ചാൽ പ്രവാസത്തിന്റെ സൂചനകൾ കടന്നുവരുന്നതായി കാണാം. എഴുത്തച്ഛൻ ജീവിതത്തെ തന്നെ ഒരു പ്രവാസമായിട്ടാണ് കരുതിയത്. ജീവിതം ഈശ്വരനെ തേടിയുള്ള യാത്രയാണ് എന്ന ആധ്യാത്മിക നിലപാടാണ് എഴുത്തച്ഛനുള്ളത്. മനുഷ്യജീവിതത്തെ പ്രവാസവുമായി നിരവധി ലക്ഷ്യങ്ങളിൽ ബന്ധിപ്പിക്കുന്നുണ്ട്. ജീവിതപ്രവാസം ക്ഷണികമാണെന്ന കാഴ്ചപ്പാടാണ് എഴുത്തച്ഛനുള്ളത്.

'പാമ്പൻ പെരുവഴിയമ്പലം തന്നിലേ  
താനരായ്'കളടി വിരോധം വരുമ്പോലെ'

ഈ ഭൂമിയെ ഒരു പെരുവഴിയമ്പലമായിട്ടാണ് എഴുത്തച്ഛൻ കാണുന്നത്. പെരുവഴിയമ്പലത്തിലെ പ്രവാസികളാണ് ഓരോരുത്തരും എന്ന ആശയം അദ്ദേഹം മുന്നോട്ടു വയ്ക്കുന്നുണ്ട്. ഭൂമിയിലെ പ്രവാസത്തിന്റെ ക്ഷണികതയും കവി ഇവിടെ സൂചിപ്പിക്കുന്നു.

നളചരിതം ആട്ടക്കഥയിലും പ്രവാസജീവിതസൂചനകൾ ഉണ്ട്. സ്വദേശം നഷ്ടപ്പെട്ട നളൻ രാജ്യഭ്രമണത്തിലൂടെ പ്രവാസിയാണ്. നാടുകടത്തൽ എന്ന വാക്കിൽ തന്നെ ദുഃഖത്തിന്റെയും അന്യതാബോധത്തിന്റെയും നിസ്സഹായതയുടെയും തിവ്രമായ ധ്വനികൾ കടന്നുവരുന്നുണ്ട്. ഇവിടെ നളൻ അധികാരഭ്രമണം നിഷ്ഠാസിതനായ പ്രവാസിയാണ്. നാടുകടത്തപ്പെട്ടവന്റെ ഉള്ളിൽ നഷ്ടപ്പെട്ട തന്റെ രാജ്യത്തിന്റെ ഓർമ്മകൾ പിൻതുടരുക തന്നെ ചെയ്യും.

'മിണ്ടാതെ നടകൊണ്ടാലും വന-  
വാസത്തിന്ന, മമ നാടതിലിരിക്കിലോ  
ഉണ്ടാമധർമ്മവുമന്യതോദിതവ്യം'

ഇങ്ങനെ പുഷ്പരൻ നളനെ വനവാസത്തിനായി ഇറക്കിവിടുന്നുണ്ട്. രാജ്യം നഷ്ടപ്പെടുന്ന നളന് തുണിയോ ആഹാരസാധനങ്ങളോ കൊടുക്കരുതെന്ന് പുഷ്പരൻ ജനങ്ങളോട് ആജ്ഞാപിക്കുന്നുണ്ട്.

നാട്ടിൻപുറത്തെ കൃഷിക്കാരുടെയും കർഷകതൊഴിലാളിയുടെയും ജീവിതത്തിന്റെ മഹത്വം മനസ്സിലാക്കിയ കവിയായാണ് ഇടശ്ശേരി. ചൂഷണവിമുക്തമായ ഒരു പുതിയ സാമൂഹികവ്യവസ്ഥിതിയെ ഇടശ്ശേരി സ്വപ്നം കണ്ടിരുന്നു. വ്യക്തമായ ജീവിതകാഴ്ചപ്പാടുകളായിരുന്ന ഇടശ്ശേരിയുടെ 'കടിയറക്കം' എന്ന കവിതയിൽ അടിമകളായി വിവിധ രാജ്യങ്ങളിലേക്ക് പോകേണ്ടി വന്ന മലയാളികളുടെ ദേഹിയചിത്രം അവതരിപ്പിക്കുന്നുണ്ട്.

'കടിയറക്കപ്പെട്ടും ഉട്ടരെ പറയുവിൻ  
പറയുവിൻ-എതുരാഷ്ട്രക്കാർ നിങ്ങൾ  
പ്രസവിച്ചതിന്ത്യയായ്, പ്രസവിച്ചതിംഗ്ലണ്ടായ്  
പ്രസവിച്ചതാഫ്രിക്കൻ വൻകരയായ്  
അതിനെതുണ്ടാർക്കാന, മുടമയില്ലാത്ത ഭൂ-  
പടമേലും പാഴ്വരയ്ക്കുർഥമുണ്ടോ?  
എവിടെവിടങ്ങളിൽച്ചട്ടി പുറത്തെടു  
ത്തെറിയപ്പെടുന്നാണിപാരിടത്തിൽ.  
അവിടവിടങ്ങളെ ചേർത്തു വരയ്ക്കുകൊ-  
ന്നിവരുടെ രാഷ്ട്രത്തിനതിർവരകൾ'

യൂറോപ്യൻ അധിനിവേശത്തിന്റെ ഫലമായിരുന്ന മലയാളിയുടെ അടിമത്തത്തിന്റെ ചരിത്രം. കേരളത്തിൽ നിന്ന് മനുഷ്യരെ അടിമകളാക്കി യൂറോപ്യൻ കോളനികളിലേക്ക് കൊണ്ടു പോയിരുന്നു. നാടും വീടും ഉപേക്ഷിച്ചുള്ള മലയാളിയുടെ ഈ പോക്കിന്റെ സാഹിത്യവിഷ്കാരമാണ് ഇടശ്ശേരിയുടെ കടിയറക്കം എന്ന കവിത.

സാധാരണ മനുഷ്യന്റെ ജീവിതപ്രശ്നങ്ങൾ കണ്ടറിഞ്ഞ കവിയായാണ് വൈലോപ്പിള്ളി. ജീവിതമാകെ പടർന്നു നിൽക്കുന്ന കാവ്യപ്രപഞ്ചമാണ് വൈലോപ്പിള്ളിയുടെ കവിതകൾ. മാനവികതയുടെ നവ്യപ്രകാശം വിതറുന്ന കവിതകളിൽ പ്രവാസത്തിന്റെ സൂചനകൾ കടന്നു വരുന്നുണ്ട്. രണ്ടാം ലോകയുദ്ധത്തിൽ ചിതറിപ്പോയ യഹൂദർ യുദ്ധം അവസാനിപ്പിച്ച അവസരത്തിൽ മാതൃദേശത്തിലേക്ക് മടങ്ങുന്നുണ്ട്. യഹൂദരുടെ ചിതറിപ്പോകലിൽ നിന്നാണല്ലോ ഡയസ്പോറ (Diaspora) എന്ന പദത്തിന്റെ നിഷ്പത്തി തന്നെ. ചിതറിപ്പോയ കരേ യഹൂദർ കേരളത്തിലും വന്നിരുന്നു. സ്വരാജ്യത്തിലേക്കുള്ള അവരുടെ യാത്രയാണ് 'കേരളത്തിലെ യഹൂദർ ഇസ്രായേലിലേക്ക്' എന്ന വൈലോപ്പിള്ളിയുടെ കവിത. ഈ കവിതയിൽ സ്വദേശത്തിലേക്ക് എത്താൻ കൊതിക്കുന്ന പ്രവാസികളായ ജൂതരെയാണ് അവതരിപ്പിക്കുന്നത്.

'തിരിച്ചെത്തിടുകയാ-  
പൂർവ്വികമാം തറവാട്ടിൽ  
ചരിത്രത്തിനടുയാർത്ഥി-  
പ്പരിഷ് ഞങ്ങൾ'

യുദ്ധവും കലഹങ്ങളും അടയാർഥികളാക്കി മാറ്റിയ മനുഷ്യരെയെന്ന് ഈ കവിതയിൽ അവതരിപ്പിക്കുന്നത്. ചരിത്രത്തിനരികിലാണ് അടയാർഥികൾ. ജൂതന്മാരുടെ സ്വദേശത്തിനുമേൽ ഏറ്റു പിറഡനങ്ങളിൽ കവി ഭൂമിക്കുന്നുണ്ട്. തങ്ങളുടെ സ്വദേശത്തെ ചൊല്ലിയുള്ള പ്രവാസിയുടെ വേദന കവി സ്വയം ഏറ്റെടുക്കുന്നു.



തൊഴിൽ തേടിയുള്ള യാത്രകളാണ് മലയാളികളെ പ്രവാസികളാക്കി മാറ്റിയത്. കൃഷിയല്ലാതെ മറ്റ് തൊഴിലവസരങ്ങൾ കേരളത്തിൽ കുറവായിരുന്നു. ഇന്ത്യയുടെ മറ്റ് ഭാഗങ്ങളിൽ സ്വകാര്യ തൊഴിൽമേഖലാസ്ഥാപനങ്ങൾ ധാരാളം ഉണ്ടായിരുന്നത് വിദ്യാഭ്യാസമുള്ള മലയാളികൾക്ക് തൊഴിലവസരങ്ങൾ നൽകി. 1940-42 കാലത്ത് പട്ടാളപ്പാളയങ്ങളുടെ നിർമ്മിതിക്കു വേണ്ടി ആസാമിലേക്ക് പോയ തൊഴിലാളികളെ വിഷയമാക്കി വൈലോപ്പിള്ളി എഴുതിയ കവിതയാണ് 'ആസ്സാംപണിക്കാർ'.

'ജനിച്ച നാടുവിട്ടുകൊണ്ടു  
പണിക്കുപോയ് വരും പരിഷകൾ ഞങ്ങൾ'

ദേശത്തെക്കുറിച്ചുള്ള പ്രവാസിയുടെ സന്ദേശങ്ങൾ ഈ കവിത പങ്കുവെക്കുന്നു. ഇവിടെ പ്രവാസം ഒരേ സമയം വ്യക്തിയുടെയും ഒരു ദേശത്തിന്റെയും അവസ്ഥയായി മാറുന്നു.

കവിതയെ സമൂഹത്തോടുപിിച്ചു നിർത്തിയ എൻ.വി കൃഷ്ണവാര്യരുടെ 'ഗ്രാമം' എന്ന കവിതയിൽ ഗ്രാമത്തിലേക്കുള്ള മടക്കയാത്രയാണ് പ്രമേയം. തൊഴിലിനും മറ്റ് സൗകര്യത്തിനും വേണ്ടി നഗരങ്ങളിലേക്ക് കുടിയേറി പാർത്തവർ തങ്ങളുടെ അസ്തിത്വം നാട്ടിൻപുറത്താണെന്ന് തിരിച്ചറിയുകയും തിരികെ അവിടെക്ക് എത്തിച്ചേരുകയും ചെയ്യുന്നു.

'പിന്നെയും തിരിച്ചെത്തി  
നഗരത്തിൽ നാം ജന-  
സമ്മർദ്ദത്തിലാ-  
ഗ്രാമത്തെ മറന്നുപോയി'

എന്ന് കവി പാടുമ്പോൾ ഗ്രാമത്തിലേക്ക് മടങ്ങാനുള്ള തന്റെ ആഗ്രഹത്തെയാണ് ധ്വനിപ്പിക്കുന്നത്. നഗരത്തിന്റെ കാപട്യങ്ങളിൽ നിന്ന് ഒഴിഞ്ഞു മാറി ശാന്തമായ ഗ്രാമത്തെ സ്വപ്നം കാണുകയാണ് കവി.

പ്രവാസിയുടെ നൊമ്പരങ്ങൾ മലയാളകവിതയിൽ അവതരിപ്പിച്ച കവിയാണ് ഒ.എൻ.വി. കുറുപ്പ്. 'പ്രവാസി' എന്ന കവിതയിൽ ജന്മഗൃഹം തേടുന്ന പ്രവാസിയെ ചിത്രീകരിച്ചിരിക്കുന്നു.

'പെയ്യിറങ്ങേണ  
മിനിയുമി ഭൂമിയിൽ  
പൈതലായ് വീണ്ടു  
മെനിക്കു പിറക്കുവാൻ!  
ജന്മഗൃഹത്തിലേ  
ക്കുള്ള വഴിതേടി  
യിന്നെൻ പ്രവാസിയായ്-  
മാതാവു തേങ്ങുന്നു.'

ജന്മദേശത്തെക്കുറിച്ചുള്ള പ്രവാസിയുടെ അഭിനിവേശം ഒ.എൻ.വി ഈ കവിതയിൽ അവതരിപ്പിക്കുന്നു. ശൈവസ്മൃതികളുണ്ടെന്ന ജന്മഗൃഹത്തിലേക്ക് മടങ്ങിപ്പോകാനുള്ള ത്വര ഒരോ പ്രവാസിയ്ക്കും അന്തർലീനമാണ്. തിരിച്ചുപോകലിന്റെ വ്യഗ്രത മനസ്സിൽ കാത്തുസൂക്ഷിക്കുന്നവനാണ് പ്രവാസി.

പുതുജീവിതവും നാഗരികതയും അഭയാർഥികളാക്കിത്തീർന്നവരെ കുറിച്ചുള്ള വിലാപമാണ് സുഗതകുമാരിയുടെ 'അഭയാർഥിനി' എന്ന കവിത. ലോകചരിത്രത്തിൽ നിന്ന് വിസ്മരിച്ചുപോയ അഭയാർഥികളുടെ ദയനീയത തന്റെ മുന്നിൽ വന്നു നിൽക്കുന്ന അഭയാർഥിയായ ഭിക്ഷുക്കാരനിലൂടെ അവതരിപ്പിക്കുന്നു. അധിനിവേശത്തിന്റെ സൃഷ്ടികളായ അവർ തങ്ങളുടെ സ്വന്തം മല്ലാത്ത നാടുകളിൽ സ്വത്വപ്രതിസന്ധി നേരിട്ടു കൊണ്ടിരിക്കുന്നു.

'എവിടെപ്പോയി നി ഹരേ  
സർവ്വവും തകർത്തിവ  
ളിരുളിൽ തപ്പിത്തട  
ഞ്ഞിങ്ങനെയുഴലുമ്പോൾ'

പണ്ടെപ്പോഴോ ചരിത്രത്തിന്റെ ഏതോ സന്ധികളിൽ വിവിധ കാരണങ്ങളാൽ വേരുകളെ ശൂന്യതയിലേക്ക് എറിയപ്പെട്ട അഭയാർഥികളുടെ വേദന സ്വയം ഏറ്റെടുക്കുകയാണ് കവി ഇവിടെ.

'എത്തിനാൽ പുണരട്ട  
നിന്നെ ഞാൻ കരഞ്ഞാല  
ല്ലതയുന്നതമല്ലോ നിന്ദ  
മെൻമനഃഷ്യത്വം'

സ്വത്വവും ദേശവും നഷ്ടപ്പെടുപോയ നാടോടികൾ അലഞ്ഞുതിരിയുകയും വഴിവക്കുകളിൽ താവളമടിക്കുകയും ചെയ്യുന്നു. അവർക്ക് ഭൂതവും ഭാവിയും ഇല്ല. വർത്തമാനകാലത്തിൽ മാത്രം അഭിമുഖീകരിക്കുന്നവരാണ് ഇക്കൂട്ടർ. ഏതു പ്രവാസിയുടെയും ഉള്ളിലുള്ള ജന്മദേശം എന്ന ആശയം അവരെ സംബന്ധിച്ച് ശൂന്യത മാത്രമാണ്. ഈ പ്രവാസിസമൂഹത്തെ നാലഭ്യ പ്രവാസികൾ (Deterritorialized) എന്നു വിളിക്കാം.

വേരുകൾ നഷ്ടപ്പെട്ടവന്റെ സ്വത്വപ്രതിസന്ധികളെ അവതരിപ്പിക്കുന്ന കൃതിയാണ് ആറ്റൂരിന്റെ 'നാട്ടിൽ പാർക്കാതെ ഇന്ത്യക്കാർ'. ഗൃഹാതുരത്വം നിറഞ്ഞ ചിന്ത അനുവാചകരിൽ ഉണർത്താൻ പര്യാപ്തമായ പദാവലിയാണ് ഈ കവിതയിൽ ഉപയോഗിക്കുന്നത്. ദേശംവിട്ട് പരദേശത്തേക്ക് പോയ ശിവനാണ് ഈ കവിതയിലെ മുഖ്യബിംബം. വേരറ്റുപോയ വേദനയിൽ നിന്ന് തന്റെ നാട്ടിലേക്കും ഭാഷയിലേക്കും തിരിച്ചെത്താനാകുമോ എന്ന ചോദ്യത്തിൽ കവിത അവസാനിക്കുന്നു.

'താനിങ്ങു ദേശകാലങ്ങളുവൻ  
പുറത്തു നില്ക്കുന്നവൻ  
സദസ്സിനു കോമാളിയായവൻ  
കടൽകൊണ്ടു മരം പോലെ കരയുറവൻ'<sup>10</sup>

ഇങ്ങനെ സ്വദേശത്ത് നിന്ന് അടർത്തിയെടുത്തവന്റെ വേദന ആറ്റർ അവതരിപ്പിക്കുന്നു. തന്റെ ബാല്യകൗമാരങ്ങളെയും അമ്മയെയും വിടുന്നതും തോടിനെയും ഉണ്ടാക്കുന്നതും കേട്ടു പാട്ടിനെയും കളഞ്ഞുപോയവനെ അവന്റെ നാട് ഉള്ളുകൊണ്ട് തിരികെ വിളിക്കും. ആറ്റർ ഈ യാഥാർത്ഥ്യത്തിന്റെ നാനാർത്ഥങ്ങളിലേക്കാണ് അനുവാചകനെ കൂട്ടിക്കൊണ്ട് പോകുന്നത്.

ഉദാത്തമായ കാവ്യസങ്കല്പങ്ങളുടെ ഉടമയായ ഡി. വിനയചന്ദ്രൻ പ്രവാസിയുടെ വിട്ടിലേക്കുള്ള മടങ്ങിവരവിന്റെ അവസ്ഥയെ അവതരിപ്പിക്കുന്ന കവിതയാണ് 'വിട്ടിലേക്കുള്ള വഴി' ഗൃഹാതുരതയാണ് ഈ കവിതയുടെ അടിസ്ഥാനഭാവം. ഒഴിവു ദിവസങ്ങളിൽ കവിയെ വിട്ടിലേക്കാനയിക്കുന്നത് അമ്മയുടെ സ്നേഹമാണ്.

'അമ്മയില്ലാത്തവർക്കേതുവിട്?  
ഇല്ല വിട്, എങ്ങങ്ങുമേ വിട്'<sup>11</sup>

വിട് എന്ന ആശയം തന്നെ അമ്മയെ കേന്ദ്രീകരിച്ചുള്ളതാണല്ലോ. വിട് സമാ അമ്മ എന്ന സമവാക്യം നിരവധി സാഹിത്യകൃതികളിൽ പ്രത്യക്ഷപ്പെടുന്നുണ്ട്. അമ്മയില്ലാത്തവർക്ക് വിട് വേദനയാണ് സമ്മാനിക്കുന്നത്. അമ്മയില്ലാത്തവരുടെ വിട് ലോകത്തിന്റെ തുറന്ന ഇടങ്ങൾ തന്നെയാണ്. ലോകം തന്നെ ഒരു വലിയ വിടാണെന്ന ആശയവും ഈ കവിതയിൽ കാണാം.

'വിട്ടിലേക്കല്ലോ വിളിക്കുന്നു തുമ്പയും  
കാട്ടുകളിയും കടത്തുവള്ളങ്ങളും  
വിട്ടിൽ നിന്നല്ലോയിറങ്ങി നടക്കുന്നു  
തോറ്റവും ചിങ്ങനിലാവും കരച്ചിലും'<sup>12</sup>

ഒരു പ്രവാസിയെ നാട് തിരികെ വിളിക്കുന്നതിന്റെ കൃത്യമായ അവതരണമാണിത്. നാട്ടിലെ തുമ്പയും കടത്തുവള്ളങ്ങളും പ്രകൃതിയും ഏതലോകത്തിലെ പ്രവാസിയുടെയും ഉള്ളിലെ മായാത്ത ഓർമ്മകളാണ്.

ഉത്തരാധുനികകവിതകളിൽ പ്രവാസം ശക്തമായ ആവിഷ്കാരമായി കടന്നുവരുന്നുണ്ട്. പ്രവാസം എന്ന പ്രമേയത്തെ ശക്തമായ ഒരുപാധിയായി ഉത്തരാധുനിക കവികൾ പ്രയോഗിച്ചിട്ടുണ്ട്. 'ജീവിതായോഗത്തിലെ ഒരു പരിണതി എന്ന നിലയിൽ പരിഗണിക്കപ്പെടുകയും സൂതി രൂപമായോ അപരിചിത ലോകങ്ങളോടുള്ള അക്ഷാങ്കഷയായോ കൈ ആവിഷ്കരിക്കു

പ്പെടുകയും ചെയ്തു പ്രവാസം ഗൗരവമേറിയ സംസ്കാരികാനുഭവവും സ്വതഃപ്രശ്നമായി മാറുകയാണ് ആധുനികാനന്തര മലയാളസാഹിത്യത്തിൽ.<sup>13</sup> ഉത്തരാധുനിക കവിതകളിൽ ഭാവന പ്രവാസത്തെ സ്വീകരിക്കുന്നതായിട്ടാണ് കാണുന്നത്. വിദേശരാജ്യങ്ങളിൽ മെച്ചപ്പെട്ട ജീവിതസാഹചര്യങ്ങൾ തേടി താൽക്കാലികമായി പ്രവാസജീവിതം നയിക്കുന്നവരും അടുത്തപ്രവാസികളായി കഴിയുന്നവരും മലയാളത്തിൽ ധാരാളം എഴുതുന്നുണ്ട്. പ്രവാസിയായ ഒരാൾ എഴുതുന്നതു കൊണ്ട് മാത്രം ഒരു കൃതിയെ പ്രവാസസാഹിത്യത്തിന്റെ ഗണത്തിൽ ഉൾപ്പെടുത്താനാവുകയില്ല. തങ്ങൾ എന്തെന്തെല്ലാം ലോകത്തിലെ ജീവിതാവസ്ഥകളിലൂടെ അഭിരുചിയെ ഏതെന്തെല്ലാം വ്യത്യസ്ത പശ്ചാത്തലത്തിൽ നിന്നുകൊണ്ട് മാത്രമേ മലയാളത്തിലെ പ്രവാസസാഹിത്യത്തെ നിർവ്വചിക്കാനാവൂ. ഡയസ്റ്റോ എന്ന പദത്തിന്റെ ക്ലാസ്സിക്കൽ അർത്ഥത്തിന്റെ പരിധിയിൽ നിന്നുകൊണ്ട് മലയാളത്തിലെ പ്രവാസസാഹിത്യത്തെ വിലയിരുത്താനാവുകയില്ല.

പ്രവാസിയുടെ സ്വതഃപ്രതിസന്ധികളെ ആവിഷ്കരിക്കുന്ന കവിതകളാണ് സർജ്ജവിന്റെ 'നഷ്ടപ്പെട്ട പാസ്റ്റോർട്ട്', 'സ്വാതന്ത്ര്യദിനത്തിൽ മനാൻ ബിൽ അഗ്രോയുടെ ചിത്രങ്ങളെക്കുറിച്ച്' തുടങ്ങിയവ.

'അതിരുകടന്നനാൾ അസ്ഥിയിൽ കൊണ്ടു  
നിയരാണെന്ന ചോദ്യം'<sup>14</sup>

ഓരോ പ്രവാസിയും അഭിമുഖീകരിക്കുന്ന ചോദ്യമാണിത് നി ആരാണ്? നിനക്കെന്താണ് ഈ നാട്ടിൽ കാര്യം? ദിർഘനാൾ വിടുപോവാൻ വേണ്ടി പരദേശവാസം തിരഞ്ഞെടുത്തവർ മെച്ചപ്പെട്ട ജീവിതസാഹചര്യം നേടി കഴിയുമ്പോൾ സ്വദേശത്ത് അയാളൊരു പ്രവാസിയായി മാറുന്നു.

'പതിനാലുവർഷങ്ങൾ അന്യരാജ്യത്ത്  
പൗരനല്ലാതെ ജീവിച്ച ഒരാൾ  
സംസാരിക്കുന്ന ഒരു ഉറമ്'<sup>15</sup>

സ്വരം നഷ്ടപ്പെട്ടുപോകുന്ന പ്രവാസിയുടെ ദയനീയതയാണ് സർജ്ജ വരച്ചുകാട്ടുന്നത്. ജന്മനാടിന്റെ നഷ്ടവും താൻ എന്തെപ്പോഴും പ്രദേശത്തിന്റെ അപരിചിതത്വവും പ്രവാസിയെ സ്വതഃപ്രതിസന്ധിയിലേക്ക് നയിക്കുന്നു.

തന്റെ മക്കളുടെ വളർച്ചയുടെ കാലത്ത് അവരെ കണ്ട് സന്തോഷിക്കാനുള്ള അവസ്ഥ ഇല്ലാത്ത പ്രവാസിയെ അവതരിപ്പിക്കുന്ന കവിതയാണ് രാജു ഇരിങ്ങാലിന്റെ 'മകന്റെ അച്ഛൻ'.

'എന്റെ കണ്ണെന്ന് വിളിക്കണമായിരുന്നു  
എനിക്ക് നിന്നെ  
കളിയായ് ഇടയ്ക്കൊക്കെ എടന്നും ചെറുക്കാനും  
മുത്തേന്നും

ദേഷ്യം വരുമ്പോൾ  
ഇവിടെ വാടാനം  
പറയണമായിരുന്നു.<sup>16</sup>

ഒരു പ്രവാസിക്ക് നഷ്ടപ്പെടുപോകുന്ന സന്തോഷത്തിന്റെ നിമിഷങ്ങളാണിവ. തന്റെ പ്രിയപ്പെട്ടവരുടെ സാമീപ്യം നഷ്ടപ്പെടുപോകുന്ന ഒറ്റപ്പെട്ട ലിന്റെ വേദന.

അതിജീവിക്കാനുള്ള പ്രവാസിയുടെ ശ്രമങ്ങളെ അവതരിപ്പിച്ച കവിയായ കഴുർ വിത്സന്റെ 'ഒരു പ്രവാസി' താൻ എത്തപ്പെട്ട നാടുകളിലേക്ക് തങ്ങളുടെ നാടിനെ പുനർനിർമ്മിക്കാൻ അവൻ ശ്രമിക്കും. ഓരോ പ്രവാസിയും വ്യത്യസ്ത വിധത്തിൽ സാങ്കല്പിക സ്വദേശത്തെ തനിക്ക് ചുറ്റും പണിത് പ്രവാസജീവിതത്തിന്റെ സങ്കീർണതകളെ അതിജീവിക്കും. പ്രവാസജീവിതത്തെക്കുറിച്ച് പറയുമ്പോൾ സൽമാൻ റഷ്ദി സാങ്കല്പികസ്വദേശം എന്ന ആശയത്തെ അവതരിപ്പിക്കുന്നുണ്ട്. കഴുർ വിത്സന്റെ 'വിവർത്തനത്തിന് ഒരു വിഫലപരിശ്രമം' എന്ന കവിയയിൽ അത്തരമൊരു ആശയത്തിന്റെ ആവിഷ്കാരം കടന്നു വരുന്നുണ്ട്.

'ഈനപ്പനകൾ  
ചോദിച്ചു  
തുറിച്ചു നോക്കുന്നതെന്തിന്  
വിവർത്തനത്തിനു  
ശേഷമുള്ള  
തെങ്ങുകളാണ്  
ഞങ്ങൾ.'<sup>17</sup>

'രണ്ട് മാങ്ങൾ' എന്ന കവിയയിൽ കുറിവേപ്പിനെക്കുറിച്ച് ഇങ്ങനെ എഴുതുന്നു.

'കഴിഞ്ഞ 6 വർഷമായി  
പുറത്തേങ്ങും  
കണ്ണ് നിറഞ്ഞ്  
ഒരു കുറുവേപ്പ്  
കാണാത്തതുകൊണ്ടാകണം  
എന്നുമെന്നും  
ഉള്ളിന്റെയുള്ളിൽ  
ഒരു കുറിവേപ്പ്  
നട്ടുനന്നച്ചത്.'<sup>18</sup>

യൂറോപ്യൻ നാടുകളിലേക്ക് കടിയേറി പാർത്തവരിൽ നിന്ന് ധാരാളം പ്രവാസകൃതികൾ ഇപ്പോൾ പുറത്ത് വരുന്നുണ്ട്. ഗൾഫ് നാടുകളിലേക്ക് പ്രവാസികളായി പോയവരിൽ നിന്ന് തികച്ചും വ്യത്യസ്തമാണ് യൂറോപ്യൻ

നാടുകളിലേക്കുള്ള കടിയേറ്റം. യൂറോപ്യൻ നാടുകളിലേക്കുള്ള കടിയേറി പാർത്തവർ കുടുംബത്തോടൊപ്പമാണ് പോകുന്നത്. ആ നാടുകളിലെ രുഖ്യ ധാരയുടെ ഭാഗമായി മാറാനുള്ള അവസരവും അവർക്കുണ്ട്. അവിടെ വാസമുറപ്പിച്ച ഒന്നാമലമുറയുടെ വേരുകൾ നാട്ടിലാണ്. അവർ വളർന്നതും ആർജിച്ചെടുത്തതുമായ സംസ്കാരത്തിൽ നിന്ന് തികച്ചും വിഭിന്നമാണ് അവരുടെ രണ്ടാം തലമുറയുടെ സംസ്കാരം. അവരുടെ സ്വത്യാനുഭവത്തിന് കേരളവുമായോ മലയാളവുമായോ ഒരു ബന്ധമുണ്ടാവുകയില്ല. അവരുടെ ദേശീയത ഇന്ത്യയുടെതല്ല. ഇത് രണ്ട് തലമുറയുടെ സംഘർഷത്തിലേക്ക് വഴിതെളിക്കുകയും ഒന്നാമലമുറയ്ക്ക് നാട്ടിലെത്തിച്ചേരാൻ സാധിക്കാത്ത സ്ഥിതിവിശേഷം ഉണ്ടാക്കുകയും ചെയ്യും. ഇത്തരം സംഘർഷത്തെ അവതരിപ്പിക്കുന്ന കവിയയാണ് വി.സി. പിറ്റർ നീണ്ടൂരിന്റെ 'മൈൻഡ് യൂവർ ഓൺ ബിസ്നെസ്'.

'ഒൻപത് മാസം ഒൻപത് ദിവസം  
ഒൻപത് നാഴിക ഒൻപത് വിനാഴിക  
ഗർഭത്തിൽ പേറി ജന്മമേറിയ അമ്മസന്താനം  
പതിനെട്ട് കഴിഞ്ഞാൽ പന്ത്രണ്ടെ പരയുന്ന  
മൈൻഡ് യൂവർ ഓൺ ബിസ്നെസ്.'<sup>19</sup>

പ്രവാസജീവിതത്തിന്റെ നേർചിത്രമാണ് ഉത്തരാധുനിക മലയാള കവിതകൾ. മലയാളത്തിലെ പുതുകവിതകളിൽ പ്രവാസജീവിതത്തിന്റെ വ്യത്യസ്താനുഭവങ്ങൾ കടന്നുവരുന്നുണ്ട്. വേരുകൾ തേടുന്ന കരുത്താണ് പ്രവാസസാഹിത്യത്തെ സമ്പന്നമാക്കുന്നത്. പ്രവാസസാഹിത്യത്തിന്റെ ഭാഗമാകുന്ന ഒട്ടേറെ എഴുത്തുകാരണ്ട്. ഗുണവിചിത്രനത്തിനു വിധേയമാകാതെ തന്നെ അനുഭവകുടുംകളും യാത്രാവിവരണങ്ങളും ആത്മകഥകളും നോവലുകളും ചെറുകഥകളും എഴുതുന്നവർ അങ്ങുതട്ടിൽ ഉൾപ്പെടും. ഈ പ്രവാസസാഹിത്യത്തിന്റെ രൂപനിർമ്മാണം അത്ര എളുപ്പമല്ല. വിശാലമായ പാഠനം അർഹിക്കണമെന്നാണ് അവ. പ്രവാസമെന്നത് മനുഷ്യജീവിതത്തിന്റെ ഭാഗധേയത്തെ നിർണയിക്കുന്ന അനുഭവവസ്തുമാണ്. ആ അവസ്ഥയെ ഓരോ എഴുത്തുകാരും ഉൾക്കൊള്ളുന്നതും അനുഭവിക്കുന്നതും ഓരോ തരത്തിലാണ്. അനുഭവങ്ങളിൽ നിന്നും അറിവുകളിൽ നിന്നും വാർന്നു വീണ അത്തരം തിരിച്ചറിവുകളാണ് ഓരോ പ്രവാസരചനയെയും ശ്രദ്ധേയമാക്കുന്നത്. അതുതന്നെയാണ് പ്രവാസികളുടെ മൂല്യവ്യക്തിത്വം.

കുറിപ്പുകൾ

- 1. എഴുത്തച്ഛൻ ഇഞ്ചിത്തത്ത്, അദ്ധ്യാത്മരാമായണംകിളിപ്പാട്ട്, മനോരമ ബുക്സ്, കോട്ടയം, 2000, പുറം-161.
- 2. പമ്പൻ രാമചന്ദ്രൻനായർ, നളചരിതം ആട്ടക്കഥ, കൈരളി വ്യാഖ്യാനം, വി.സി. ബുക്സ്, കോട്ടയം, 2011, പുറം-419.

3. ഇടശ്ശേരി ഗോവിന്ദൻ നായർ, കടിയിറക്കം, ഇടശ്ശേരികവിതകൾ, സമ്പൂർണ്ണ സമാഹാരം, മാതൃഭൂമി ബുക്സ്, കോഴിക്കോട്, 2007, പുറം-285.
4. വൈലോപ്പിള്ളി ശ്രീധരമേനോൻ, കേരളത്തിലെ യഹൂദർ ഇന്ത്യയിലേക്ക്, വൈലോപ്പിള്ളി സമ്പൂർണ്ണകൃതികൾ, വാല്യം ഒന്ന്, കറന്റ് ബുക്സ്, തൃശ്ശൂർ, 2013, പുറം-354.
5. വൈലോപ്പിള്ളി ശ്രീധരമേനോൻ, ആസ്സാം പണിക്കർ, വൈലോപ്പിള്ളി സമ്പൂർണ്ണകൃതികൾ, കറന്റ്ബുക്സ് തൃശ്ശൂർ, 2013, പുറം 351.
6. എൻ.വി.കൃഷ്ണവാര്യർ, ഗ്രാമം, എൻ.വി.യുടെ കവിതകൾ സമ്പൂർണ്ണം, കേരള സാഹിത്യ അക്കാദമി, തൃശ്ശൂർ, 2006, പുറം-235.
7. ഒ.എൻ.വി. കുറുപ്പ്, പ്രവാസി, ഒ.എൻ.വിയുടെ കവിതകൾ ഒരു ബൃഹത് സമാഹാരം, ഡി.സി. ബുക്സ് കോട്ടയം, 2008, പുറം-1017.
8. സുഗതകുമാരി, അഭയാർഥിനി, സുഗതകുമാരിയുടെ കവിതകൾ സമ്പൂർണ്ണം, ഡി.സി. ബുക്സ്, കോട്ടയം, 2001, പുറം-56.
9. അതേപുസ്തകം, പുറം-57.
10. ആറ്റൂർ രവിവർമ്മ, നാട്ടിൽ പാർക്കാത്ത ഇന്ത്യക്കാർ, ആറ്റൂർ രവിവർമ്മയുടെ കവിതകൾ, ഡി.സി. ബുക്സ്, കോട്ടയം, 1995, പുറം-143.
11. ഡി.വിനയചന്ദ്രൻ, വീട്ടിലേക്കുള്ള വഴി, വിനയചന്ദ്രന്റെ കവിതകൾ, ഡി.സി. ബുക്സ്, കോട്ടയം, 2009, പുറം-15.
12. അതേപുസ്തകം, പുറം-24.
13. പി.കെ. രാജശേഖരൻ, പ്രവാസരേഖകൾ, ഭാഷാപോഷിണി, മെയ് 2011, പുറം-14.
14. സർജ്ജ ചാത്തന്തൂർ, നഷ്ടപ്പെട്ട പാസ്‌പോർട്ട്, ഗൾഫ് മലയാളികവിതകൾ രാവുണ്ണി, (എഡി:) കേരള സാഹിത്യ അക്കാദമി, തൃശ്ശൂർ, 2009, പുറം-32.
15. സർജ്ജ ചാത്തന്തൂർ, സ്വാതന്ത്ര്യദിനത്തിൽ മനാൽ ബിൻ അമ്രോയുടെ ചിത്രങ്ങളെക്കുറിച്ച്, ഡയസ്പോറ പ്രവാസികളുടെ കാവ്യസമാഹാരം, ഉമ്മർ തറമേൽ (എഡി:), ഹരിതം ബുക്സ് കോഴിക്കോട്, 2012, പുറം- 96.
16. രാജു ഇരിങ്ങൽ, മകന്റെ അച്ഛൻ, ഡയസ്പോറ, പ്രവാസികളുടെ കാവ്യസമാഹാരം (എഡി:) ഉമ്മർ തറമേൽ, ഹരിതം ബുക്സ്, കോഴിക്കോട് 2012, പുറം -42.
17. വിൽസൺ കൃഷ്ണൻ, വിവർത്തനത്തിന് ഒരു വിഫലപരിശ്രമം, ഡയസ്പോറ, പ്രവാസികളുടെ കാവ്യസമാഹാരം ഉമ്മർ തറമേൽ (എഡി:), ഹരിതം ബുക്സ്, കോഴിക്കോട് 2012, പുറം-53.
18. വിൽസൺ കൃഷ്ണൻ, രണ്ട് മരങ്ങൾ, കൃഷ്ണൻ വിൽസന്റെ കവിതകൾ, ഡി.സി. ബുക്സ്, കോട്ടയം 2012, പുറം-54.
19. പീറ്റർ നിണ്ടൂർ.വി.സി, മൈൻഡ് യുവർ ഓൺ ബിസ്നസ്, അമേരിക്കൻ മലയാളികവിതകൾ, രാവുണ്ണി, (എഡി:) കേരള സാഹിത്യ അക്കാദമി, തൃശ്ശൂർ, 2008, പുറം-32.

# പ്രവാസ സാഹിത്യം

സമ്പാദനം പഠനം  
ഡോ. എ.എസ്. പ്രതീഷ്



ചുട്ടുനീറുന്ന ആകുലതകളുടെ കൊടിയടയാളമായി 'പ്രവാസം' എന്ന സംജ്ഞ മാറിക്കഴിഞ്ഞിരിക്കുന്നു. സ്വന്തം നാട്ടിൽനിന്നും അന്യദേശത്ത് ജീവിക്കേണ്ടിവരുന്ന ഏതുമനസ്സുകാരനും അനുഭവിക്കുന്നത് 'പ്രവാസം' തന്നെയാണ്. സഹനത്തിന്റെയും കണ്ണുനീരിന്റെയും പതംപറച്ചിലുകൾക്കപ്പുറം സുഖസമൃദ്ധിയുടെയും ലോകസൗഹൃദങ്ങളുടെയും മറ്റൊരു വിശാലവേദികൂടി പ്രവാസം ചിലർക്ക് നൽകാറുണ്ട്.

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ഡോ. എ.എസ്. പ്രതീഷ്

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ഡോ. എ.എസ്. പ്രതീഷ്

സമ്പാദനം പഠനം



കേരള ഭാഷാ ഇൻസ്റ്റിറ്റ്യൂട്ട്  
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## ഉള്ളടക്കം

അവതാരിക	പേജ് നമ്പർ
പ്രവാസമെന്ന ബഹുവചനം കെ. ജയകുമാർ ഐ.എ.എസ്	xv
ആമുഖപഠനം - 1 പ്രവാസസാഹിത്യം ഡോ. എ.എസ്. പ്രതീഷ്	xix
ആമുഖപഠനം - 2 പ്രവാസരേഖകൾ ഡോ. പി.കെ. രാജശേഖരൻ	xxiv
ആമുഖപഠനം - 3 പ്രവാസത്തിന്റെ പൊരുൾ വി. രാജകൃഷ്ണൻ	xli

## ഭാഗം ഒന്ന് നോവൽ

1. മുറിഞ്ഞുവീണ ഗൗളിവാലുകൾ ഡോ. ആർ. ചന്ദ്രബോസ്	3
2. അവസാനിക്കാത്ത ആടുജീവിതം ഡോ. ജോർജ്ജ് ഓണക്കൂർ	10
3. അപമാനവീകരണത്തിന്റെ ആഖ്യാനാനുഭവം ഡോ. സുനീത ബാബു. വി.എസ്	13
4. ഇരുപത്തിയൊന്നാം നൂറ്റാണ്ടിലെ പ്രവാസം ഡോ. ഡി.വി. അനിൽകുമാർ	21
5. ചട്ടക്കൂടുകൾക്കുള്ളിലെ ഹമാമുകൾ അശ്വനി. എ.പി	29
6. പുത്തുമലരുന്ന നിലയിടങ്ങൾ ദേവിശ്രീ. ജി	39

7.	തക്കാളിത്തോട്ടത്തിലെ ജീവിതയാതനകൾ ഡോ. നീലിമ ജയദേവൻ	47
8.	തലമുറകളുടെ പ്രവാസം അലക്സ് ബാബു	55
9.	കണ്ണനീർ വീണാനന്തര മണൽപ്പുരപ്പുകൾ റീജ. പി	73
10.	കടിയേറ്റജീവിതത്തിന്റെ സ്വത്വസംഘർഷങ്ങൾ സുര്യ ഭാളി. എസ്	80
11.	ദേശങ്ങളിൽ നിന്ന് സ്ഥാനഭ്രഷ്ടരായവർ അശ്വതി. റ്റി.ജി	85
12.	പ്രവാസവും പ്രയാണവും പിന്നെ, അതിജീവനവും ആര്യാരാജ്. ആർ	90
13.	നീതിതേടിയുള്ള യാത്രകൾ സുജ സാവിധി	94
14.	കരിക്കോട്ടക്കരി എന്ന കനാൻദേശം ഹരിത ജി. മോഹൻ	99
15.	വേരുകൾ തേടി ഗ്രാമത്തിലെത്തുന്നവർ ശാജ. ആർ	112
16.	തലമുറകൾ തമ്മിലുള്ള സംഘർഷം ഡോ. ജി.ജി. പി	121
17.	കാലത്തിനു മുന്നിൽ വേഷപ്പകർച്ചയാടുന്നവർ രഞ്ജിനി. എസ്	124
18.	പ്രവാസത്തിന്റെ ജീവപരിസരം ദീപ. എസ്	131

**ഭാഗം രണ്ട്  
ചെറുകഥ**

1.	പ്രവാസാനുഭവവും മലയാളകഥാഭാവനയും ഡോ. ടി. മധു	143
2.	പ്രവാസിയുടെ രാഷ്ട്രീയം ഡോ. ഇ. ബാനർജി	152
3.	ഉയിർന്നൊന്ന് ഉടുവസ്ത്രം തേടുന്നവർ ഡോ. എസ്. അജയലോഷ്	162

4.	നഗരകാനനത്തിലെ പ്രവാസകാലം ഡോ. എസ്. ജയൻ	169
5.	അന്നംതേടുന്ന തൊഴിൽപ്രവാസങ്ങൾ ഡോ. എസ്. ഹേമലാൽ	174
6.	പ്രവാസത്തിന്റെ ജീവിതവ്യാഖ്യാനങ്ങൾ ആർ. രമ്യ	181
7.	കബീറിന്റെ ചിരിയിലെ മൃകഭാഷ്യങ്ങൾ ഡോ. ദീപ്തി. വി.എസ്	186
8.	നിശബ്ദതയാൽ മുറിവേൽപ്പിക്കപ്പെട്ടവർ മൈത മോഹൻ	194
9.	അഹ്റാജിലെ ബഹുസ്വരത സുരാതി മോഹൻ. ജെ	200
10.	മരുഭൂമിയുടെ ഊഷ്മരയിൽ നിന്നും ഇടവപ്പാതിയുടെ കളിരിലേക്ക് സുര്യ ശ്രീധരൻ	206
11.	ചരിത്രത്തിൽ ഇടനിഷേധിക്കപ്പെട്ടവർ സിബി. വി	211
12.	കടൽ കടന്നുപോകുന്നവർ ഹെമൻ. എം	215

**ഭാഗം മൂന്ന്  
കവിത**

1.	പ്രവാസികവിത മലയാളത്തിൽ ഡോ. ശിവദാസ് കെ.കെ.	221
2.	ഒടിച്ചുകത്തിച്ചെടിയുടെ വിഹലതകൾ ഡോ. എം.എസ്. സുചിത്ര	234
3.	വീട്ടിലേക്കു പോകുന്നവർ ഐശ്വര്യ മാധവൻ	239
4.	പ്രവാസവും സ്വത്വനഷ്ടവും ഗീതു. പി.ജി	246
5.	കവിതയിലെ പ്രവാസകാലം രോഷ്ണി. എം	253

**ഭാഗം നാല്  
തിരക്കഥ**

1. മലയാളസിനിമയും പ്രവാസസ്വതന്ത്രപ്രതിസന്ധിയും രേഖ. എസ്	265
2. പ്രവാസജീവിതത്തിന്റെ നേർക്കാഴ്ചകൾ കിരൺ മോഹൻ. എം	272
3. പെൺപ്രവാസം മലയാളസിനിമയിൽ കവിത. സി.കെ	277
4. പ്രവാസി തൊഴിൽസംസ്കാരം അജി. ഡി	284
5. സ്വപ്നങ്ങൾ വിൽക്കുന്നവർ ഐശ്വര്യ. എ	289
6. പ്രവാസജീവിതം പത്തേഴായിൽ പെടീഷ്യ ജോൺ	295
7. മലയാളിയുടെ ഗൾഫ്കടിയേറ്റം രാജേഷ്. ആർ	299

**ഭാഗം അഞ്ച്  
ചലച്ചിത്രഗാനങ്ങൾ**

1. പ്രവാസജീവിതവിഷ്കാരം മലയാളചലച്ചിത്രഗാനങ്ങളിൽ കൃഷ്ണപ്രിയ. ആർ.വി	307
--	-----

**ഭാഗം ആറ്  
നാടകം**

1. സ്വത്വം നഷ്ടപ്പെടുന്നവർ സതീഷ് ജി. നായർ	315
--	-----

**ഭാഗം ഏഴ്  
ഓർമ്മക്കുറിപ്പുകൾ**

1. ജീവിതഗന്ധിയായ സൊറകൾ ആഷിത എസ്. ഷാബു	323
--	-----

2. പ്രവാസിയുടെ ഓർമ്മക്കുറിപ്പുകൾ അശ്വതി. എം.സി	327
3. വേരുകളില്ലാത്ത പാഴ്കുരങ്ങൾ ലീയ. ജെ	333
4. പ്രവാസമെന്ന ദുരിതദ്രമിക അരുൺ. ജെ.ജി	336

**ഭാഗം എട്ട്  
സഞ്ചാരസാഹിത്യം**

1. കാപ്പിരികളുടെ നാട്ടിലെ ഇന്ത്യാക്കാർ ജി.എസ്	347
2. മലയാളികളുടെ അറബ്ജീവിതം ഷിഹാബി. കെ.എസ്	351

**ഭാഗം ഒൻപത്  
സംസ്കാരം**

1. സംസ്കാരം പ്രവാസി രചനകളിൽ ഡോ. സീമാ ജെറോം	361
2. ദേശം ഒരു കഥയെഴുതുന്നു ശ്രീല. എസ്	373

**ഭാഗം പത്ത്  
ഇതിഹാസങ്ങൾ**

1. ഇതിഹാസകൃതികളിലെ പ്രവാസം ഡോ. സുഷമകുമാരി. എസ്	381
2. ബൈബിൾ: പ്രവാസജീവിതവിഷ്കാരങ്ങളുടെ അക്ഷയഖനി എബി എം. അലക്സ്	388

**ഭാഗം പതിനൊന്ന്  
ഫെയ്സ്ബുക്ക്/ബ്ലോഗ്**

1. പ്രവാസം ഫെയ്സ്ബുക്ക് സാഹിത്യത്തിൽ സംഗീത് മാത്യു	399
2. ബ്ലോഗെഴുത്തിലെ പ്രവാസം അന ജെയിംസ്	409

# മുറിഞ്ഞുവീണ ഗൗളിവാലുകൾ പ്രവാസത്തിന്റെ അനുഭൂതിചരിത്രം

ഡോ. ആർ. ചന്ദ്രബോസ്

## പ്രവാസവും ആധുനികതയും

മലയാളികളുടെ അനുഭൂതിചരിത്രത്തിൽ പ്രവാസം മുറിഞ്ഞുപോയ ഗൗളിവാൽപോലെ പിടഞ്ഞു നിശ്ചലമായ ഓർമകളാണ്. ആ ഓർമകളെക്കൂടി രേഖപ്പെടുത്തിയാലേ നമ്മുടെ സാംസ്കാരികചരിത്രം പൂർണ്ണമാവുകയുള്ളൂ. പ്രവാസത്തിന്റെയും അത് സൃഷ്ടിച്ച സങ്കീർണ്ണങ്ങളായ വൈകാരിക പ്രശ്നങ്ങളുടെയും നൂറ്റാണ്ടായിരുന്നു ഇരുപതാം നൂറ്റാണ്ട്. വിവരസാങ്കേതിക സംവിധാനങ്ങളുടെ വർത്തമാനകാലത്ത് പ്രതീതിയാമാർദ്ദങ്ങളുടെ പ്രതലങ്ങളിൽ പ്രവാസം അതിന്റെ വൈകാരികഭാവങ്ങൾ ഇറക്കിവെച്ച് ഇളവേല്ക്കുന്നുണ്ട്. എന്നാൽ കഴിഞ്ഞ നൂറ്റാണ്ടിൽ പ്രവാസത്തിലേക്ക് റെയിലേറിപ്പോയവരും കപ്പലേറിപ്പോയവരുമായ നമ്മുടെ മുൻതലമുറകൾക്ക് അത് അനിശ്ചിതത്വങ്ങളിലേക്കുള്ള യാത്രകളായിരുന്നു.

നമ്മുടെ സമൂഹത്തെ പരിഷ്കാരത്തിലേക്കും ആധുനികതയിലേക്കും വളർത്തിയതിൽ നവോത്ഥാനമുന്നേറ്റങ്ങളും പുരോഗമനപ്രസ്ഥാനങ്ങളും വഹിച്ച പങ്കുപോലെതന്നെ പ്രധാനമാണ് പ്രവാസികളുടെ ഭൗതികവും ബൗദ്ധികവുമായ നീക്ഷേപങ്ങൾക്കുമുള്ളത്. കോളോണിയൽ ആധുനികത കൊണ്ടുവന്ന ഗതാഗതസൗകര്യങ്ങളും നഗരകേന്ദ്രിത വിദ്യാഭ്യാസ സൗകര്യങ്ങളും പത്തൊൻപതാം നൂറ്റാണ്ടിന്റെ അവസാനദശകങ്ങളിൽ ഫ്യൂഡൽ കുടുംബങ്ങളിലെ ചില ധിഷണശാലികളെ വിലക്കുകളുടെ 'കോരപ്പുകൾ' മുറിച്ചുകടന്ന് വിജ്ഞാനനഗരങ്ങളിലേക്ക് പോകാൻ പ്രേരിപ്പിച്ചിരുന്നു. മലബാറിൽ നിന്ന് സൈദാപേട്ട കാർഷികകോളേജിൽ കൃഷിശാസ്ത്രം പഠിക്കാൻ വേങ്ങയിൽ കുഞ്ഞിരാമൻ നായനാർ എന്ന ജന്മിത്തമ്പുരാൻപോയത് ചരിത്രമാണ്. മലബാർ കളക്ടറായിരുന്ന ലോഗൻസായ്യാണ് ആധുനികമായ അറിവിന്റെ ലോകത്തേക്ക് നായനാറെ പറഞ്ഞെച്ചതത്രേ. ഏതായാലും വിദ്യാർജ്ജനത്തിനായുള്ള പ്രവാസശേഷം തിരികെ വന്ന നായനാർ മലബാറിൽ പുത്തൻ കാർഷികസംസ്കാരത്തിനും മലയാളസാഹിത്യത്തിൽ ചെറുകഥയ്ക്കും വിതയൊരുക്കി. അങ്ങനെ ആധുനികതയിലേക്കുള്ള മലയാളി

സ്വന്തം കടുബന്തെ സംരക്ഷിക്കാനുള്ള ബാധ്യത എറ്റെടുത്ത്, യുദ്ധ സമാനസാഹചര്യമാണെന്ന് തിരിച്ചറിഞ്ഞിട്ടും വിദേശത്ത് ജോലിക്ക് വേണ്ടി ഇറങ്ങിപ്പോകുന്ന നല്ലമാരിൽ ഒരാളാണ് സമീറയും. എന്ത് പ്രതിസന്ധിയിലും മനോനില കൈവിടാതെ ആത്മബലവ്യയത്തോടെ പ്രശ്നങ്ങളെ അഭിമുഖീകരിക്കുന്ന കരുത്തുള്ള വർത്തമാനകാല സ്ത്രീയുടെ പ്രതിനിധിയാണവൾ. ഒരേ സമയം തന്നെ അമ്മയായും രണ്ടാം ഭാര്യയായും ഒരു കടുബത്തിന്റെ മുഴുവൻ പ്രതീക്ഷയായും ഒക്കെ മാറുന്ന പകമതിയായ ഒരു സ്ത്രീയാണവൾ. തീവ്രവാദികളുടെ പിടിയലകപ്പെട്ടപ്പോഴും അവൾ സ്വന്തം ജീവനും ഭർത്താവിന്റെയും സഹപ്രവർത്തകരുടെയും ജീവനും രക്ഷിച്ചെടുത്തത് അവളുടെ മനോബലവ്യയത്തിന്റെ തെളിവാണ്. ശക്തമായ ഉറപ്പു നിലപാടുകൾ കൊണ്ടും മനശ്ശക്തികൊണ്ടും ശ്രദ്ധേയമായ കഥാപാത്രമായി സമീറ പ്രേക്ഷകമനസ്സിൽ നിലനില്ക്കുക തന്നെ ചെയ്യും.

പുരുഷകേന്ദ്രീകൃത ചലച്ചിത്രങ്ങൾ അങ്ങുവാനുന്ന സിനിമാമേഖലയിൽ പ്രവാസിസ്ത്രീകളുടെ വ്യത്യസ്ത അനുഭവങ്ങൾ കൊണ്ടും വ്യത്യസ്തതയാർന്ന അവതരണം കൊണ്ടും ശ്രദ്ധേയമായി നിൽക്കുന്നു സീതയും അശ്വതിയും സമീറയും.

## പ്രവാസജീവിതം പത്തേമാരിയിൽ

പെരിഷ്കര ജോൺ

പ്രവാസജീവിതത്തിന്റെ നേർക്കാഴ്ചകൾ അടയാളപ്പെടുത്തിയ ശ്രദ്ധേയമായ ഒരു സിനിമയാണ് സലീം അഹമ്മദ് സംവിധാനം നിർവഹിച്ച 2015-ൽ പുറത്തിറങ്ങിയ പത്തേമാരി. അറുപത് എഴുപത് കാലഘട്ടത്തിൽ മലയാളക്കരയൊക്കെ പടർന്നുപിടിച്ച 'ഗൾഫ്' എങ്ങനെയാണ് സമൂഹത്തിന്റെ താഴേത്തട്ടിൽ ജീവിക്കുന്ന ഒരു സാധാരണക്കാരന്റെ ജീവിതത്തെ മാറ്റിമറിച്ചത് എന്ന് ഈ ചിത്രം വിശദമായി ചർച്ച ചെയ്യുന്നു. കേവലമായ സാമ്പത്തികനേട്ടവും അതിനെത്തുടർന്നുണ്ടാകുന്ന കടുബഭദ്രതയും സാമ്പത്തിക ഡ്രോതസ്സിനെ ചുറ്റിപ്പറ്റി പരാഭയപ്പെടുന്ന നിൽക്കുന്ന ബന്ധുക്കളും എല്ലാം പ്രത്യക്ഷത്തിൽ ഈ ചിത്രം അനാവരണം ചെയ്യുന്നുണ്ടെങ്കിലും പരോക്ഷമായി കടുബജീവിതത്തിലെ അടിച്ചമർത്തലുകളും അതിനെത്തുടർന്ന് സംജാതമാകുന്ന ഉൾസംഘർഷങ്ങളും ഈ ചിത്രം പ്രേക്ഷകർക്കു മുന്നിൽ വയ്ക്കുന്നുണ്ട്. പ്രവാസിയുടെ നേട്ടങ്ങൾ എന്നത് അവന്റെ നഷ്ടപ്പെട്ടവകൾക്ക് നൽകേണ്ടിവരുന്ന വിലയാണ് എന്ന് ചിത്രം കാണുന്ന എന്തൊരാൾക്കും ബോധ്യമാകും. ഈ നഷ്ടപ്പെടലിൽ നാടും നാടിന്റെ ഗൃഹാതുരത്വമുണർത്തുന്ന ഓർമ്മകളും മാത്രമല്ല ഉള്ളത്, കടുബജീവിതത്തിന്റെ ഈഷ്ടതയും സംഘ്രാമിയും എല്ലാം ഈ നഷ്ടപ്പെടലുകളുടെ കൂട്ടത്തിൽ ഉൾപ്പെടുന്നു.

പള്ളിക്കൽ നാരായണൻ എന്ന മുഖ്യകഥാപാത്രം വളരെ ചെറുപ്രായത്തിൽ തന്നെ കടുബത്തിന്റെ പ്രാധാന്യം എറ്റെടുത്ത് ഒരപാട് സ്വപ്നങ്ങളുമായി ഗൾഫിലേക്ക് യാത്ര തിരിക്കുന്ന ഒരാളാണ്. സ്വന്തം കടുബത്തിന്റെ സുഖവും സമൃദ്ധിയും സ്വപ്നം കണ്ട അയാൾ വരുംവരായുകൾക്കെടുപ്പിച്ച് പോലും ആലോചിക്കാതെ ചേർന്നു കടപ്പാട് നിന്ന് സുഹൃത്തിനോടൊപ്പം വേലായുധൻ എന്നയാളുടെ പത്തേമാരിയിൽ യാത്ര പുറപ്പെട്ടുകയാണ്. ഒരപാട് പ്രതിബന്ധങ്ങളും പ്രകൃതിയുടെ ക്രൂരഭാവങ്ങളും മറികടന്ന് ഗൾഫിൽ എത്തിച്ചേരുന്ന അയാളെ കാത്തിരുന്നത് മരുഭൂമിയുടെ വറ്റിപ്പൊളിച്ച കാഴ്ചകളും കഷ്ടപ്പാടുകളുമായിരുന്നു. അധ്വാനിയായ നാരായണൻ പ്രതികൂല സാഹചര്യങ്ങൾക്കിടയിൽ നിന്നും സാവധാനം ഒരു ജീവിതം കരുപ്പിടിപ്പിക്കുകയായിരുന്നു. എന്നാൽ കല്യാണം കഴിഞ്ഞതിനു ശേഷമുള്ള കാലഘട്ടത്തിൽ പള്ളിക്കൽ നാരായണന്റെ മനസ്സിലേർഷങ്ങൾ പുതിയൊരുതലത്തിലേക്ക് തുറന്നു

# പ്രവാസ സാഹിത്യം

സമ്പാദനം പഠനം  
ഡോ. എ.എസ്. പ്രതീഷ്



ചുട്ടുനീറുന്ന ആകുലതകളുടെ കൊടിയടയാളമായി 'പ്രവാസം' എന്ന സംജ്ഞ മാറിക്കഴിഞ്ഞിരിക്കുന്നു. സ്വന്തം നാട്ടിൽനിന്നും അന്യദേശത്ത് ജീവിക്കേണ്ടിവരുന്ന ഏതുമനസ്സുകാരനും അനുഭവിക്കുന്നത് 'പ്രവാസം' തന്നെയാണ്. സഹനത്തിന്റെയും കണ്ണുനീരിന്റെയും പതംപറച്ചിലുകൾക്കപ്പുറം സുഖസമൃദ്ധിയുടെയും ലോകസൗഹൃദങ്ങളുടെയും മറ്റൊരു വിശാലവേദികൂടി പ്രവാസം ചിലർക്ക് നൽകാറുണ്ട്.

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## ഉള്ളടക്കം

	പേജ് നമ്പർ
അവതാരിക	xv
പ്രവാസമെന്ന ബഹുവചനം കെ. ജയകുമാർ ഐ.എ.എസ്	
ആമുഖപഠനം - 1	xix
പ്രവാസസാഹിത്യം ഡോ. എ.എസ്. പ്രതീഷ്	
ആമുഖപഠനം - 2	xxiv
പ്രവാസരേഖകൾ ഡോ. പി.കെ. രാജശേഖരൻ	
ആമുഖപഠനം - 3	xli
പ്രവാസത്തിന്റെ പൊരുൾ വി. രാജകൃഷ്ണൻ	
<b>ഭാഗം ഒന്ന് നോവൽ</b>	
1. മുറിഞ്ഞുവീണ ഗൗളിവാലുകൾ ഡോ. ആർ. ചന്ദ്രബോസ്	3
2. അവസാനിക്കാത്ത ആടുജീവിതം ഡോ. ജോർജ് ഓണക്കൂർ	10
3. അപമാനവീകരണത്തിന്റെ ആഖ്യാനാനുഭവം ഡോ. സുനീത ബാബു. വി.എസ്	13
4. ഇരുപത്തിയൊന്നാം നൂറ്റാണ്ടിലെ പ്രവാസം ഡോ. ഡി.വി. അനീൽകുമാർ	21
5. ചട്ടക്കൂടുകൾക്കുള്ളിലെ ഹമാമുകൾ അശ്വനി. എ.പി	29
6. പുത്തുമലരുന്ന നിലയിടങ്ങൾ ദേവിശ്രീ. ജി	39

7.	തക്കാളിത്തോട്ടത്തിലെ ജീവിതയാനകൾ ഡോ. നവീൽ ജയറാജ്	47
8.	തലമുറകളുടെ പ്രവാസം അഷ്ലീഖ് ബാബു	55
9.	കണ്ണൂരിൽ വിഭജനത്തെ മണൽപ്പാപുകൾ റീമ പി	73
10.	കടിയേറ്റുജീവിതത്തിന്റെ സ്വത്വസംഘർഷങ്ങൾ സുജ ഫ്രാൻസ്	80
11.	ദേശങ്ങളിൽ നിന്ന് സമാനദ്രവ്യായവൾ അശ്വതി റ്റി.ജി	85
12.	പ്രവാസവും പ്രയാണവും പിന്നെ, അതിജീവനവും ആര്യാരത്ത്. ആർ	90
13.	നീതിതടയില്ലാത്ത യാത്രകൾ സുര സാധിയാ	94
14.	കവിയോട്ടക്കുറി എന്ന കനാൽദേശം ഹാരിത ജി. മോഹൻ	99
15.	വേഷകൾ തോടി ഗ്രാമത്തിലെത്തുന്നവർ ശരണ ആർ	112
16.	തലമുറകൾ തമ്മിലുള്ള സംഘർഷം ഡോ. ജി.പി. പി	121
17.	കാലത്തിന് മുന്നിൽ വേഷപ്പകർച്ചയാടുന്നവർ മണിനീല എസ്	124
18.	പ്രവാസത്തിന്റെ ജീവപരിസരം ദീപ എസ്	131
<b>ഭാഗം രണ്ട് ചെറുകഥ</b>		
1.	പ്രവാസാനുഭവവും മലയാളകഥാഭാവനയും ഡോ. ടി. സു	143
2.	പ്രവാസിയുടെ രാഷ്ട്രീയം ഡോ. ഇ. മധനമണി	152
3.	ഉയിർന്നൊന്നിട്ടുണ്ടാകാതെ മരിക്കുന്നവർ ഡോ. എസ്. അരുൺദാസ്	162

4.	നഗരകാനനത്തിലെ പ്രവാസകാലം ഡോ. എസ്. ജയ്	169
5.	അനാതോളിയൻ തൊഴിലിടപ്രവാസങ്ങൾ ഡോ. എസ്. ഹൈന്ദാവ്	174
6.	പ്രവാസത്തിന്റെ ജീവിതവ്യായാമങ്ങൾ ആർ. രാജ	181
7.	കണിനിന്റെ ചിന്തിച്ചിട്ടുള്ള മൂലകാവ്യങ്ങൾ ഡോ. സി.പി. വി.എസ്	186
8.	നിമഗ്നനായാൽ മുറിയപ്പെട്ടിരിക്കപ്പെട്ടവർ ജൈന മോഹൻ	194
9.	അഹ്‌റാബിലെ ബഹുസ്വരത സദതി മോഹൻ ജെ	200
10.	മരുഭൂമിയുടെ ഉറപ്പാക്കലിൽ നിന്നും ഇടവുമ്പതിയുടെ കളിയിലേക്ക് സുജ ഫ്രാൻസ്	206
11.	ചരിത്രത്തിൽ ഇടംനിലക്കുറവുള്ളവർ സുബി. വി	211
12.	കടൽ കടന്നുപോകുന്നവർ പൊതുവേ എം	215
<b>ഭാഗം മൂന്ന് കവിത</b>		
1.	പ്രവാസികവിത മലയാളത്തിൽ ഡോ. ശിവമന്ത് കെ.കെ	221
2.	മടിച്ചുകയറിയവരുടെ വിഹിതങ്ങൾ ഡോ. എം.എസ്. സുചിത്ര	234
3.	നിട്ടിലേക്കു പോകുന്നവർ മഹേഷ്വര മധനൻ	239
4.	പ്രവാസവും സ്വത്വനഷ്ടവും ഗീതു പി.ജി	246
5.	കവിതയിലെ പ്രവാസകാലം പൊതുവേ എം	253

**ഭാഗം നാല്  
തിരക്കഥ**

1. മലയാളസിനിമയും പ്രവാസസ്വതന്ത്രപ്രതിസന്ധിയും കെ.എസ്	265
2. പ്രവാസജീവിതത്തിന്റെ നേർക്കാഴ്ചകൾ കിരീട് മോഹൻ, എം	272
3. പെൺപ്രവാസം മലയാളസിനിമയിൽ കവിത, സി.കെ	277
4. പ്രവാസി തൊഴിൽസംസ്കാരം അശ്വി, ഡി	284
5. സ്വപ്നങ്ങൾ വിൽക്കണവർ പുഴംപാട്ട്, എ	289
6. പ്രവാസജീവിതം പത്തൊമ്പതാം നൂറ്റാണ്ടിൽ കെ.ടി.എസ്. ജോൺ	295
7. മലയാളിയുടെ ഗൾഫ്കടിയേറ്റം രാമകൃഷ്ണൻ, തൃശ്ശൂർ	299

**ഭാഗം അഞ്ച്  
ചലച്ചിത്രഗാനങ്ങൾ**

1. പ്രവാസജീവിതവിഷ്ണുരംഗം മലയാളചലച്ചിത്രഗാനങ്ങളിൽ കൃഷ്ണപ്രിയ, തൃശ്ശൂർ	307
--	-----

**ഭാഗം ആറ്  
നാടകം**

1. സ്വതന്ത്ര നഷ്ടപ്പെടുന്നവർ സതീഷ്, ഡി, നായർ	315
---	-----

**ഭാഗം ഏഴ്  
ഓർമ്മക്കുറിപ്പുകൾ**

1. ജീവിതഗന്ധിയായ സൊറകൾ ആശിത, എസ്, സാബു	323
---	-----

2. പ്രവാസിയുടെ ഓർമ്മക്കുറിപ്പുകൾ അശ്വി, എം.സി	327
3. വേരുകളില്ലാത്ത പാറ്റകൾ ടി.പി. ജെ	333
4. പ്രവാസമെന്ന ദുരിതദ്രുമിക അനന്ദൻ, മെ.ജി	336

**ഭാഗം എട്ട്  
സഞ്ചാരസാഹിത്യം**

1. കാറ്റിരികളുടെ നാട്ടിലെ ഇന്ത്യാക്കാർ ജി.ജി. എസ്	347
2. മലയാളികളുടെ അറബ്ജീവിതം സി.എസ്. കെ.എസ്	351

**ഭാഗം ഒൻപത്  
സംസ്കാരം**

1. സംസ്കാരം പ്രവാസി രചനകളിൽ മധു, സീമ ജെറോം	361
2. ദേശം ഒരു കഥയെഴുതുന്ന ശ്രീലാ, എസ്	373

**ഭാഗം പത്ത്  
ഇതിഹാസങ്ങൾ**

1. ഇതിഹാസകൃതികളിലെ പ്രവാസം മധു, സുഷമകുമാരി, എസ്	381
2. ബൈബിൾ: പ്രവാസജീവിതവിഷ്ണുരംഗങ്ങളുടെ അക്ഷയഖനി എബി എം. അലക്സ്	388

**ഭാഗം പതിനൊന്ന്  
ഫെയ്സ്ബുക്ക്/ബ്ലോഗ്**

1. പ്രവാസം ഫെയ്സ്ബുക്ക് സാഹിത്യത്തിൽ സംഗീത്, മാത്യു	399
2. ബ്ലോഗെഴുത്തിലെ പ്രവാസം അന ജെയിംസ്	409

# മുറിഞ്ഞുവീണ ഗൗളിവാലുകൾ പ്രവാസത്തിന്റെ അനുഭൂതിചരിത്രം

ഡോ. ആർ. ചന്ദ്രബോസ്

## പ്രവാസവും ആധുനികതയും

മലയാളികളുടെ അനുഭൂതിചരിത്രത്തിൽ പ്രവാസം മുറിഞ്ഞുപോയ ഗൗളിവാൽപോലെ പിടഞ്ഞു നിശ്ചലമായ ഓർമകളാണ്. ആ ഓർമകളെ കൂടി രേഖപ്പെടുത്തിയാലേ നമ്മുടെ സാംസ്കാരികചരിത്രം പൂർണ്ണമാവുകയുള്ളൂ. പ്രവാസത്തിന്റെയും അത് സൃഷ്ടിച്ച സങ്കീർണ്ണങ്ങളായ വൈകാരിക പ്രശ്നങ്ങളുടെയും നൂറ്റാണ്ടായിരുന്നു ഇരുപതാം നൂറ്റാണ്ട്. വിവരസാങ്കേതിക സംവിധാനങ്ങളുടെ വർത്തമാനകാലത്ത് പ്രതീതിയാമാർദ്ദങ്ങളുടെ പ്രതലങ്ങളിൽ പ്രവാസം അതിന്റെ വൈകാരികഭാവങ്ങൾ ഇറക്കിവെച്ച് ഇളവേല്ക്കുന്നുണ്ട്. എന്നാൽ കഴിഞ്ഞ നൂറ്റാണ്ടിൽ പ്രവാസത്തിലേക്ക് റെയിലേറിപ്പോയവരും കപ്പലേറിപ്പോയവരുമായ നമ്മുടെ മുൻതലമുറകൾക്ക് അത് അനിശ്ചിതത്വങ്ങളിലേക്കുള്ള യാത്രകളായിരുന്നു.

നമ്മുടെ സമൂഹത്തെ പരിഷ്കാരത്തിലേക്കും ആധുനികതയിലേക്കും വളർത്തിയതിൽ നവോത്ഥാനമുന്നേറ്റങ്ങളും പുരോഗമനപ്രസ്ഥാനങ്ങളും വഹിച്ച പങ്കുപോലെതന്നെ പ്രധാനമാണ് പ്രവാസികളുടെ ഭൗതികവും ബൗദ്ധികവുമായ നീക്ഷണങ്ങൾക്കുമുള്ളത്. കോളോണിയൽ ആധുനികത കൊണ്ടുവന്ന ഗതാഗതസൗകര്യങ്ങളും നഗരകേന്ദ്രിത വിദ്യാഭ്യാസ സൗകര്യങ്ങളും പത്തൊൻപതാം നൂറ്റാണ്ടിന്റെ അവസാനദശകങ്ങളിൽ ഫ്യൂഡൽ കുടുംബങ്ങളിലെ ചില ധിഷണശാലികളെ വിലക്കുകളുടെ 'കോരപ്പുകൾ' മുറിച്ചുകടന്ന് വിജ്ഞാനനഗരങ്ങളിലേക്ക് പോകാൻ പ്രേരിപ്പിച്ചിരുന്നു. മലബാറിൽ നിന്ന് സൈദാപേട്ട കാർഷികകോളേജിൽ കൃഷിശാസ്ത്രം പഠിക്കാൻ വേണ്ടയിൽ കഞ്ഞിരാമൻ നായനാർ എന്ന ജന്മിത്തന്മാന്മാർപോലെയെ ചരിത്രമാണ്. മലബാർ കളക്ടറായിരുന്ന ലോഗൻസായ്യാണ് ആധുനികമായ അറിവിന്റെ ലോകത്തേക്ക് നായനാറെ പറഞ്ഞയച്ചതത്രേ. ഏതായാലും വിദ്യാർജ്ജനത്തിനായുള്ള പ്രവാസശേഷം തിരികെ വന്ന നായനാർ മലബാറിൽ പുത്തൻ കാർഷികസംസ്കാരത്തിനും മലയാളസാഹിത്യത്തിൽ ചെറുകഥയും വിതയൊരുക്കി. അങ്ങനെ ആധുനികതയിലേക്കുള്ള മലയാളി

# പ്രവാസം സാഹിത്യം

സമ്പാദനം പഠനം  
ഡോ. എ.എസ്. പ്രതീഷ്



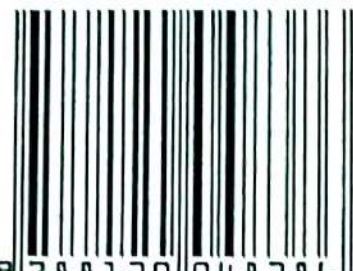
ചുട്ടുനിറുന്ന ആകുലതകളുടെ കൊടിയടയാളമായി 'പ്രവാസം' എന്ന സാജ്ഞ മാറിക്കഴിഞ്ഞിരിക്കുന്നു. സ്വന്തം നാട്ടിൽനിന്നും അന്യദേശത്ത് ജീവിക്കേണ്ടിവരുന്ന ഏതാനാട്ടുകാരനും അനുഭവിക്കുന്നത് 'പ്രവാസം' തന്നെയാണ്. സഹനത്തിന്റെയും കണ്ണുനീരിന്റെയും പതംപറച്ചിലുകൾക്കപ്പുറം സുഖസമൃദ്ധിയുടെയും ലോകസൗഹൃദങ്ങളുടെയും മറ്റൊരു വിശാലവേദികയിൽ പ്രവാസം ചിലർക്ക് നൽകാറുണ്ട്.

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# സാഹിത്യഗവേഷണവും കലയും വിമർശനവും

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ഡോ.എ.എസ്. പ്രതീഷ്

# സാഹിത്യഗവേഷണം കലയും വിമർശനവും

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SAHITHYA GAVESHANAM  
KALAYUM VIMARSANAVUM  
Compiled and study by  
Dr. A.S. Pratheesh

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ഡോ. എ.എസ്. പ്രതീഷ്



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## ഉള്ളടക്കം

1.	കവിത്രയകവിതകളിലെ ക്ലാസിക്കു ചാരുതകൾ - ഡോ. വിജയൻ ചാലോട് .....	1
2.	കാൽപ്പനികകവിതയിലെ സങ്കടങ്ങൾ - ഡോ. കെ. പ്രസന്നരാജൻ .....	21
3.	ഭ്രമകൽപ്പനയിൽ കഥമെന്നയുന്വോൾ - ഡോ. വൽസലൻ വാതുശ്ശേരി .....	41
4.	കുമാരനാശാന്റെ കവിതയിലെ സ്വാതന്ത്ര്യസങ്കല്പം - ഡോ. നുജും .....	53
5.	കവിതയും പ്രകൃതിയും - ഡോ. സുരേഷ് .....	63
6.	കവിതയിലെ കേരളീയമുദ്രകൾ - ഡോ. സുചിത്ര.എം.എസ് .....	71
7.	കവിതയും പ്രത്യയശാസ്ത്രവും - ഡോ. ഗംഗാദേവി.എം. ....	96
8.	പ്രണയത്തിന്റെ കാവ്യപുസ്തകം - ഡോ. തുളസീമണി .....	110
9.	പാരമ്പര്യവും ആധുനികതയും - ഡോ. സി. ഉണ്ണികൃഷ്ണൻ .....	113
10.	ചീരാമകവിയുടെ സാഹിത്യഭംഗികൾ - ഡോ. എൻ. ലീലാബായ് .....	122
11.	മാനവികതയുടെ കാവ്യപ്രയാണങ്ങൾ - ഡോ. എ. രമാദേവി .....	141



12.	മണിപ്രവാളകവിത എന്ന സൗന്ദര്യചക്ഷുസ്സും - ഡോ. ഐഷ്വരീദേവി.....	149
13.	ഗുരുസങ്കല്പം മലയാള കവിതയിൽ - ഡോ. ഉഷാകുമാരി.....	165
14.	എം.ടി. - കഥാഖ്യാനത്തിന്റെ സൂക്തവഴികൾ - ഡോ. എ.എസ്. പ്രതീഷ്.....	180
15.	ആധുനികകവിതയും രാഷ്ട്രീയവും - ഡോ. സുനീൽകുമാർ.....	195
16.	കാവ്യലോകങ്ങളിൽ മലയാളി - ഡോ. ഇന്ദുശ്രീ.എസ്.ആർ.....	237
17.	കവിവൃത്തിയുടെ പരിണാമം അക്കിത്തത്തിന്റെ കവിതകളിൽ - ഡോ. കെ. ബാബു.....	247

## കവിത്രയകവിതകളിലെ ക്ലാസിക്കലിസം

ഡോ. വിജയൻ ചാലോട്

നൂറ്റാണ്ടുകളിലായി വ്യാപിച്ചുകിടക്കുന്ന വികാസപരിണാമങ്ങളെ ഉൾക്കൊണ്ട് രൂപംപുണ്ട ഒരു അർത്ഥകൽപ്പനയാണ് ഇന്നു സാഹിത്യത്തിൽ 'ക്ലാസിക്ക' എന്ന പദത്തിനുള്ളത്. 'ക്ലാസിക്ക' സങ്കല്പത്തെ നിർവചിക്കുന്നതിനു പകരം അതിന്റെ സവിശേഷതകൾ നിർണയിക്കാനാണ് പലരും ശ്രദ്ധിച്ചുകാണുന്നത്. സന്തുലിതാവസ്ഥ, ആന്തരികൈക്യം, ക്ലിപ്തത, മഹത്തായ ലാളിത്യം, പ്രശാന്ത ഗാഭീര്യം എന്നിങ്ങനെയുള്ള ചില സ്വഭാവങ്ങൾ ക്ലാസിക്കുകൾക്ക് ഉണ്ടായിരിക്കുമെന്ന് 'എ റിഡേഴ്സ് ഗൈഡ് ടു ലിറ്റററി ടേംസ്' എന്ന ഗ്രന്ഥത്തിൽ നിർണയിക്കുന്നുണ്ട്.

### ക്ലാസിക്കുകൾ

പാശ്ചാത്യ നവോത്ഥാനകാലത്ത് ക്ലാസിക്കുകൾക്കു വർദ്ധിച്ച പ്രാധാന്യം കൈവരികയും അതു നവക്ലാസിക്കിസം (Neo-Classicism) അതിന്റെ പ്രാചുര്യത്തിനു വഴിതെളിക്കുകയും ചെയ്തു. ബാലോ, ഡ്രൈഡൻ, അലക്സാണ്ടർ പോപ്പ്, ഡോ. ജോൺസൺ എന്നിവർ യൂറോപ്പിൽ നിയോക്ലാസിക്ക പ്രസ്ഥാനത്തിന്റെ വക്താക്കളും പ്രയോക്താക്കളുമായി മാറി. ഹോമർ, ഹോറസ്, വെർജീൻ തുടങ്ങിയവരുടെ കാവ്യ മാർഗത്തിലൂടെയും സങ്കല്പത്തിലൂടെയും മാത്രമേ കവികൾ സഞ്ചരിക്കാവൂ എന്ന് ബാലോ നിഷ്കർഷിച്ചു. കാവ്യത്തിനു നിയമങ്ങളുണ്ടാകുകയും ടൈപ്പുകൾ സൃഷ്ടിക്കുകയും പ്രകൃതിയെ ചിത്രീകരിക്കുന്നതിനു പകരം ക്രമീകരിച്ച പ്രകൃതി (Methodised Nature) യെ ആവിഷ്കരിക്കാൻ നിർബന്ധിക്കുകയും ചെയ്തത് ഇതിന്റെ ഭാഗമായിട്ടായിരുന്നു. ക്ലാസിക്ക

# സാഹിത്യഗവേഷണ കലയും വിമർശനവും



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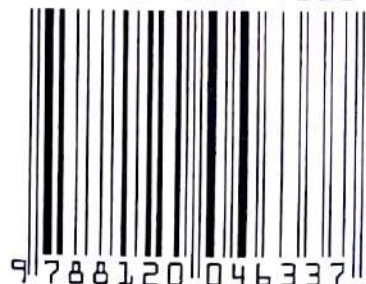
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ഡോ. എ. എസ്. പ്രതിഷ്ഠ

# ഹാസ്യവും മലയാള കവിതയും



# ഹാസ്യവും മലയാളകവിതയും

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HASYAVUM MALAYALA KAVITHAYUM  
(A study)  
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## ഉള്ളടക്കം

ഹാസ്യവും വീക്ഷണവും	10
സഞ്ജയൻ - കാലത്തെ നോക്കി ചിരിച്ച കവി	36
സീതാരാമൻ - സാഹിത്യത്തിലെ ഹാസ്യചിത്രകാരൻ	68
ഒരേ താളത്തിൽ ചിരിച്ച രണ്ടു കവികൾ	89

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മനുഷ്യസഹജമായ ഒരു ഭാവസ്ഫുരണമാണ് ഹാസ്യം അഥവാ ചിരി. ചിരി പ്രകൃതിയുടെ മനോഹരവും സൂക്ഷ്മവുമായ ഒരു സംവിധാനകുശലമാണ്. ചിരിക്കുന്ന മൃഗമാണ് മനുഷ്യൻ എന്നും ചിരിക്കാനറിയാത്തവനാണ് യഥാർത്ഥ സംസ്കൃതൻ എന്നും ഉള്ള ഉക്തികൾ ചിരിയുടെ പ്രാധാന്യം വ്യക്തമാക്കുന്നതാണ്. സഹജീവികളുടെ വികലതകളും ദൗർബല്യങ്ങളും വ്യക്തിമനസ്സിലുണ്ടാക്കുന്ന സവിശേഷമായ അവസ്ഥയിൽ നിന്ന് മോചനം ലഭിക്കുന്നതിനുള്ള രക്ഷാമാർഗ്ഗമായി പ്രകൃതിവിന്യസിച്ച് ഉള്ള ഉപകരണമാണ് ചിരി. അത് അനുകമ്പയ്ക്കുള്ള ഒരു മറുമറുന്ന് കൂടിയാണ്. നമുക്കുണ്ടാകുന്ന നൈരാശ്യങ്ങളെയും ജീവിതാനുഭവങ്ങളെയും ക്രീഡ മനോഭാവത്തോടെ സ്വീകരിക്കാനും ദുരഭീഷ്ടങ്ങളെ കഴിവതും ഉല്ലാസപൂർവ്വം സഹിക്കാനും നമ്മെ സന്നദ്ധനാക്കുന്നതിനു പ്രകൃതി നമ്മളിൽ വിന്യസിച്ച് ചിരിക്കുന്ന ഒരു ജന്മവാസനയാണ് ഹാസ്യം.

അസംഗതമായ വസ്തുക്കളേയോ, വ്യാപാരങ്ങളേയോ കാണുമ്പോൾ ഉണ്ടാകുന്ന വിനോദഭാവമാണ് ഹാസ്യം. ഹേതു, കാര്യം, സഹകാരി എന്നിവയാൽ പരിപൂർണ്ണി നേടി അത് ഹാസ്യരസമായി പരിണമിക്കുന്നു. സാധാരണഗതിയിൽ കൺമുന്നിലുള്ള ഒരു യാഥാർത്ഥ്യത്തിന്റേയോ ഒരു ആലോചനയുടെയോ ഉരസലിൽ നിന്നാണ് ഹാസ്യം ഉണ്ടാകുന്നത്. ഹാസഹാസ്യങ്ങൾ ജീവിതത്തിലും കലയിലും സവിശേഷമായി പ്രവർത്തിക്കുന്നു. ഹാസ്യം ആസ്വദിക്കണമെങ്കിൽ വികാരത്തെ ഒരുവുവരെ മാറ്റിവയ്ക്കേണ്ടതായും വരും. ജീവിതത്തിൽ ഹാസ്യത്തിനും പ്രാധാന്യം ഉണ്ട്. ഒറ്റപ്പെട്ടവന് ചിരിക്കുക സാധ്യമല്ല. മനോവികാസമാണ്



**ഹാസ്യവും മലയാളകവിതയും**  
ഡോ. എ. എസ്. പ്രതീഷ്

ചിരിക്ക് കാരണമാകുന്ന മാനസികാവസ്ഥയുടെ ഭാവുകത്വ പരിണാമത്തെ അടയാളപ്പെടുത്തുന്ന പുസ്തകം. മലയാള ഹാസ്യസാഹിത്യത്തിൽ അസാമാന്യ പ്രതിഭാവിഭാവം പ്രകടമാക്കിയ സഞ്ജയന്റെയും സീതാരാമന്റെയും കൃതികളെ വിശകലനം ചെയ്തുകൊണ്ട് ഭാവുകത്വസാഭാവവും സൂക്ഷ്മ രാഷ്ട്രീയവും ഈ പുസ്തകത്തിൽ വിലയിരുത്തുന്നു.




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# आधुनिक हिन्दी काव्यों में प्रजातांत्रिक मूल्यों का अध्ययन



डॉ. सतीष कुमार, जी



आधुनिक हिन्दी काव्यों में  
प्रजातान्त्रिक मूल्यों का अध्ययन

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जवाहर पुस्तकालय  
हिन्दी पुस्तक प्रकाशक एवं वितरक  
मथुरा (उ.प्र.)-281001

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## अनुक्रम

1. प्रजातंत्र - एक सामान्य परिचय	9
2. आधुनिक हिन्दी कविता की विकास-यात्रा	22
3. आधुनिक हिन्दी कविता में प्रजातंत्र का स्वरूप	39
4. आधुनिक हिन्दी कविता में प्रजातांत्रिक मूल्यों का अवलोकन	42
उपसंहार	63
संदर्भ ग्रंथसूची	65

## प्रजातंत्र : एक सामान्य परिचय

प्रजातंत्र, लोकतंत्र और जनतंत्र तीनों पर्यायवाची शब्द हैं। प्रजा, लोक और जन का अर्थ जनता है और तन्त्र का अर्थ है शासन पद्धति। इस प्रकार प्रजातंत्र का अर्थ होता है वह शासन प्रणाली जिसमें शासन का सब अधिकार जनता के हाथ में निहित होता है। दूसरे अर्थ में प्रजातंत्र का मतलब है प्रजा या जनता का शासन, वह शासन जिसमें शासन करने का अधिकार जनता को प्राप्त होता है।

### प्रजातंत्र का अर्थ

प्लेटो के समय से आज तक शासन पद्धति से जोड़कर 'लोकतंत्र' तथा प्रजातंत्र की चर्चा होती रही है। "जिसे हम प्रजातंत्र कहते हैं वह अंग्रेजी शब्द 'डेमोक्रेसी' का हिन्दी अनुवाद है। इस शब्द की उत्पत्ति प्राचीन यूनान में प्रचलित 'डेमोस' और 'क्रेटोस' से हुई थी। इन दो शब्दों के योग से 'डेमोक्रेसी' शब्द बना। डेमोस का अर्थ है 'जनसाधारण' और 'क्रेटोस' का अर्थ है 'शासन'। इस प्रकार इस पूरे शब्द का अर्थ निकलता है - जनसाधारण या जनता का शासन।' अब्राहम लिंकन ने लोकतंत्र की परिभाषा देते हुए कहा है, "लोकतंत्र जनता का, जनता के द्वारा और जनता के लिए स्थापित शासन प्रणाली है।"

प्रजातंत्र में शासन या सत्ता का अंतिम सूत्र जनसाधारण के हाथ में रहता है। 'लोकतंत्र' अथवा 'डेमोक्रेसी' मूलतः पश्चिम से निकली अवधारणा है। लेकिन कई लोग ऐसे हैं जो प्राचीन भारतीय परंपराओं में भी इसके सूत्र की तलाश करते हैं। गाँधीजी हमेशा रामराज्य की चर्चा करते थे क्योंकि उसे रामराज्य में प्रजातंत्र के सारे गुण दिखाई पड़ते थे। कुछ लोग ऐसे हैं जो छठी शताब्दी ईसा पूर्व बुद्धकालीन गणराज्यों की व्यवस्था को एक तरह का प्रजातंत्र ही मानते हैं। कुछ लोगों का यही विचार है कि चाणक्य ने 'अर्थशास्त्र' में लोकतांत्रिक शासन पद्धति की पूरी संभावनाओं की चर्चा की है। "जिस मध्यकाल को मध्ययुगीन बर्बरता की संज्ञा दी जाती है उस काल में भी कइयों को लोकतंत्र के तत्व दिखाई पड़ते हैं। हमारे यहाँ जब से



**डॉ. सतीष कुमार, जी**

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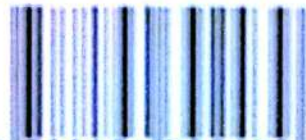
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डॉ. सतीष कुमार, जी

# आधुनिक हिन्दी रामकाव्यों में समाज मनोविज्ञान की भूमिका

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## विषयानुक्रमणिका

1. समाज मनोविज्ञान : एक सैद्धान्तिक अध्ययन 13(v)(v)
- समाज मनोविज्ञान : परिभाषा एवं स्वरूप - समाज मनोविज्ञान का इतिहास - समाज मनोविज्ञान का दूसरे सामाजिक विज्ञानों से सम्बन्ध : समाज मनोविज्ञान और सामान्य मनोविज्ञान, समाज मनोविज्ञान और समाज शास्त्र, समाज मनोविज्ञान और मानव शास्त्र; प्राणि-शास्त्र, शरीर-शास्त्र और समाज मनोविज्ञान, समाज मनोविज्ञान और अर्थ-शास्त्र, समाज मनोविज्ञान और नीति शास्त्र, समाज मनोविज्ञान और राजनीति शास्त्र, समाज मनोविज्ञान और असामान्य मनोविज्ञान, समाज मनोविज्ञान और रेडियो, टेलीविज़न, प्रेस तथा फिल्म।
- समाज मनोविज्ञान : क्षेत्र तथा समस्याएँ - समाज मनोविज्ञान की समस्याएँ - सामाजिकीकरण, सामाजिक संज्ञान एवं प्रत्यक्षीकरण, सामाजिक अन्तक्रिया, सामाजिक अभिप्रेरणा, सामाजिक अभिवृत्तियाँ, अभिवृत्तियाँ और मूल्य, अभिवृत्ति और विश्वास, जनमत, प्रचार, पूर्वधारणा
- सामाजिक मानक - परम्परा, प्रथा, कानून, जनरीतियाँ, रूढ़ियाँ
- नेतृत्व : नेता के कार्य - व्यक्तित्व और संस्कृति - सामाजिक परिवर्तन।
2. हिन्दी के आधुनिक रामकाव्य - कथ्य विश्लेषण एवं चरित्र चित्रण 30
- हिन्दी के आधुनिक रामकाव्य - कथ्य विश्लेषण-पंचवटी, साकेत, राम की शक्ति-पूजा, वैदेही-वनवास, साकेत-संत, उर्मिला, राम-राज्य, संशय की एक रात, शबरी, अग्नि-लीक, प्रवाद-पर्व, शम्बूक।

चरित्र-चित्रण, पुरुष पात्र : राम, लक्ष्मण, भरत, रावण, शत्रुघ्न, दशरथ, हनुमान, विभीषण, शम्बूक।

नारी पात्र - सीता, ऊर्मिला, मांडवी, कैकेयी, कोसल्या, सुमित्रा, शूर्पणखा, शवरी

3. व्यक्ति के व्यवहार के सांस्कृतिक निर्धारक तत्त्व 86
- समाज - संस्कृति - संस्कृति का अर्थ तथा परिभाषा : भारतीय संस्कृति - भारतीय संस्कृति के तत्त्व - संस्कृति का समाजमनोवैज्ञानिक आधार
- विचार : वर्ण एवं आश्रम व्यवस्था, नारी भावना, स्त्री-पुरुष सम्बन्ध, मानवतावाद, भारतीय संस्कृति और मानवतावाद, मानवतावाद की साहित्यिक पृष्ठभूमि
- धर्म - अहिंसा, तत्त्व, गांधीवाद का प्रभाव, धर्म और अर्थ। दर्शन - आस्तिकता, आध्यात्मिकता, अद्वैतवाद, कर्मवाद, नियतिवाद। सामाजिक मानक - परम्परा, पति का आदर्श, पत्नी का आदर्श, पुत्र-धर्म, अतिथि तत्कार, शकुन-अपशकुन, पत्नी का धर्म, विवाह-संस्कार, त्याग-भावना, संयुक्त परिवार, जन्मभूमि-प्रेम, कमफल पर विश्वास, मुहुर्त की स्वीकृति, आत्मा का अवतरण, टैवू।
- अभिवृत्तियाँ - अभिवृत्तियों के विकास का निर्धारक - सांस्कृति निर्धारक, मनोवैज्ञानिक निर्धारक, व्यावहारिक निर्धारक। प्रमुख सामाजिक अभिवृत्तियों का अध्ययन - सहयोग की अभिवृत्ति, प्रतिद्वन्द्विता की अभिवृत्ति, सामाजिक प्रतिष्ठा की अभिवृत्ति।
- विशिष्ट व्यक्तियों के प्रति अभिवृत्ति - नारी के प्रति पुरुष की अभिवृत्ति, पुरुष के प्रति नारी की अभिवृत्ति।
4. प्रमुख सामाजिक प्रक्रियाओं का निरूपण 140
- सामाजिक संघटन - सामाजिक संघटन की आवश्यकता
- सामाजिक नियन्त्रण - सामाजिक नियन्त्रण की आवश्यकता, सामाजिक नियन्त्रण का प्रभाव
- सामाजीकरण - पात्रों के व्यक्तित्व में सामाजीकरण का प्रभाव
- सामाजिक परिवर्तन - सामाजिक परिवर्तन और सांस्कृति का परिवर्तन - पात्रों के व्यवहार में सामाजिक परिवर्तन का प्रभाव

(X)

5. समूह प्रक्रियाओं का अध्ययन

अन्तक्रिया और समूह व्यवहार - अन्तक्रियाओं का अध्ययन - आधुनिक हिन्दी रामकाव्यों में चित्रित अन्तक्रियात्मक सम्बन्ध

नेतृत्व - परिभाषा - नेताओं के गुण और कार्य - नेतृत्व का वर्गीकरण - सत्तावादी नेता, प्रजातान्त्रिक नेता, आधुनिक हिन्दी राम काव्यों में नेतृत्व का स्वरूप।

भीड़ व्यवहार - परिभाषा, विशेषताएँ, भीड़ के प्रकार : औपचारिक भीड़, अनौपचारिक भीड़

भीड़ व्यवहार की दृष्टि में नरेश मेहता का "संशय की एक रात"।

6. सौन्दर्यशास्त्रीय विशेषताएँ

सौन्दर्य शास्त्र - सौन्दर्य शास्त्र की परिभाषाएँ - सौन्दर्य : पारिभाषिक परिचय - भारतीय अवधारणा - पाश्चात्य अभिमत - सौन्दर्य : वस्तुनिष्ठ एवं व्यक्तिनिष्ठ - सौन्दर्यानुभूति - सौन्दर्यानुभूति का समाजमनोवैज्ञानिक आधार - सौन्दर्यानुभूति की अभिव्यक्ति के विविध आयाम - विषय विस्तार - सौन्दर्यबोध का आधुनिक सन्दर्भ - प्रकृति सौन्दर्य - मानवीय सौन्दर्य - विन्ध्य विधान - प्रतीक योजना।

उपसंहार

पुस्तक सूची

155

170

187

192

(xi)

# समाज मनोविज्ञान : एक सैद्धान्तिक अध्ययन

## समाज मनोविज्ञान : परिभाषा एवं स्वरूप

समाज मनोविज्ञान मनोविज्ञान की एक महत्त्वपूर्ण शाखा है जिसके अन्तर्गत व्यक्ति के मानसिक जीवन एवं चरित्र का अध्ययन सामाजिक परिस्थितियों के आधार पर किया जाता है। मानव के जन्म से लेकर मृत्यु तक की सब मानसिक प्रक्रियाएँ एवं प्रवृत्तियाँ विभिन्न सामाजिक घटकों से प्रभावित रहती हैं। मनोविज्ञान की तरह समाज मनोविज्ञान में भी अध्ययन का केन्द्र बिन्दु मानवी व्यवहार ही है। समाज मनोविज्ञान विशेष रूप से उस मानवी व्यवहार पर विचार करता है, जो दूसरों को उद्दीप्त करता है अथवा दूसरे व्यक्तियों के व्यवहार द्वारा उद्दीप्त होकर अनुक्रिया के रूप में किया जाता है। समाज मनोविज्ञान व्यक्ति के व्यवहार का विवेचन सामाजिक दशा और मानवीय अन्तःक्रियाओं के सन्दर्भ में करता है। व्यक्ति के जटिल मानसिक जीवन को सामाजिक पर्यावरण किस प्रकार रूपायित करता है, उसकी आदतों में वह किस प्रकार के प्रभाव डालता है, इन सभी प्रश्नों का उत्तर समाज मनोविज्ञान ही दे सकता है। इस प्रकार यह वह विज्ञान है, जो समाज में व्यक्ति के व्यवहार का वैज्ञानिक अध्ययन करता है। इस तरह समाज में रहने वाले व्यक्ति को समझने का विज्ञान ही वास्तव में समाज मनोविज्ञान कहलाता है।

यह विज्ञान व्यक्ति और समाज की पारस्परिक प्रतिक्रियाओं और इनसे प्रभावित व्यक्ति की भावनाओं, संवेगों, अनुभवों और विचारों का विशेष रूप से अनुशीलन करता है। मनुष्य समाज तथा उसमें मनुष्य की प्रकृति व व्यवहार को आधारभूत मानते हुए मनोवैज्ञानिकों ने समाज मनोविज्ञान को अपने-अपने ढंगों से परिभाषित किया है। नीचे कुछ मुख्य मान्य परिभाषाओं और उनकी व्याख्या प्रस्तुत की गई है—

प्रसिद्ध मनोवैज्ञानिक वी.वी. अकोलकर के अनुसार समाज मनोविज्ञान व्यक्ति के सामाजिक पर्यावरण के विशेष सन्दर्भ में व्यक्ति के मानसिक जीवन और व्यवहार का अध्ययन है। सामाजिक पर्यावरण के विशिष्ट सन्दर्भ में व्यक्ति के मानसिक जीवन और व्यवहार के अध्ययन को ही वे समाज मनोविज्ञान के नाम से पुकारते



### डॉ. सतीष कुमार. जी

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# ക്രിയാപദ കര്യക്രമങ്ങൾ

സാക്ഷാത്കാരം  
ഡോ: എ.എസ്.പ്രതീഷ്

ഫാത്തിമ മാതാ നാഷണൽ കോളേജ്  
മലയാള സമാജം വക  
പ്രസിദ്ധീകരണം



# ക്യാമ്പസ് കവിതകൾ

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# ക്യാമ്പസ് കവിതകൾ

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ഹേമന്തത്തിനും ശിശിരത്തിനും മായ്ക്കാനാവാത്ത  
 ഒരു പിടി ക്യാമ്പസ് ഓർമ്മകൾ നിനക്കും ഇല്ലേ?  
 മറവിയുടെ ഈർപ്പം നിറഞ്ഞ ഇരുട്ടിൽ നിന്ന്  
 അവയൊക്കെ കുഴിച്ചെടുത്ത് ഇവിടെ ചേർക്കുന്നു. ഈ  
 കവിതാ പുസ്തകത്തിന്റെ അവസാന താളുകളിൽ നിന്റെ  
 ഓർമ്മയുടെ നിശ്വാസം പതിയണം. അത് ഈ കവിതാ  
 പുസ്തകത്തിന് ജീവനേകും. നിന്റെ ഓർമ്മയുടെ ജീവൻ.







## നിഴൽ

നിഴലെന്നു നാം നിനച്ചിടുന്ന നിഴലുകൾ  
 നിഴലല്ല മനുഷാ അതുമൊരു ജീവനാണു ഭൂവിൽ  
 നൻമതൻ വഴികാട്ടിയാകേ യജമാനൻ നീ  
 പലപ്പോഴും തിൻമതൻ വഴികാട്ടിയായ് മാറിടുന്നു.  
 കറുത്തിരുണ്ടൊരു രൂപമുണ്ട്  
 നിന്നോടൊപ്പം, അതുനിൻ അന്തരാത്മാവറിയുന്നില്ല  
 നീ പലപ്പോഴും  
 ഇരുട്ടാണു നിൻ അന്തരാത്മാവ് മുഴുവനും  
 ബാഹ്യാത്മാവിനാകട്ടേ വെളിച്ചം മറയാക്കുന്നു നീ  
 പ്രകൃതി തൻ കനിവാം വെളിച്ചത്തിൽ മറവിട്ട്  
 ഇരുട്ടിന്റെ മറവിനായ് കൊതിക്കുന്നു മനുഷാ  
 കറുത്തിരുണ്ടൊരു നിൻ നിഴലുകൾ  
 അനുകരിച്ചിടുന്നു തൻ യജമാനന്റെ പ്രവൃത്തികൾ  
 അറിയാൻമകൊണ്ടവൻ ചെയ്യുന്ന പ്രവൃത്തികൾ  
 അറിഞ്ഞും നീ അതു കണ്ടില്ലെന്നു നടിക്കുന്നു;  
 അധികാരത്തിൻ തലപ്പത്തിരിക്കുന്നു മനുഷാ  
 അറിയുന്നോ നിൻ നിഴലാം മനുഷ്യമേ.

സുരഭി. എൽ. എസ്  
 മൂന്നാം വർഷ മലയാള ബിരുദം

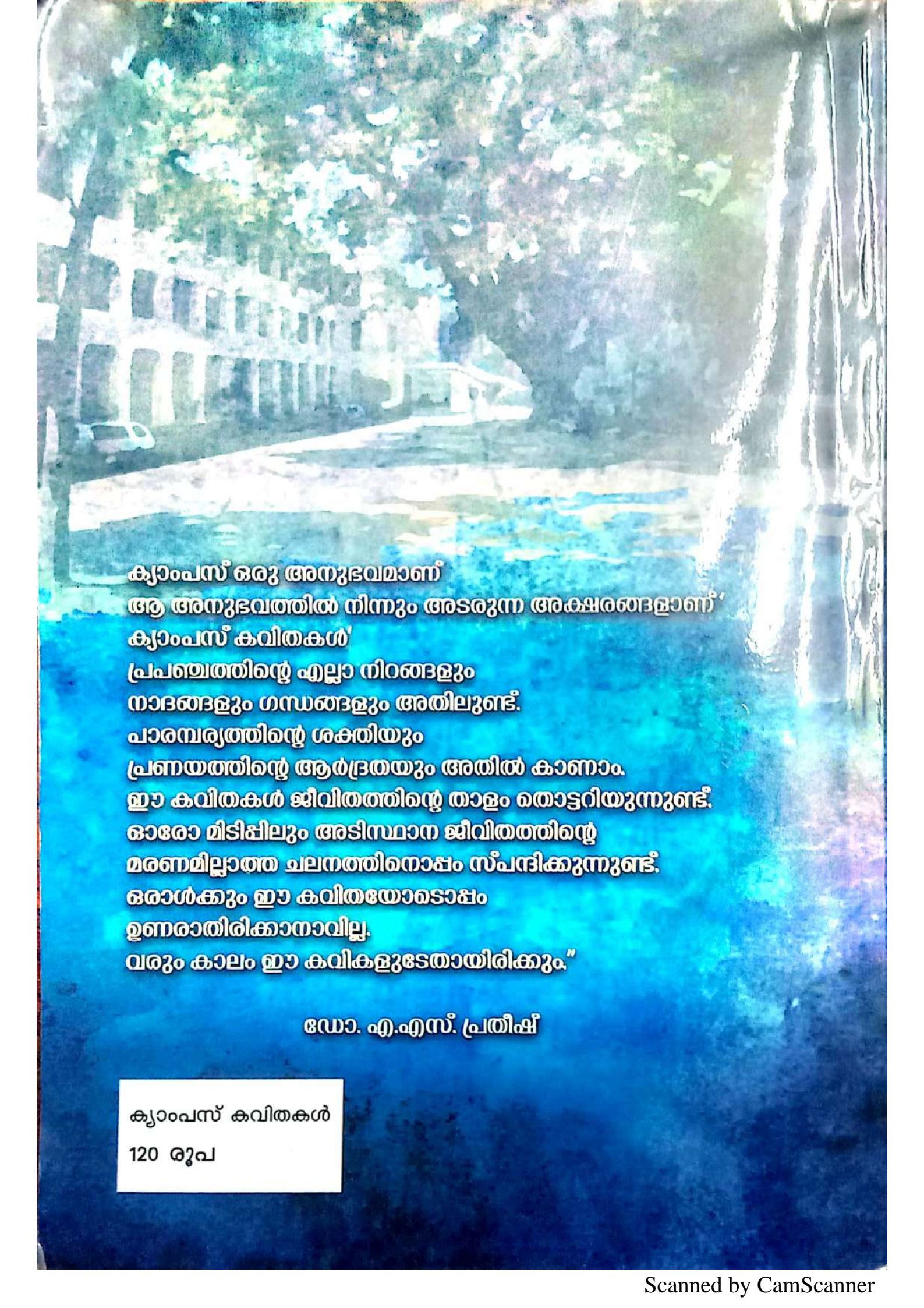


## എന്റെ അമ്മ

വിണ്ട കാലടികൾ നോക്കുന്ന  
 മകനുമുണ്ടൊരാ പുച്ഛം ....  
 ഓടിയ ഓട്ടത്തിനടയാളമാ കാലുകൾ  
 അമ്മയും പറഞ്ഞു  
 കഴിഞ്ഞ കണ്ണുകൾ കോലമാണമ്മേ  
 മകനും പറഞ്ഞു....  
 എന്റെ കൺനീരുകൾ കലക്കിയതാ കണ്ണുകൾ  
 അമ്മയും പറഞ്ഞു  
 മെലിഞ്ഞ ഉടൽ കോലാട് പോലമ്മേ  
 യന്ത്രത്തെപ്പോലെ ഞാനെടുത്ത-  
 പണികളുടെ അടയാളമാണ് മകനേ  
 അമ്മയും പറഞ്ഞു.  
 എനിക്കു ജന്മം നൽകിയതെന്തിനാണമ്മേ,  
 എന്റെ ജന്മം പൂർണ്ണമാകാനായ്  
 മകനേ.....  
 എങ്കിലും ഞാൻ തൊഴുന്നമ്മേ  
 അമ്മയെന്ന മഹാസത്യത്തിനുമുന്നിൽ.

ഷിബി. കെ. ബാബു  
 മൂന്നാം വർഷ മലയാള ബിരുദം





ക്യാമ്പസ് ഒരു അനുഭവമാണ്  
ആ അനുഭവത്തിൽ നിന്നും അടരുന്ന അക്ഷരങ്ങളാണ്  
ക്യാമ്പസ് കവിതകൾ  
പ്രപഞ്ചത്തിന്റെ എല്ലാ നിറങ്ങളും  
നാദങ്ങളും ഗന്ധങ്ങളും അതിലുണ്ട്.  
പാരമ്പര്യത്തിന്റെ ശക്തിയും  
പ്രണയത്തിന്റെ ആർദ്രതയും അതിൽ കാണാം.  
ഈ കവിതകൾ ജീവിതത്തിന്റെ താളം തൊട്ടറിയുന്നുണ്ട്.  
ഓരോ മിടിച്ചിലും അടിസ്ഥാന ജീവിതത്തിന്റെ  
മരണമില്ലാത്ത ചലനത്തിനൊപ്പം സ്പന്ദിക്കുന്നുണ്ട്.  
ഒരാൾക്കും ഈ കവിതയോടൊപ്പം  
ഉണരാതിരിക്കാനാവില്ല.  
വരും കാലം ഈ കവിതകളുടേതായിരിക്കും."

ഡോ. എ.എസ്. പ്രതീഷ്

ക്യാമ്പസ് കവിതകൾ  
120 രൂപ

# പാട്ടൊഴുകിയ

വഴികളിലൂടെ...

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ട ബി ബി

ഡോ. എം. ആർ. ഐ. പി.



പാട്ടൊഴുകിയ വഴികളിലൂടെ



Malayalam  
**Pattozhukiya vazhikaliloode**  
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# പാട്ടൊഴുകിയ വഴികളിലൂടെ

ഡോ. ഷെല്ലി. എം.ആർ



സുജിലി പബ്ലിക്കേഷൻസ്, കൊല്ലം



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## ഉള്ളടക്കം

ആമുഖം

പാട്ടിന്റെ നീരാഴുകുകൾ

രാമചരിതത്തിലൂടെ

തിരുനിഴൽമാല

രാമകഥപ്പാട്ട്

പാട്ടിന്റെ കണ്ണശ്ശപാതയിലൂടെ

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കവിത ആത്മാവിന്റെ വിലയനവും ഋഷിത്വത്തിന്റെ ഉത്പന്നവുമാണെന്നാണു പൂർവ്വികരുടെ മതം. ഋഷിയല്ലാത്തവൻ കവിയല്ല എന്ന ദർശനസൂക്തം രൂപം കൊണ്ടു ലഘുതരമെങ്കിലും ഭാവംകൊണ്ടു ഗുരുതമമാണ്... ചുറ്റുപാടുമുള്ള ജീവിതയാഥാർത്ഥ്യങ്ങളിൽനിന്ന് ഒളിച്ചോടി നിമീലിതാക്ഷനായി ഏകാന്തതയിൽ തപമനുഷ്ഠിക്കുന്ന ഋഷിത്വത്തിന്റെ സന്തതിയാണോ കാവ്യം? അല്ലേയല്ല. ചുറ്റുപാടുകളോടു സജീവമായി സംവദിച്ചുകൊണ്ടുതന്നെ മനനവ്യഗ്രനായി ഉൾക്കണ്ണുതുറന്നിരിക്കുന്നവനാണ് ഋഷി... ആ സംവേദനാത്മകതയും മനനബുദ്ധിയും ക്രാന്തദർശിത്വവും കവിയിലേക്ക് അഭിസംക്രമിക്കുമ്പോഴാണ് ഉത്തമമായ കവിത ജനിക്കുന്നത്. ഇങ്ങനെയാണു പരിണതപ്രജ്ഞരായ ആചാര്യന്മാർ കവിയിലെ ഋഷിയെയും ഋഷിയിലെ കവിയെയും കണ്ടെത്തി നിർവചിച്ചത്. നൈസർഗ്ഗികമായ പ്രതിഭയും ബഹുനിർമ്മലമായ അറിവും അമന്ദമായ അഭ്യാസവും ചേരുമ്പോഴാണു കവിത്വം ജന്മമെടുക്കുന്നത്. ഒരു വ്യക്തി കവിയാണെങ്കിൽ ജന്മമെടുക്കുന്നത് ആർക്കുവേണ്ടി? തനിക്കു വേണ്ടിയോ ഇതരർക്കുവേണ്ടിയോ? അതൊരു വിവാദവിഷയമാണ്. അനുകൂലിച്ചും പ്രതികൂലിച്ചും ധാരാളം





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ഡോ. എം. ആർ. ഷെല്ലി



ഭാഷാവിചിന്തനം



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## മലയാളത്തിന്റെ വ്യാകരണ പാരമ്പര്യം

കേരളം ഉൾപ്പെട്ട പഴയ വിശാലതമിഴകത്തിന്റെ വ്യാകരണ ഗ്രന്ഥമായ തൊൽക്കാപ്പിയ 'വും മലയാളദേശം സ്വതന്ത്രമായതിനു ശേഷം തമിഴകത്ത് ആവിർഭവിച്ച 'നന്നുലും' തുടങ്ങിവച്ച പാരമ്പര്യത്തിൽ നിന്നാണ് 'മലയാളത്തിലെ ആദ്യത്തെ വ്യാകരണ ഗ്രന്ഥം എന്നു വിളിക്കാവുന്ന ലീലാതിലകം പിറവിയെടുക്കുന്നത്. തമിഴ് സ്വാധീനവും ആര്യസംസർഗ്ഗജാതമായ സംസ്കൃതാഭിനിവേശവും മലയാളഭാഷയെയും സാഹിത്യത്തെയും പുതിയൊരു പരിപ്രേക്ഷ്യത്തിലേക്കു നയിച്ചതിന്റെ പ്രതിഫലനം ലീലാതിലകത്തിൽ കാണാം. പതിനാലാംശതകത്തിൽ ഉണ്ടായ 'ലീലാതിലകം' എന്ന ഈ മണിപ്രവാളലക്ഷണഗ്രന്ഥത്തിലാണ് മലയാളഭാഷാ വ്യാകരണ ചർച്ചകൾ തുടങ്ങുന്നത്. പൂർണാർമത്തിൽ ഇതൊരു വ്യാകരണ ഗ്രന്ഥം അല്ലെങ്കിലും ഭാഷയിലെ ലിംഗം, വചനം, സന്ധി മുതലായവ ഇതിൽ പരാമ്യം ആകുന്നു. മണിപ്രവാളത്തിനു ലക്ഷണ നിർവചനത്തിലൂടെ സുതാര്യത നൽകിയ 'ലീലാതിലക'ത്തിനുശേഷം ഏറെക്കാലം ഭാഷയിൽ കാര്യമായ വ്യാകരണചർച്ചകൾ ഉണ്ടായതായി തെളിവുകളില്ല.

ഏതാണ്ടു രണ്ടു നൂറ്റാണ്ടിനു ശേഷം മതപ്രചരണം എന്ന ആശയവുമായി കേരളത്തിലെത്തിയ വിദേശ മിഷണറിമാർ മലയാളവ്യാകരണ മേഖലയിൽ ആധിപത്യം ഉറപ്പിക്കുന്നതു പിന്നീട് നാം കാണുന്നു. സാധാരണക്കാരുടെ മനസ്സിൽ തങ്ങളുടെ മതചിന്തകളെ കടത്തിവിടുന്നതിനു ഈ മിഷണറി സഞ്ചയത്തിനു



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ഡോ. എം. ആർ. ഷെല്ലി

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പഠനം



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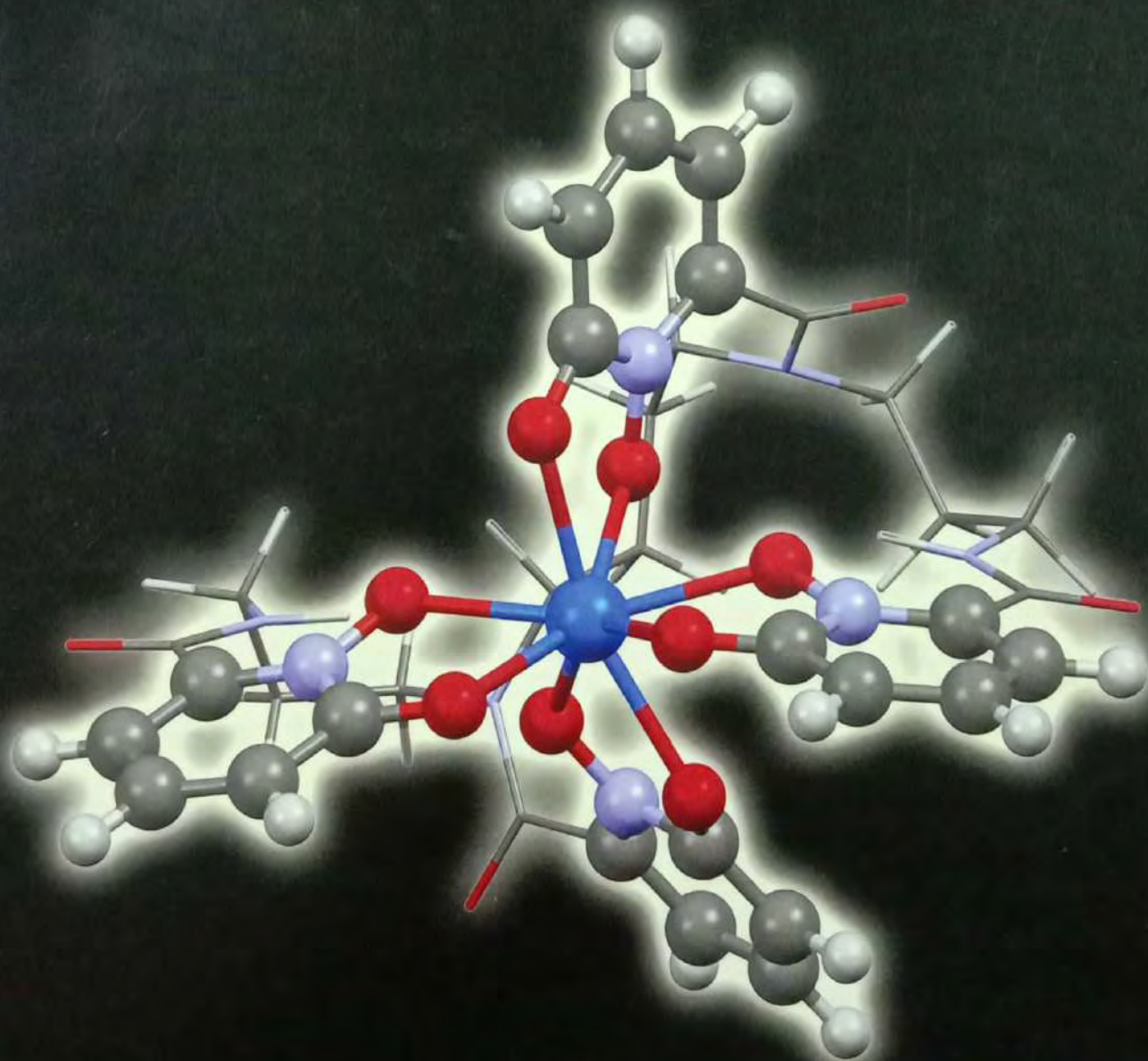
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# DFT COMPUTATIONAL STUDY OF BIOACTIVE MOLECULES



**Dr. Shyma Mary. Y**  
**Dr. Sheena Mary. Y**

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Written by :  
Dr. Shyma Mary. Y  
Dr. Sheena Mary. Y

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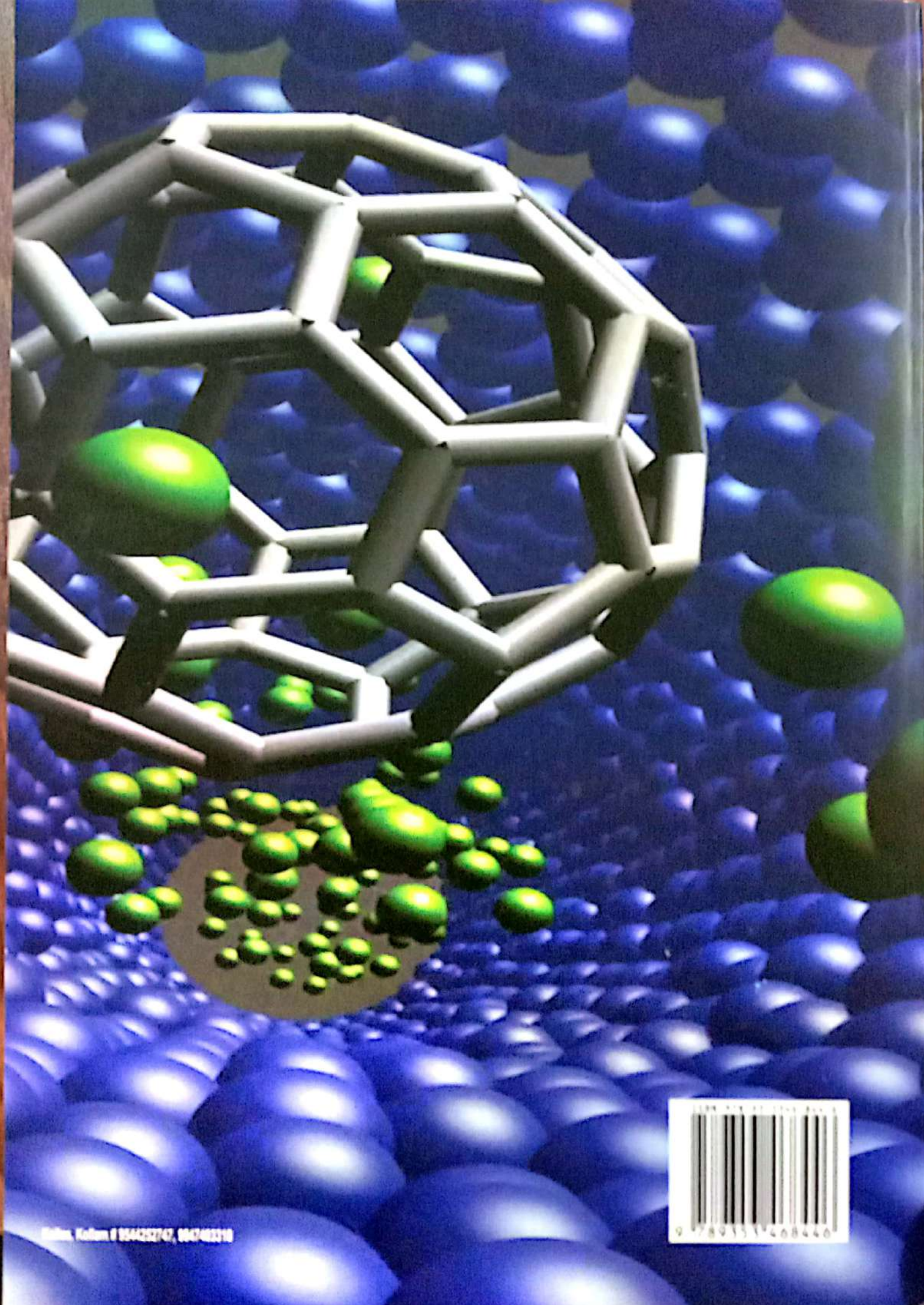
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## CHAPTER 1 INTRODUCTION

### 1.1 Spectroscopy – An Introduction

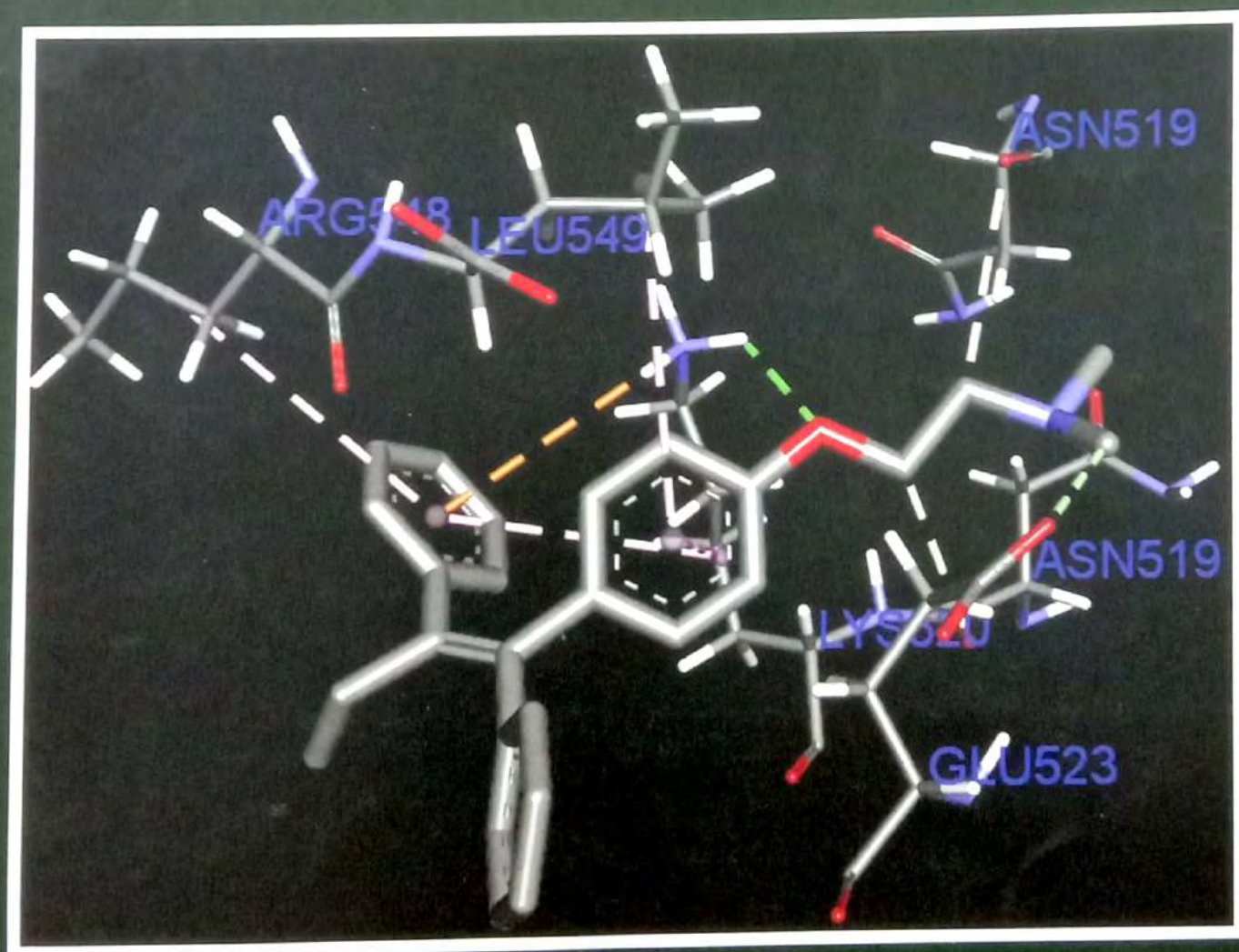
Spectroscopy is the study of interaction between matter and radiation energy. Spectroscopic data is often represented by a spectrum, a plot of the response of interest as a function of wavelength or frequency. Spectroscopy is used in physical and analytical chemistry because the atoms and molecules have unique spectra. These spectra can be interpreted to derive information about the atoms and molecules, and they can also be used to detect, identify and quantify chemicals. Different spectroscopic techniques give different kinds of information [Williams *et al.* 1988; Banwell and McCash 1995; Aruldas 2000]. Molecular spectroscopy aims to understand the interaction of molecular energy with electromagnetic radiation. A molecule possesses various forms of energy due to its different kinds of motion and intermolecular interactions. Vibrational spectroscopy has been used to make significant contribution in many areas of physics and chemistry as well as in other areas of science. Its important applications are in the study of intra molecular and inter molecular forces, molecular structure determinations, computation of degree of association in condensed phases, elucidation of molecular symmetries, identification and characterization of molecules, deducing thermodynamical properties of molecular systems, etc. [Bernhard 1995]. Vibrational spectroscopy is one of the most widely used tools for the study of physical and chemical processes in molecular systems and their internal structure which deals with the changes in the vibrational energy levels of the molecules. The two important tools for obtaining vibrational spectra are infrared and Raman spectroscopies. Qualitative method yields information about the atomic or molecular species or the functional groups that exist in a sample which provides numerical information about the relative amount of the functional groups present. Reliable assignments of the experimentally observed IR and Raman bands provide a clear understanding of the geometry and structure of the molecule. Theoretical simulations can assist in obtaining a deeper understanding of the vibrational spectra of complicated molecules. Vibrational spectra are the effective tool to identify the molecular properties such as intramolecular charge transfer and hydrogen bonding, which enhances the nonlinearity of the molecule. The density functional theory method is an efficient tool for the comparison between vibrational spectra and quantum chemical calculations. Vibrational spectroscopy provides the most definitive means of identifying the surface species generated upon molecular adsorption and the species generated by surface reactions. In principle, any technique that can be used to obtain vibrational data from solid state or gas phase samples (IR, Raman etc.) can be applied to the study of surfaces, in addition, there are a number of techniques which have been specifically developed to study the vibrations of molecules at interfaces. Infrared spectroscopy is one of the most common spectroscopic techniques used by organic and inorganic chemists and it is the absorption measurement of different IR frequencies by a sample positioned in the path of an IR beam. Raman scattering of light by molecules may be used to provide information on a sample's chemical composition and molecular structure. The IR and Raman spectroscopies generally yield similar types of information



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# DFT Studies : Pyrazine and Anthracene Derivatives



**Dr. Sheena Mary Y**  
**Dr. Shyma Mary Y**

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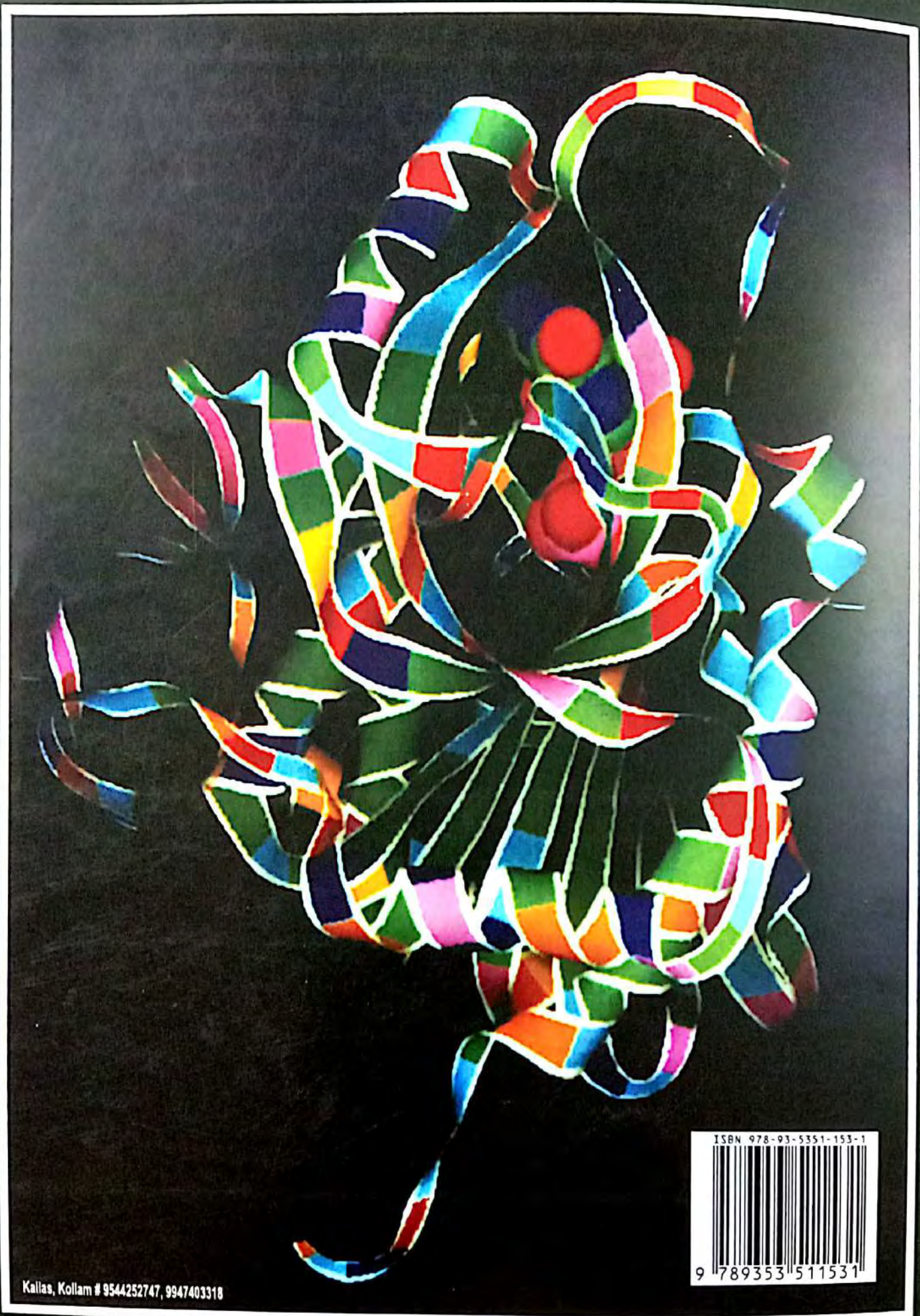
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Spectroscopic (FT-IR, FT-Raman), first order hyperpolarizability, NBO analysis, HOMO and LUMO analysis of *N*-[(4-(trifluoromethyl)phenyl)pyrazine-2-carboxamide] by density functional methods

### Introduction

Pyrazinecarboxamide is among the first line drugs for the treatment of tuberculosis and it kills or stops the growth of certain bacteria that cause tuberculosis [1]. Recent years have seen increased incidence of tuberculosis in both developing and industrialized countries, the wide spread emergence of drug-resistant strains and a deadly synergy with human immunodeficiency virus [2,3]. Pyrazine and its derivatives form an important class of compounds present in several natural flavours and complex organic molecules [4]. 2-Chloropyrazine and 2,6-dichloropyrazine are mainly found as medical and agricultural drug intermediates [4]. The resistance of Pyrazinamide arises by the absence of the enzyme, Pmc A. The major side effect of Pyrazinamide is dose-related hepatotoxicity. Pyrazinoic acid disrupts membrane energetics and inhibits membrane transport function in *M.tuberculosis* [5]. A different analog of Pyrazinamide, 5-chloropyrazine-2-carboxamide, has previously been shown to inhibit mycobacterial fatty acid synthase I [6]. Pyrazinamide is a member of the pyrazine family and it is known as a very effective antimycobacterial agent, with a well established role in tuberculosis treatment [7]. Pyrazinamide is bactericidal to semidormant mycobacteria and reduces total treatment time [8]. The finding that pyrazinamide-resistant strains lose amidase (pyrazinamidase or nicotinamidase) activity and the hypothesis that amidase is required to convert pyrazinamide to pyrazinoic acid intracellularly led to the synthesis and study of various prodrugs of pyrazinoic acid [9]. The activity of Pyrazinamide appears to be pH dependent, since it is bactericidal at pH 5.5, but inactive at neutral pH. Pyrazinamide is used in combinations with INH and rifampicin. It is especially effective against semi-dormant mycobacteria. Its mechanism of action appears to involve its hydrolysis to pyrazinoic acid via the bacterial enzyme pmcA [10]. Pyrazinamide can also be metabolized by hepatic microsomal deamidase to pyrazinoic acid, which is a substrate for xanthine oxidase, affording 5-hydroxypyrazinoic acid. The acid is believed to act as an antimetabolite of nicotinamide and interferes with NAD biosynthesis. Spleen tyrosine kinase activities of a series of aminopyrazine were reported by Forns *et al.*, [11]. Akyuz *et al.*, [12] reported the vibrational spectroscopic study of two dimensional polymer compounds of pyrazinamide. It has been reported that the amides of substituted pyridine-4-carboxylic acids [13] as well as anilides of the substituted pyrazine-2-carboxylic acids [14-16] inhibited oxygen evolution rate in spinach chloroplasts and they showed some antialgal properties. Pyrazine derivatives are important drugs with antibacterial, diuretic, hypolipidemic, antidiabetic, hypnotic, anticancer and antiviral activity. Pyrazinamide, another first-line TB drug, was discovered through an effort to find antitubercular nicotinamide derivatives [16]. Although the exact biochemical basis of pyrazinamide activity in vivo is not known, under acidic conditions it is thought to be a prodrug of pyrazinoic acid, a compound with antimycobacterial activity [17]. Wang *et al.*, [18] reported the synthesis of a series of pyrimidine carboxamides and evaluated as cholecystokinin I receptor agonists. The dynamical pattern of the 2-aminopyrazine-3-carboxylic acid molecule by inelastic and incoherent neutron scattering, Raman spectroscopy and ab initio calculations was reported by Pawlukojs *et al.* [19]. Billes *et al.* [20] calculated the vibrational frequencies of the three parent diazines (pyrazine,

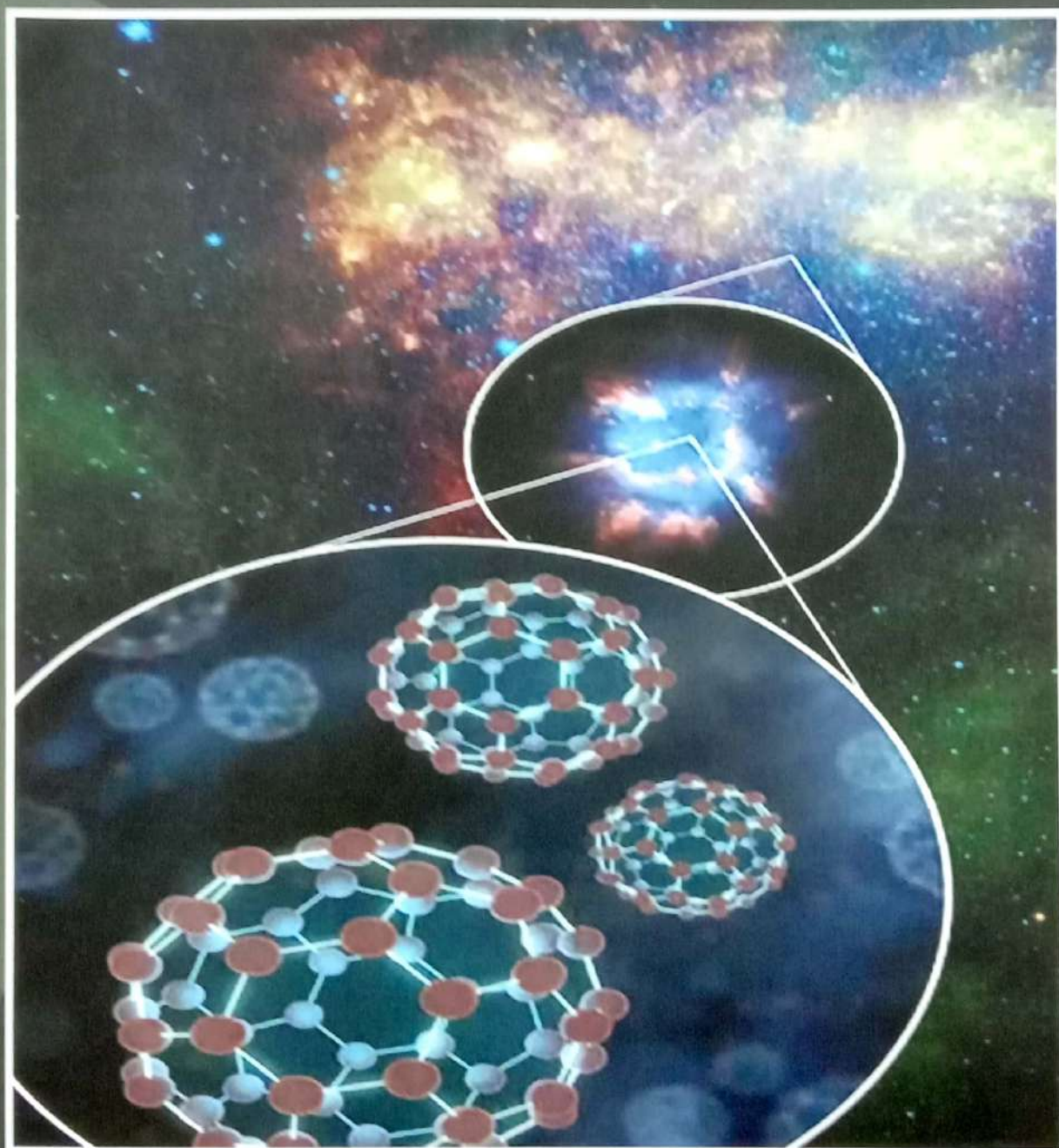


Kallas, Kollam # 9544252747, 9947403318



# CHAPTERWISE SYNOPSIS AND PRACTICE QUESTIONS

Vol-1



Dr. B. Sureshkumar  
Dr. Sheena Mary. Y

Chapterwise Synopsis  
and Practice Questions  
Vol -1

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## ATOMIC STRUCTURE - XI - SYNOPSIS

1. Electron was discovered by **J.J Thomson** by discharge tube experiment
2. The name electron was proposed by **George Stoney** for the fundamental unit of electricity.
3. The charge on an electron ( $-1.602 \times 10^{-19}$  C or  $-4.808 \times 10^{-10}$  esu) was determined by **Millikan** by his **oil drop experiment**.
4. The charge on **one mole** of electrons is 96484.56 coulombs ( $\approx 96500$ C) or one **Faraday**.
5. The ratio of charge to mass (e/m value) was determined by **J.J. Thomson** in 1897 using cathode ray tube. The value comes out to be  $1.76 \times 10^{11}$  coulomb per/kg. Therefore, the rest mass of electron,

$$m = \frac{e}{e/m} = \frac{1.602 \times 10^{-19} \text{ C}}{1.76 \times 10^8 \text{ Cg}^{-1}}$$

$$= 9.11 \times 10^{-28} \text{ g} = 9.11 \times 10^{-31} \text{ kg}$$

or 0.0005486 amu.

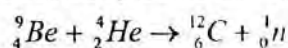
6. The mass of one mole of electrons is  $= 9.11 \times 10^{-28} \times 6.023 \times 10^{23} \text{ g}$  or 0.55 mg nearly
7. The mass of an electron moving with velocity  $v$  is given by the relation :

$$m' = \frac{m}{\sqrt{1 - \left(\frac{v}{c}\right)^2}}$$

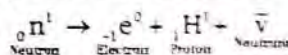
where  $c$  is the velocity of light.

Therefore, the mass of electron moving with velocity of light is infinite.

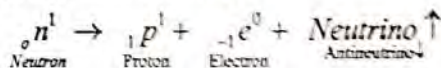
8. The ratio  $e/m$  for electron is known as its **specific charge**. The specific charge of an electron decreases with increase in velocity which increases the mass of electron.
9. The anode rays are also known as **canal rays** or positive rays. These were discovered by **E. Goldstein**.
10. **Protons** are the anode rays produced when the hydrogen gas is used in the discharge tube.
11. The charge on a proton is  $+1.602 \times 10^{-19}$  coulomb or  $+4.808 \times 10^{-10}$  esu. (electrostatic unit)
13. The mass of a proton is  $1.672 \times 10^{-24} \text{ g}$  or  $1.672 \times 10^{-27} \text{ kg}$  and mass of one mole of protons is 1.0073 g.
14. The mass of proton is about 1837 times the mass of an electron.
15. The volume of a proton  $\left(\frac{4}{3} \pi r^3\right)$  is nearly  $1.5 \times 10^{-38} \text{ cm}^3$ .
16. Neutron is a neutral sub-atomic particle having mass  $1.675 \times 10^{-24} \text{ g}$  or  $1.675 \times 10^{-27} \text{ kg}$ .
17. Mass of one mole of neutrons is 1.0087 g.
18. Neutron was discovered by **James Chadwick** in 1932 and the reasons of its late discovery was its neutral character. The nuclear expt. which led to the discovery of neutron was conducted by **Bothe and Becker**



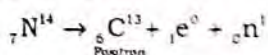
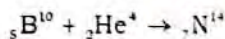
19. Neutron is slightly heavier than protons.
20. Of all the fundamental particles present in an atom, electron is the lightest and neutron is heaviest particle.
21. Neutron is an unstable particle and in isolated form it undergoes disintegration into **electron, proton and neutrino**.



22. The particles like mesons, positrons, neutrino etc. about twenty in number are created by stress in the nucleus, but do not exist as components of nucleus.
23. **Neutrino** is a particle with zero mass and zero charge. **Pauli** (1927) postulated that a particle with zero mass and zero charge is formed during **neutron decay**. **Fermi** named this particle as **neutrino**. **Allen and Rodeback** (1952) demonstrated the free existence of neutrino.
24. **Antineutrino** is a particle identical to neutrino but has opposite spin. According to **Fermi** (1934) neutron decays as

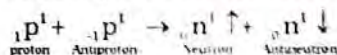


25. **Antielectron or positron** has same negligible mass and amount of charge as electron. However, the charge is positive. Positron was discovered by **Anderson** (1932). The bombardment of boron with  $\alpha$ -particle resulted in the emission of positron.



Positron has transitory existence of **about  $10^{-8}$  second** and quickly unites with electrons producing gamma ( $\gamma$ ) rays.

26. **Anti-proton** has same mass and spin as protons but has opposite charge i.e.,  $-1$ . It was produced by **Segre** at university of California by bombarding copper target with accelerated protons.
27. **Antineutron** is a particle identical with neutron but has opposite spin to neutron. It was produced by **Cork** (1956). It is produced when a proton strikes an antiproton.

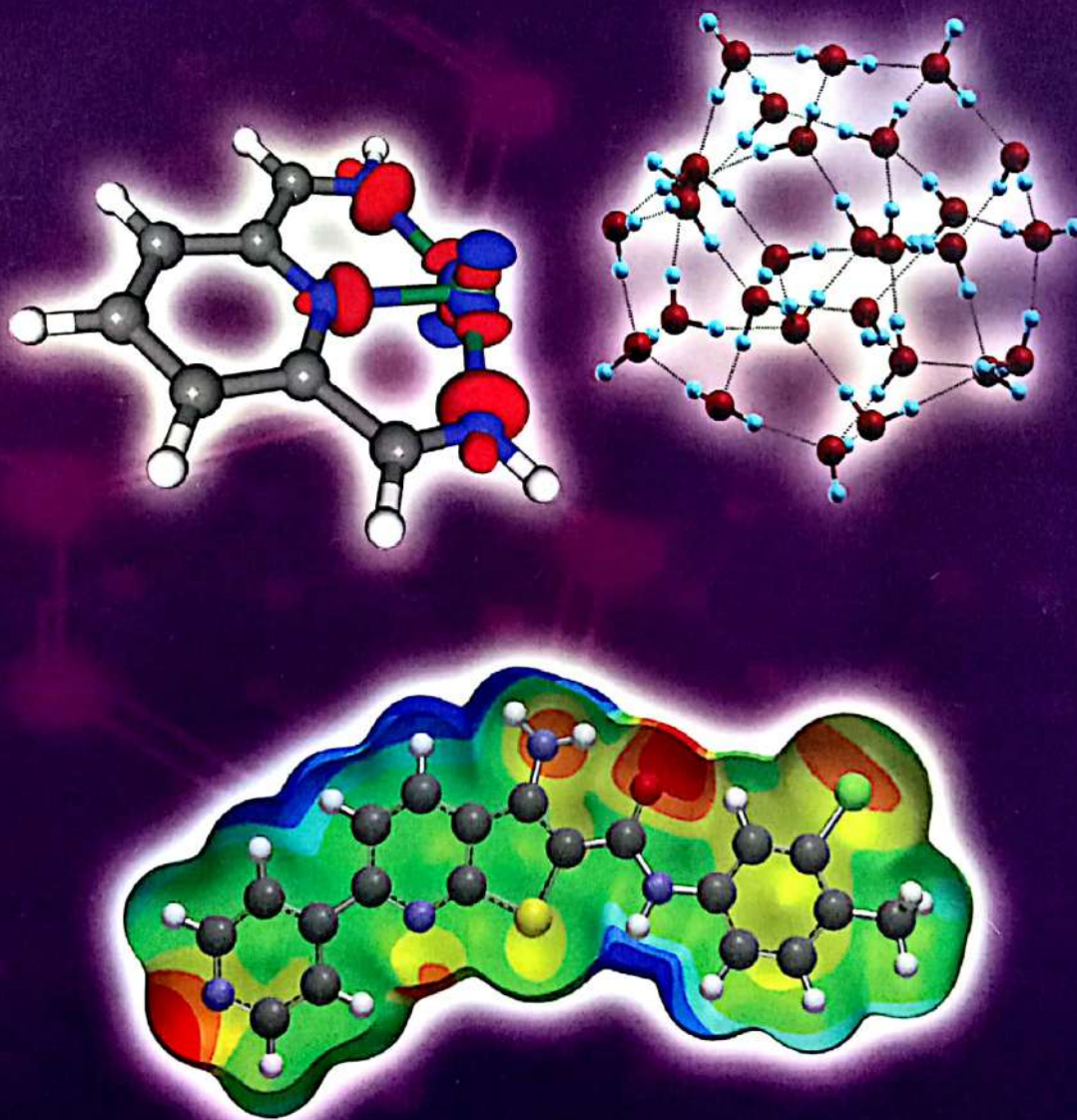


28. **Mesons** are the particles having mass intermediate between that of electron and proton. Positive and negative mesons were postulated by a Japanese physicist, **Hideki Yukawa** (1935) and the neutral  $\pi$ -mesons were postulated by **Kemmer**.
  - (i)  **$\pi$ -Mesons or pions** have mass about 273 times that of electron and the charge on them may be negative or positive.



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# DFT Studies Of Organic Derivatives



**Dr. Shyma Mary. Y**  
**Dr. Sheena Mary. Y**



# DFT Studies Of Organic Derivatives

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Investigation of spectroscopic, reactive, transport and docking properties of 1-(3,4-dichlorophenyl)-3-[3-(trifluoromethyl)phenyl]thiourea (ANF-6): combined experimental and computational study

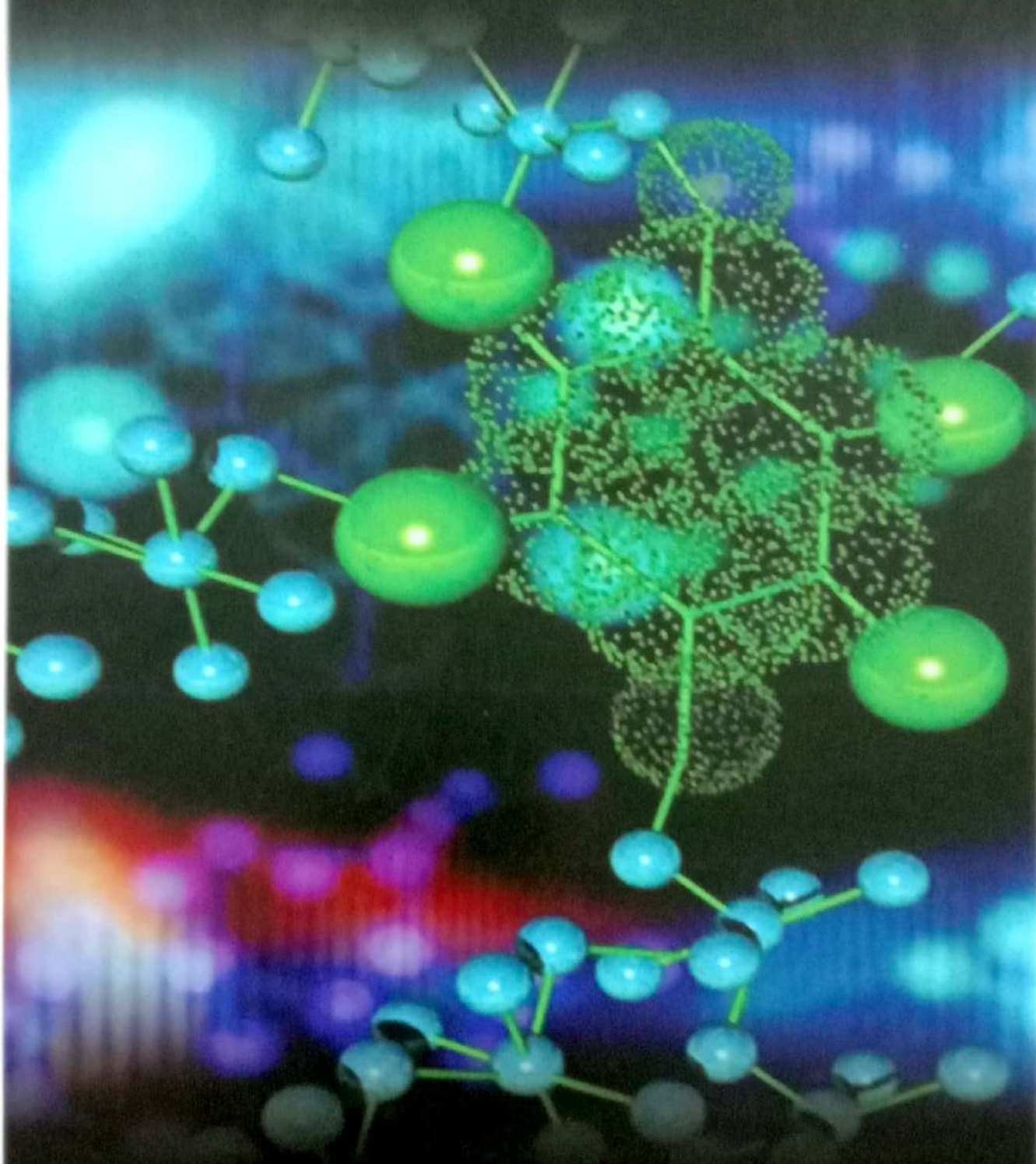
## Introduction

Over the last several years, the important role of thiourea derivatives in the field of new chemotherapeutics development is undisputed, due to their significant antibacterial [1-3], antifungal [4,5], anti-tubercular [2, 6] and cytotoxic [1, 2, 7-9] properties. Their significant inhibitory effect on the growth of *Staphylococcus epidermidis* and *Staphylococcus aureus* strains is the result of a blockade of bacterial topoisomerase IV and/or gyrase action [1, 2, 10]. What is more, these thiourea-based derivatives possessing a halogen atom in their structure are known to inhibit and disperse bacterial bio-film [1, 2, 11]. According also to other author findings, fluorine-containing arylthiourea molecules express higher biological activity when compared to analogs with electron-donating substituent [1, 2, 12, 13]. Simultaneously, di-substituted derivatives are more active than mono-substituted halogen connections, as they exert stronger electronegative effect [1, 2, 5, 14, 15]. The title compound 3-(trifluoromethyl)phenyl-thiourea was found as a powerful inhibitor of the growth of standard and hospital methicillin-resistant staphylococcal strains; it also turned out as cytotoxic against MT-4 cells and reduced a proliferation of human leukaemia/lymphoma cell lines [1]. Popularity of compounds based on thiourea has been demonstrated by numerous other studies. From the aspect of organocatalysis it is important to mention the work by Koutoulogenis et al. [16]. Just recently they have reported synthesis of functionalized six-membered rings with multiple chiral centers mediated by thiourea. Coordination, biological and structural properties of thiourea derivatives have been thoroughly processed in the article reported by Saeed et al. [17]. Simplicity of synthesis of various thiourea derivatives and their possibility to form two hydrogen bonds with anion are another property emphasizing the great potential of thiourea based compounds [18]. Thiourea compounds also have significant potential in the material science. For example these compounds can form multiple inter- and intramolecular hydrogen bonds thanks to which some amidothiourea compounds have been efficiently utilized as colorimetric and fluorescent anions sensors [19]. Thiourea compounds also have the possibility to be applied as OLED materials as well, thanks to the lone pairs of nitrogen, sulfur and oxygen atoms [20]. The aim of this work was to thoroughly investigate title molecule by spectroscopic characterization and by computational investigation of reactive properties. IR, Raman and NMR spectroscopic approaches have been employed for characterization, while computational prediction of reactive properties has been performed by density functional theory (DFT) calculations and molecular dynamics (MD) simulations. To validate the used level of theory experimentally and theoretically obtained spectra haven compared. Computational study of reactivity encompassed both global and local reactive properties. Global reactivity properties have been assessed by frontier molecular orbitals thanks to which quantum-molecular descriptors such as HOMO-LUMO gap, global hardness and electrophilicity have been calculated. Local reactivity properties have been assessed by inspection of charge distribution according to molecular electrostatic potential (MEP) surfaces, average local ionization energy (ALIE) surfaces and Fukui functions. In this work we have also investigated sensitivity of title molecule towards autoxidation and hydrolysis mechanisms. Both of these mechanisms are important from the ecological aspect, concretely for the understanding of degradation properties of title molecule. Pharmaceutical molecules such as thiourea derivatives have been detected in all types of water and therefore they are great threat for aquatic organisms [21-23]. Degradation of

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# DFT ANALYSIS OF SALICYLATES AND BENZAMIDES



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Vibrational spectra, NBO analysis, HOMO-LUMO and first hyperpolarizability of 2-[[2-(2-Methylprop-2-en-1-yl)oxy]methyl]-6-phenyl-2,3,4,5-tetrahydro-1,2,4-triazine-3,5-dione, a potential chemotherapeutic agent based on density functional theory calculations.

### Introduction

The structural diversity and biological importance of nitrogen containing heterocycles have made them attractive over many years [1-3]. Substituted 1,2,4-triazine is an important class of nitrogen containing hetero-cycle and derivatives of 1,2,4-triazine present important core in many natural and synthetic compounds [4-7]. 1,2,4-Triazine-3,5(2*H*,4*H*)-diones (6-azauracils) represent an important class of biologically-active heterocyclic compounds. Several 1,2,4-triazine-3,5-diones showed antiviral [8-10], antimicrobial [11-14], anti-inflammatory activities [15, 16], anti-malarial [17], anticancer [18-21] and antiulcer [22] activities. The title compound was synthesized as a potential antimicrobial agent *via* the reaction of bis(2-methylallyloxy)methane with silylated 6-phenyl-1,2,4-triazine-3,5-dione [14]. Yurdakul and Tanribuyurdu [23] reported the theoretical and experimental study of solvent effects on the structure, vibrational spectra and tautomerism of a 1,2,4-triazine derivative. El-Brollosy et al. [24] reported the single crystal XRD studies of the title compound. The present study describes the electronic properties and vibrational spectra of the title compound (molecular formula  $C_{14}H_{15}N_3O_3$ ), with the hope that the results of present study would be helpful in future synthesis of more potent chemotherapeutic analogues. The energies, degrees of hybridization, populations of the lone electron pairs of oxygen, energies of their interaction with the anti-bonding orbital of the benzene ring and the electron density distributions and E(2) energies have been calculated by NBO analysis using DFT method to give clear evidence of stabilization originating from the hyper-conjugation of various intra-molecular interactions. There has been growing interest in using organic materials for nonlinear optical devices, functioning as second harmonic generators, frequency converters, electro-optical modulators etc., because of the large second order electric susceptibilities of organic materials. Since the second order electric susceptibility is related to first hyperpolarizability, the search for organic chromophores with large first hyperpolarizability is fully justified.

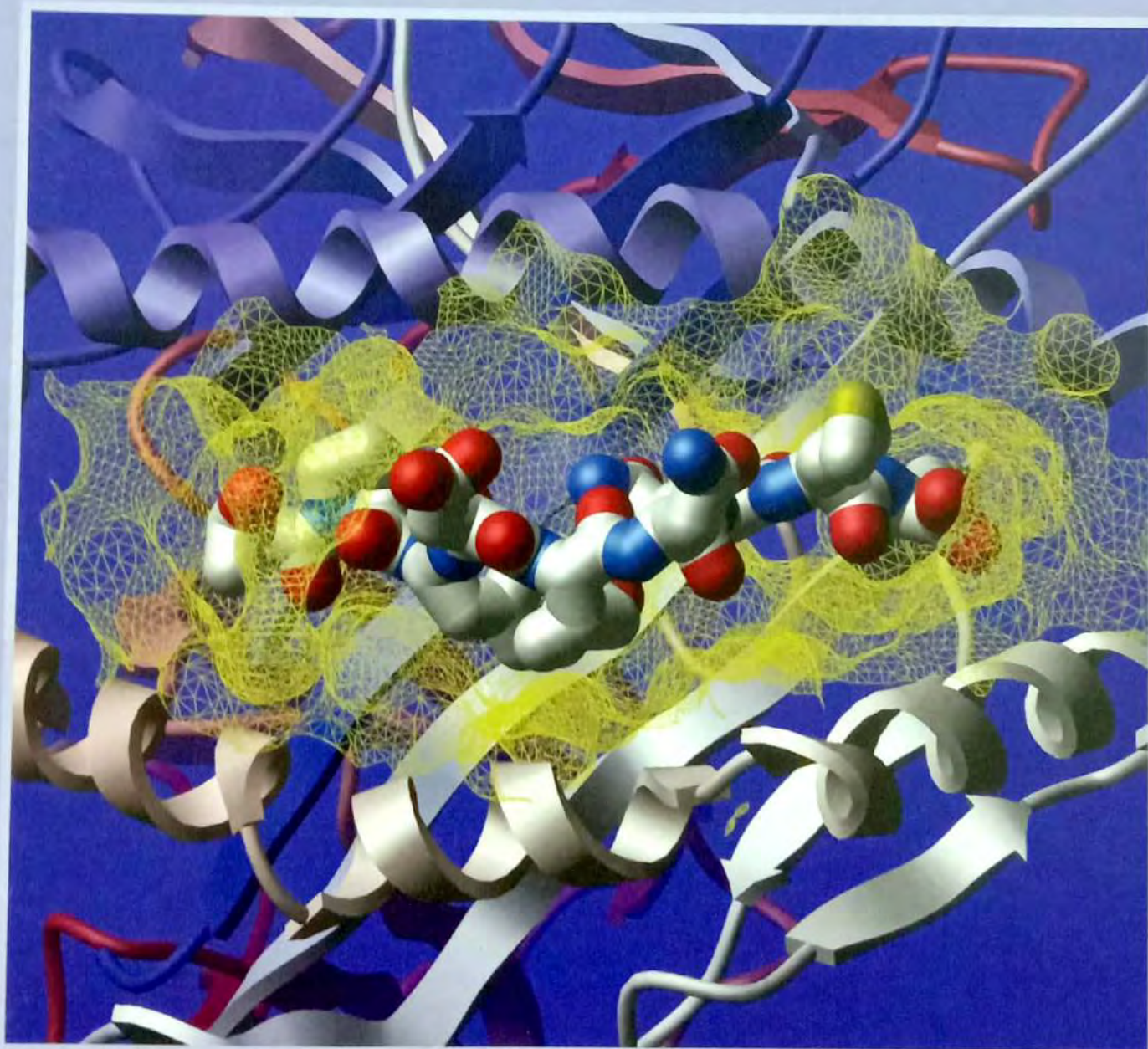




Kallas, Kollam # 9544252747, 9947403318



# DFT INVESTIGATIONS OF ORGANIC DERIVATIVES - II



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# DFT Investigations Of Organic Derivatives - II

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# Reactive, spectroscopic and antimicrobial assessments of 5-[(4-methylphenyl)acetamido]-2-(4-tert-butylphenyl)benzoxazole: Combined experimental and computational study

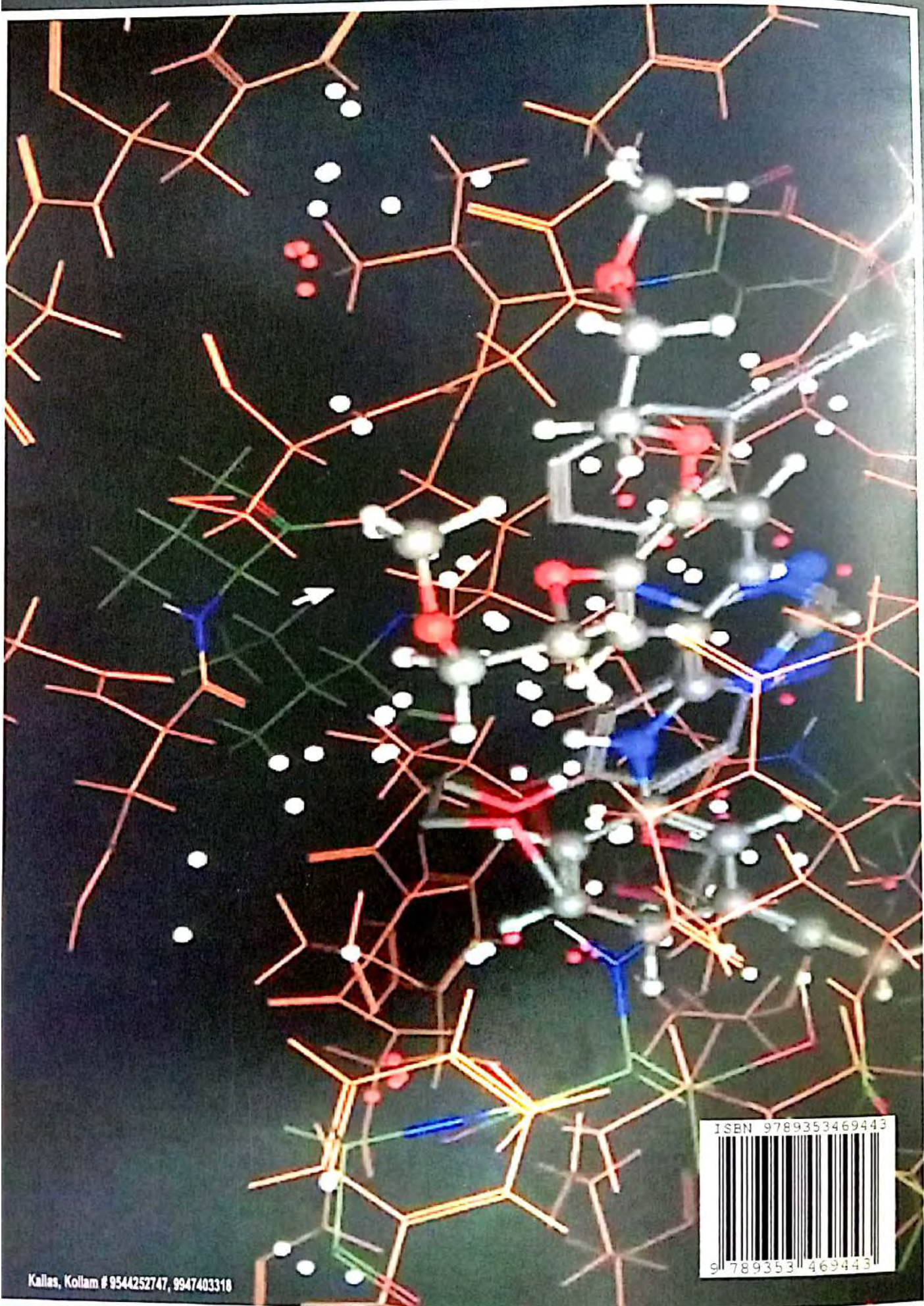
## Introduction

Heterocyclic compounds such as benzoxazoles have attracted attention due to their diverse pharmacological and biological properties like antibacterial, antifungal, anti-tubercular, anti-tumor and antiviral [1-6]. Benzoxazoles are the structural bio-isomers of nucleotides such as guanine and adenine and they interact easily with biopolymers of living system [7, 8] and they inhibit essential bacterial enzymes, such as hyaluronanlyase [9] and isocitratelase [10] as well as bacterial two component systems [11, 12]. Mabied et al. [13] reported the crystal structure of stereochemistry study of 2-substituted benzoxazole derivatives and Jayana et al. [14] reported the synthesis, antibacterial and antioxidant evaluation of novel 1-(5,7-dichloro-1,3-benzoxazol-2-yl)-1H-pyrazolo[3,4-b]quinoline derivatives. Studies of reactive properties of newly synthesized organic molecules with potential important biological activities are very important for the development and improvement of methods for water purification. Namely, molecules that are active components of pharmaceutical products are synthesized to be very stable, thus natural conditions and conventional purification methods are not enough effective for their degradation [15-17.]. Unfortunately, due to various reasons drugs are entering the environment and are accumulating especially in the water resources, where they are toxic to aquatic organisms. So far these types of compounds have been detected in all types of waters [18]. Fortunately, advanced oxidation processes are seen as the alternative when it comes to the degradation of these compounds [19-21]. Forced degradation experiments are very important in the process of making of new pharmacological formulations [22]. These experiments serve as tools by which it is possible to evaluate degradation mechanisms and toxicity. These experiments are expensive and tedious, but principles of molecular modeling are very useful for their rationalization. In this regard it is important to note that DFT calculations and MD simulations are able to provide important reactive properties thanks to which autoxidation and hydrolysis properties can be effectively initially assessed. Taking this into account in this work we have also been devoted to the investigation of specific local reactivity properties based on DFT calculations and MD simulations.

## Experimental

### Materials and methods

The chemicals and solvents were purchased from Sigma-Aldrich (Munich, Germany) and Fisher Scientific (Pittsburgh, PA, USA); they were used without purification. Silica gel HF<sub>254</sub> chromatoplates (0.3 mm) were used for thin layer chromatography, and the mobile phase was chloroform/methanol (10:0.5). Melting point was recorded on a Stuart Scientific SMP1 instrument (Bibby Scientific Limited, Staffordshire, UK) and is uncorrected. NMR spectra were recorded on a Varian Mercury 400 MHz NMR spectrometer (Palo Alto, CA, USA); trimethylsilane (TMS) was used as an internal standard. The mass spectra was recorded on a Waters ZQ Micromass LC-MS spectrometer (Milford, MA, USA) using the ESI(+) method. The FT-IR spectrum was recorded using KBr pellets on a DR/Jasco FT-IR 6300 spectrometer. The FT-Raman spectrum was obtained on a Bruker RFS 100/s, Germany. For excitation of the spectrum



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# DFT Studies - Oxadiazole and Pyrazine Derivatives



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Synthesis, spectroscopic analyses (FT-IR and NMR), vibrational study, chemical reactivity and molecular docking study and anti-tubercular activity of condensed oxadiazole and pyrazine derivatives

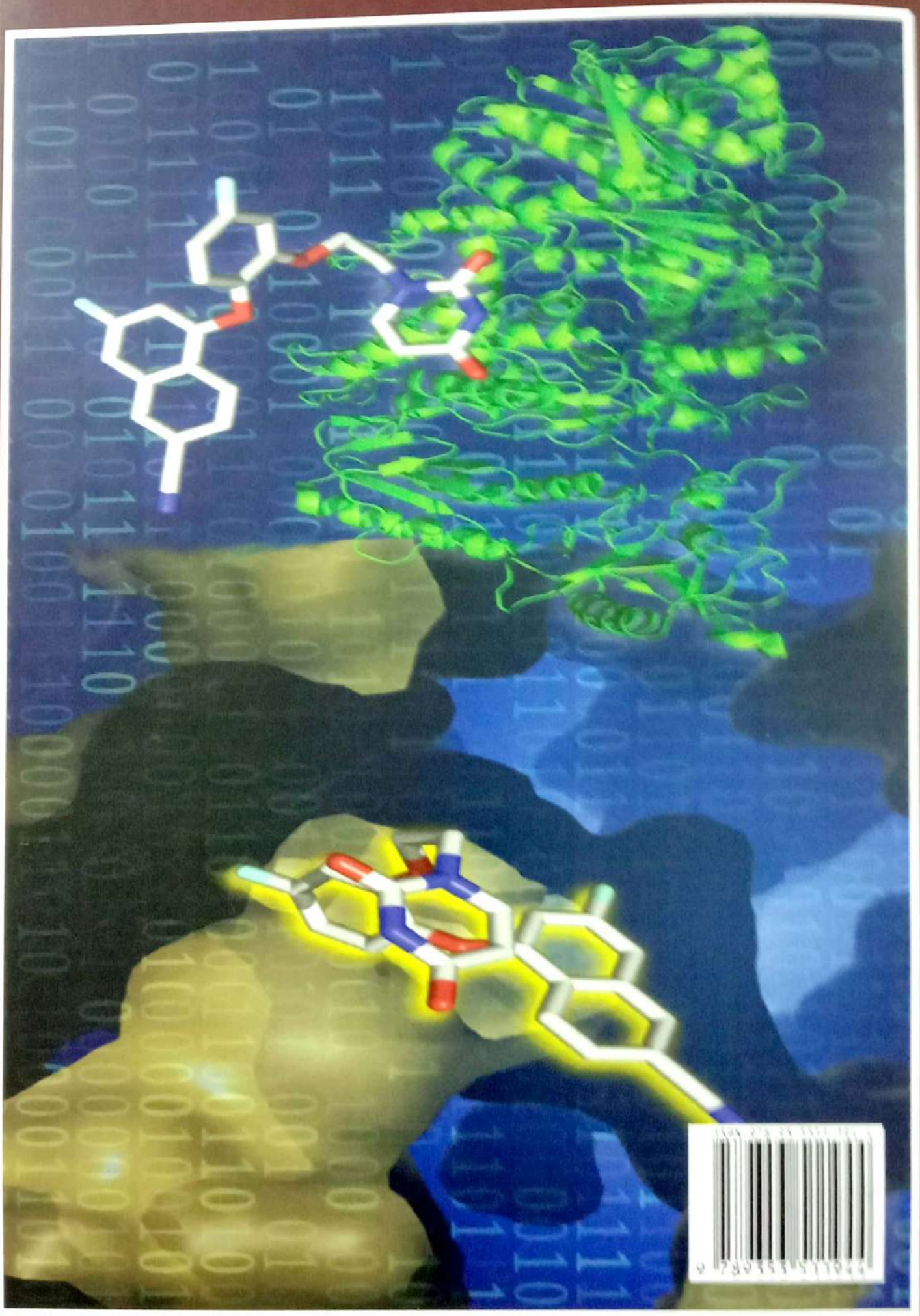
## Introduction

Tuberculosis (TB) is a contagious disease. According to World Health Organization (WHO) report estimates, there were 9.27 million new cases and 13.7 million prevalent cases of TB in 2007 [1]. As much as one-third of world's population is currently infected, and more than 5000 people die from TB every day [2]. TB remains a serious epidemiological problem especially in underdeveloped countries. Multidrug-resistant strains of *Mycobacterium tuberculosis* (MTb) in conjunction with the spread of Human Immunodeficiency Virus (HIV) infection, often leads to the treatment failure [3]. There are two basic approaches to get a new drug for TB : (i) synthesis of analogues, modification or derivatives of existing compounds for improving anti-microbial treatment; and (ii) searching novel structures, that the micro-organisms has never been seen before. The pyrazine nucleus is found to have various biological activities like anti-tubercular, anti-cancer, anti-microbial etc. The very important application of this nucleus is drug pyrazinamide which is used as first line agent in the treatment of tuberculosis. But due to the resistance developed by the MTb, there is urgent need to develop new derivatives of existing drug having greater potency than that of parent drug [4]. So, here is an attempt made to develop the derivatives of pyrazinamide condensed with the oxadiazole ring which is imparting various biological activities like anti-bacterial, anti-inflammatory, anti-tubercular etc. [5-7]. Hence the various condensed oxadiazole and pyrazine derivatives have been synthesized whose characterization has been made by spectroscopic, infrared (IR) and <sup>1</sup>H Nuclear magnetic Resonance (<sup>1</sup>HNMR) studies and their anti-tubercular activity have been screened against MTb H<sub>37</sub>R<sub>V</sub>. Aside of spectroscopic characterization, newly synthesized oxadiazole compounds were also investigated by computational molecular modeling techniques, which are considered to very useful and frequently used tools for investigation of reactive properties [8-12]. Identification of reactive molecular sites by molecular modeling principles is also of importance for the area of degradation of organic pollutants [13-16]. When it comes to the degradation procedures, DFT calculations and MD simulations are especially useful for the determination of molecule parts sensitive towards the oxidation and for evaluation of stability in water [17-19].

## Experimental

### Materials and Instrumentation

The starting material, pyrazinamide was extracted from the tablet PZA CIBA 750 mg, as per the procedure given in the Indian Pharmacopeia (IP). It was characterized by melting point and IR. The chemicals and organic solvents used for synthesis were of laboratory grade (LR) grade. The progress of the reaction and purity of the compounds was confirmed by Merck pre-coated Thin Layer Chromatography (TLC) plates and spots were rendered visible by exposing to UV light and iodine fumes. Melting points were determined in open capillaries using melting point apparatus (VEEGO VMP-D) and reported as uncorrected. FT-IR spectra were recorded by JASCO FTIR 4100 series in the



# DFT STUDIES OF CARBAMIMIDOYL DERIVATIVES



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## FT-IR, FT-Raman and Quantum Chemical calculations of (E)-N-carbamimidoyl-4-((3,4-dimethoxybenzylidene) amino) benzenesulfonamide

### Abstract

FT-IR and FT-Raman spectra of (E)-N-carbamimidoyl-4-((3,4-dimethoxybenzylidene) amino)benzenesulfonamide were recorded and analyzed. The vibrational wavenumbers were computed using HF/6-31G\*, B3PW91/6-31G\* and B3LYP/6-31G\* basis. The data obtained from vibrational wavenumber calculations are used to assign vibrational bands obtained experimentally. The results indicate that the B3LYP method is able to provide satisfactory results for predicting vibrational frequencies and structural parameters. The calculated first hyperpolarizability is comparable with the reported values of similar derivatives and is an attractive object for future studies of non-linear optics. The geometrical parameters of the title compound are in agreement with that of similar derivatives.

### 1. Introduction

Sulfonamides form a significant class of compounds in medicinal and pharmaceutical chemistry with several biological applications [1-4]. Many chemotherapeutically important sulfa drugs, like sulphadiazine, sulphathiazole, sulphamerazine and sulfonamides, possess  $\text{SO}_2\text{NH}$  moiety which is an important toxophoric function [5]. The chemistry of sulfonamides has been known as synthons in the preparation of various valuable biologically active compounds [6, 7] used as antibacterial [8], protease inhibitor [9], diuretic [10], anti-tumor [11] and hypoglycaemic [12]. There has been growing interest in using organic materials for nonlinear optical (NLO) devices, functioning as second harmonic generators, frequency converters, electro-optical modulators etc. because of the large second order electric susceptibilities of organic materials. The organic compound showing high hyperpolarizability are those containing an electron-donating group and an electron withdrawing group interacting through a system of conjugated double bonds. In the case of sulfonamides, the electron withdrawing group is the sulfonyl group [13]. To our knowledge, no theoretical HF or density functional theory (DFT) calculations or detailed vibrational spectroscopic analyses have been performed on the title compound.

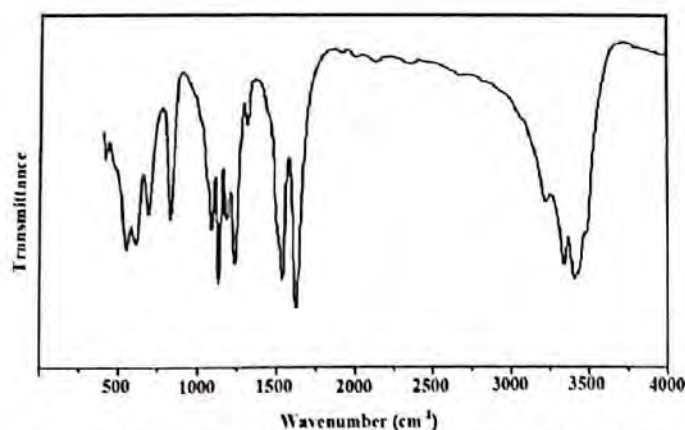
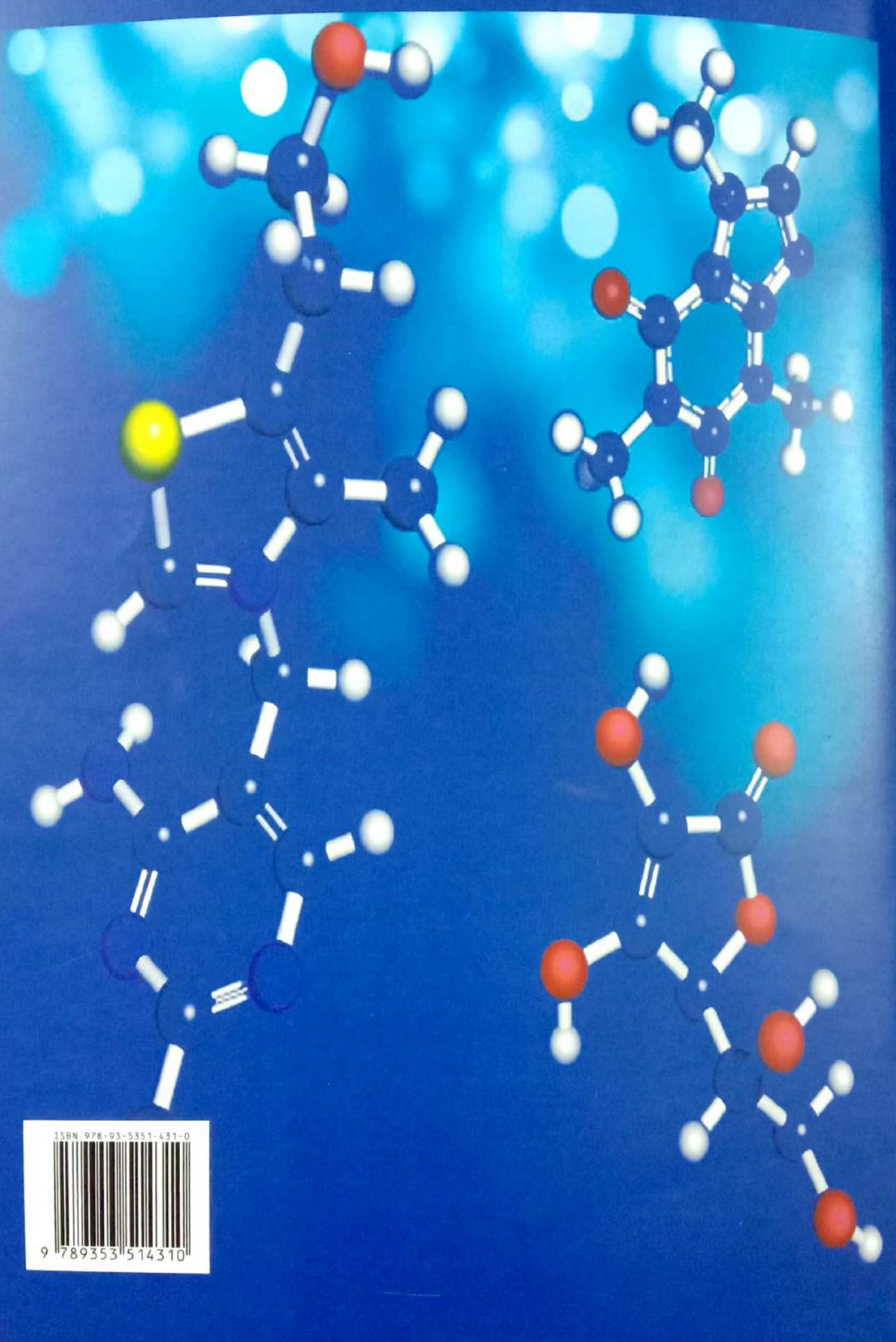


Figure 1. FT-IR spectrum of (E)-N-carbamimidoyl-4-((3,4-dimethoxybenzylidene)amino)benzenesulfonamide



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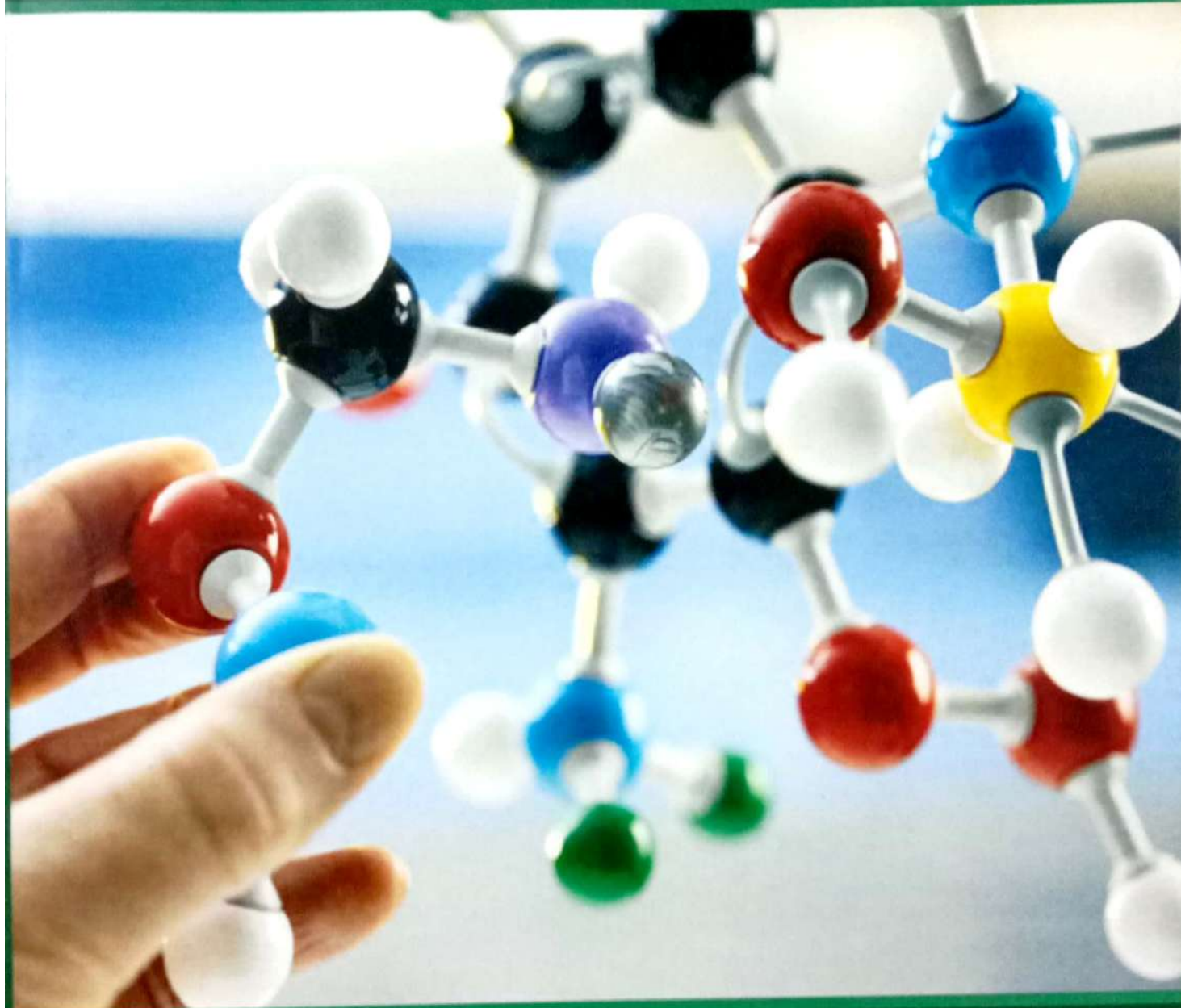


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# SPECTROSCOPIC STUDIES OF ORGANIC DERIVATIVES



Sheena Mary. Y  
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# Spectroscopic Studies of Organic Derivatives

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(English)

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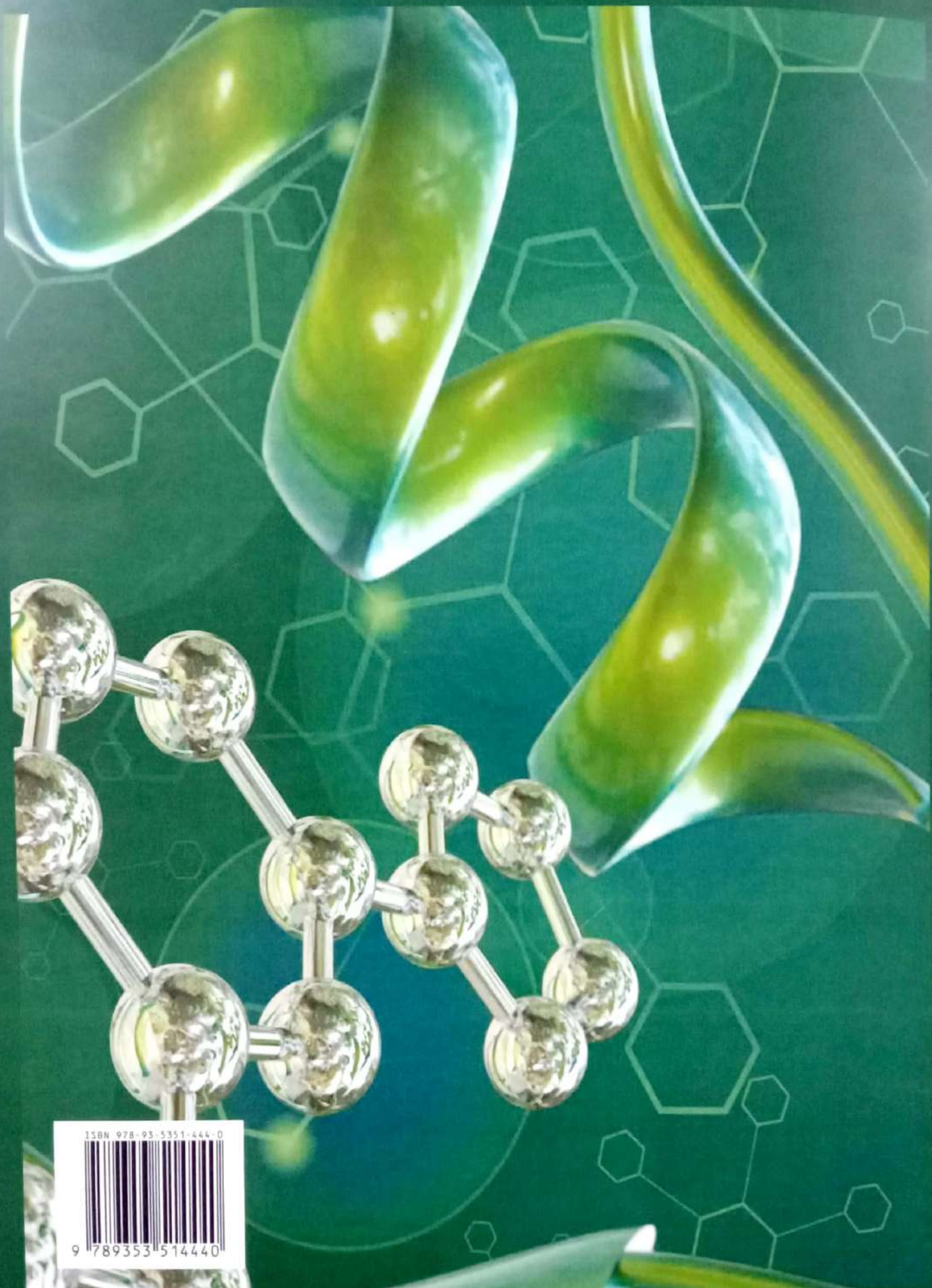
## Infrared and Raman spectroscopic analysis and theoretical computation of 4-butyl-1-(4-hydroxyphenyl)-2-phenyl-3,5-pyrazolidinedione

### Abstract

Infrared and Raman spectroscopic analyses were carried out on 4-butyl-1-(4-hydroxyphenyl)-2-phenyl-3,5-pyrazolidinedione. The interpretation of the spectra was aided by DFT calculation of the molecule. The vibrational wavenumbers were examined theoretically using the Gaussian03 set of quantum chemistry codes and the normal modes were assigned by potential energy distribution calculations. A computation of the first hyperpolarizability of the compound indicates that the compound may be a good candidate as a NLO material. Optimized geometrical parameters are in agreement with the reported XRD results. The RMS error of the observed Raman bands and IR bands are found to be 35.09 and 39.57 for HF method and 14.31 and 17.17 for DFT method. The predicted infrared intensities and Raman activities are reported.

### 1. Introduction

Pyrazolidinediones have been investigated due to interest on their pharmacological and therapeutic properties along with other uses, e.g. as color agents, photo-graphic light sensitive and thermal printing materials [1-3]. 4-butyl-1-(4-hydroxyphenyl)-2-phenyl-3,5-pyrazolidinedione a metabolite and perhaps the active form of phenylbutazone is a widely used non-narcotic analgesic and anti-inflammatory pyrazolidinediones derivative. Like other structurally different anti-inflammatory analgesics, the drug action is believed through the inhibition of prostaglandin biosynthesis [4, 5]. The inherent flexibility and strongly hydrophobic nature of oxyphenbutazone were its favorable properties for interactions with the enzyme as an inhibitor. It is also noteworthy that the doubly substituted pyrazolidine-3,5-diones at the 4-position possess altered biological profiles compared to their non- or mono-substituted parent pyrazolidinedione derivatives[6-10]. The bis(hydroperoxyethyl) pyrazolidine-3,5-dione showed a weak anti malarial activity [7]. Droge *et al.* reported the allosteric properties of the oxyphenbutazone-human serum albumin complex [11]. Singh *et al.* [12] studied the crystal structure, hydrophobic intractions and mode of binding of the complex formed between an enzyme phospholipase A<sub>2</sub> and oxyphenbutazone. Viegas *et al.*[13] reported the intractions of oxyphenbutazone with different cyclodextrins in aqueous medium and in the solid state. Computational method is at present widely used for simulating IR spectra. Such simulations are indispensable tools to perform normal coordinate analysis so that modern vibrational spectroscopy is unimaginable without involving them. Nonlinear optics deals with the interaction of applied electromagnetic fields in various materials to generate new electromagnetic fields, altered in wavenumber, phase, or other physical properties [14]. Organic molecules able to manipulate photonic signals efficiently are of importance in technologies such as optical communication, optical computing, and dynamic image processing [15, 16]. In this context, the dynamic first hyperpolarizability of the title compound is also calculated in the present study. The first hyperpolarizability ( $\beta_0$ ) of this novel molecular system is calculated using B3LYP/6-31G(d) method, based on the finite field approach. In the presence of an applied electric field, the energy of a system is a function of the electric field. First hyperpolarizability is a third rank tensor that can be described by a  $3 \times 3 \times 3$  matrix. The 27 components of the 3D matrix can be reduced to 10 components due to the Kleinman symmetry [17]. The components of  $\beta$  are defined as the coefficients in the



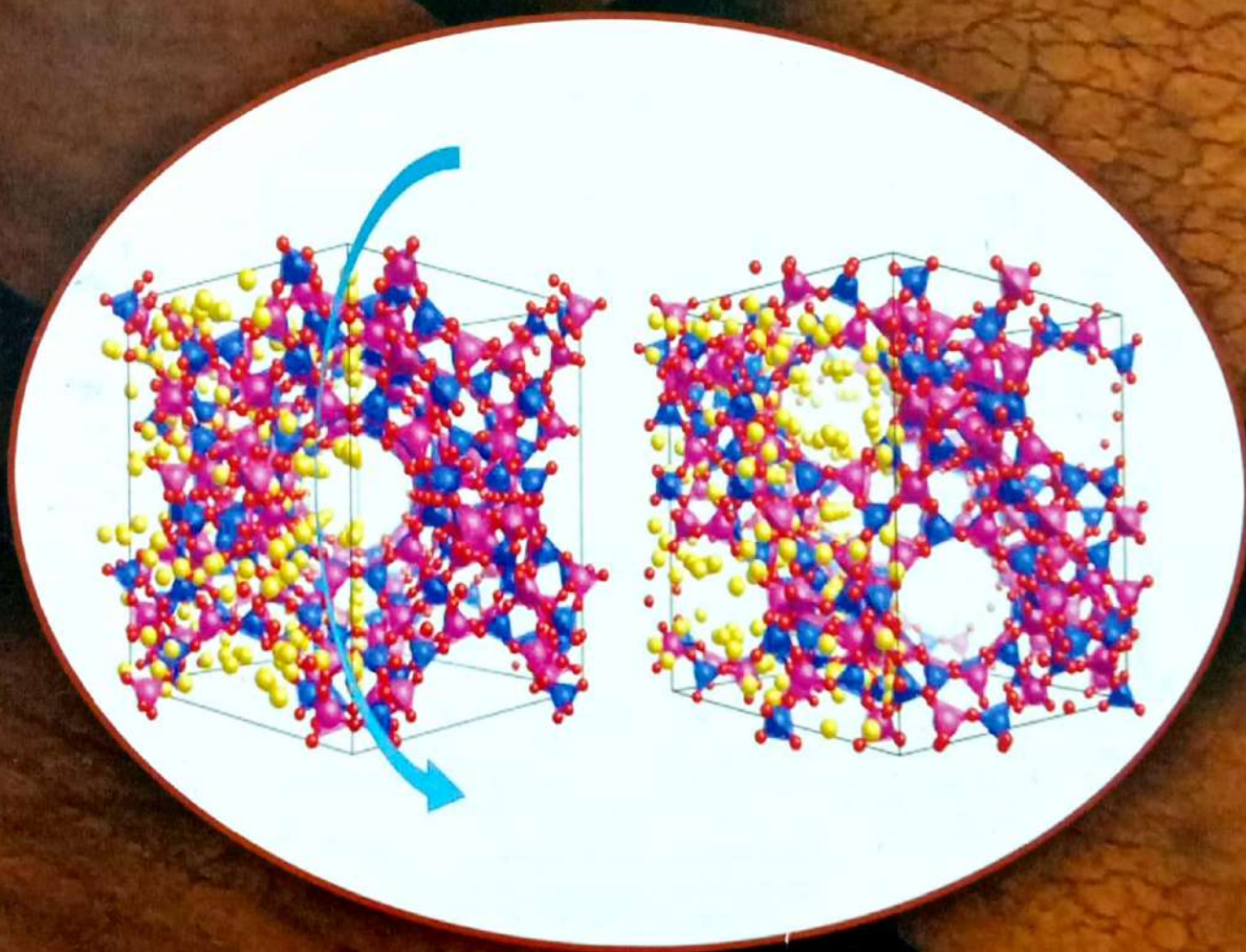
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# DFT STUDIES - SULFONAMIDE DERIVATIVES



Sheena Mary. Y  
Shyma Mary. Y

# DFT Studies - Sulfonamide Derivatives

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(English)

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Vibrational Spectroscopic and quantum chemical calculations of (*E*)-*N*-Carbamimidoyl-4-((naphthalen-1-yl-methylene)amino)benzene sulfonamide

#### Abstract

FT-IR and FT-Raman spectra of (*E*)-*N*-Carbamimidoyl-4-((naphthalen-1-yl-methylene)amino)benzene sulfonamide were recorded and analyzed. The vibrational wavenumbers were computed at various levels of theory. The data obtained from theoretical calculations are used to assign vibrational bands obtained experimentally. The results indicate that B3LYP method is able to provide satisfactory results for predicting vibrational frequencies and structural parameters. The calculated first hyperpolarizability is comparable with reported values of similar derivatives and is an attractive object for future studies of non-linear optics. The geometrical parameters of the title compound are in agreement with that of similar derivatives.

#### 1. Introduction

The naphthalene and its derivatives are of great interest in biological activity and widely used as a parent compound to make drugs. Srivastava has investigated the infrared and Raman spectrum of the condensed and liquid phase naphthalene and its cation [1]. Extensive recent studies of vibrational spectra of substituted naphthalene compounds have assigned [1-4] complete vibrational mode and frequency analyses. Naphthalene is classified as a benzenoid polycyclic aromatic hydrocarbon which is crystalline white solid with the structure of two fused benzene rings and do not contain heteroatoms or carry substituents. Like benzene, naphthalene can undergo electrophilic aromatic substitution. It constitutes a group of widespread pollutants of great environmental interest [5,6]. It is widely recognized that polycyclic aromatic hydrocarbons and their metabolites are among the most toxic, carcinogenic and mutagenic atmospheric contaminants [7-10]. Sulfonamides form a significant class of compounds in medicinal and pharmaceutical chemistry with several biological applications [11-14]. Many chemotherapeutically important sulfa drugs, like sulphadiazine, sulphathiazole, sulphamerazine and sulfonamides, possess  $\text{SO}_2\text{NH}$  moiety which is an important toxophoric function [15]. The chemistry of sulfonamides has been known as synthons in the preparation of various valuable biologically active compounds [16,17] used as antibacterial [18], protease inhibitor [19], diuretic [20], anti-tumor [21], and hypoglycaemic [22]. To our knowledge, no theoretical HF or density functional theory (DFT) calculations or detailed vibrational spectroscopic analyses have been performed on the title compound.



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### ദൈവത്തിന്റെ വികൃതികൾ നോവൽ പഠനങ്ങൾ

എഡിറ്റർ. പ്രതാപൻ തായാട്ട്

നോവലായും സിനിമയായും മലയാളിയെ ഏറെ മോഹിപ്പിച്ച കൃതിയാണ് ദൈവത്തിന്റെ വികൃതികൾ. അൽഫോൻസ് അച്ചൻ, മഗി മദാമ്മ മുതൽ കൂടുന്ന നന്നാക്കുന്ന ചോയിച്ചൻ വരെയുള്ള കഥാപാത്രങ്ങൾ മലയാളിക്ക് ഏറെ പ്രിയപ്പെട്ടതാണ്. ഗോപിനാഥ് മുതുകാട്, ഡോ. ജോണിൻ ചാമക്കാല, ഡോ. ആർ. ശ്രീലതാവർമ്മ, ജാജി പുൽപ്പള്ളി, ഡോ. എ.എസ്. പ്രതീഷ്, ഡോ. കെ. ദേവികൃഷ്ണൻ, ഡി.വി. അനിൽകുമാർ, ഡോ. എം.എസ്. നസീറ, ഡോ. ജാജു വർഗീസ്, കെ.കെ. ശിവദാസ്, ഡോ. ബിൻസി ഡൊമിനിക്ക, സമയ ജോസ്, ഡോ. ആർ. ചന്ദ്രബോസ്, ഡോ. ടി.എം. മാത്യു, ഡോ. അഖില എസ്. നായർ, അനൂപ് വി, ഡോ. ശ്രീജിത് ജി, പ്രഷീന എസ്.എൽ എന്നിവരുടെ നോവൽപഠനങ്ങളും എം. മുക്കുനന്റെ എഴുത്തനുഭവവും.

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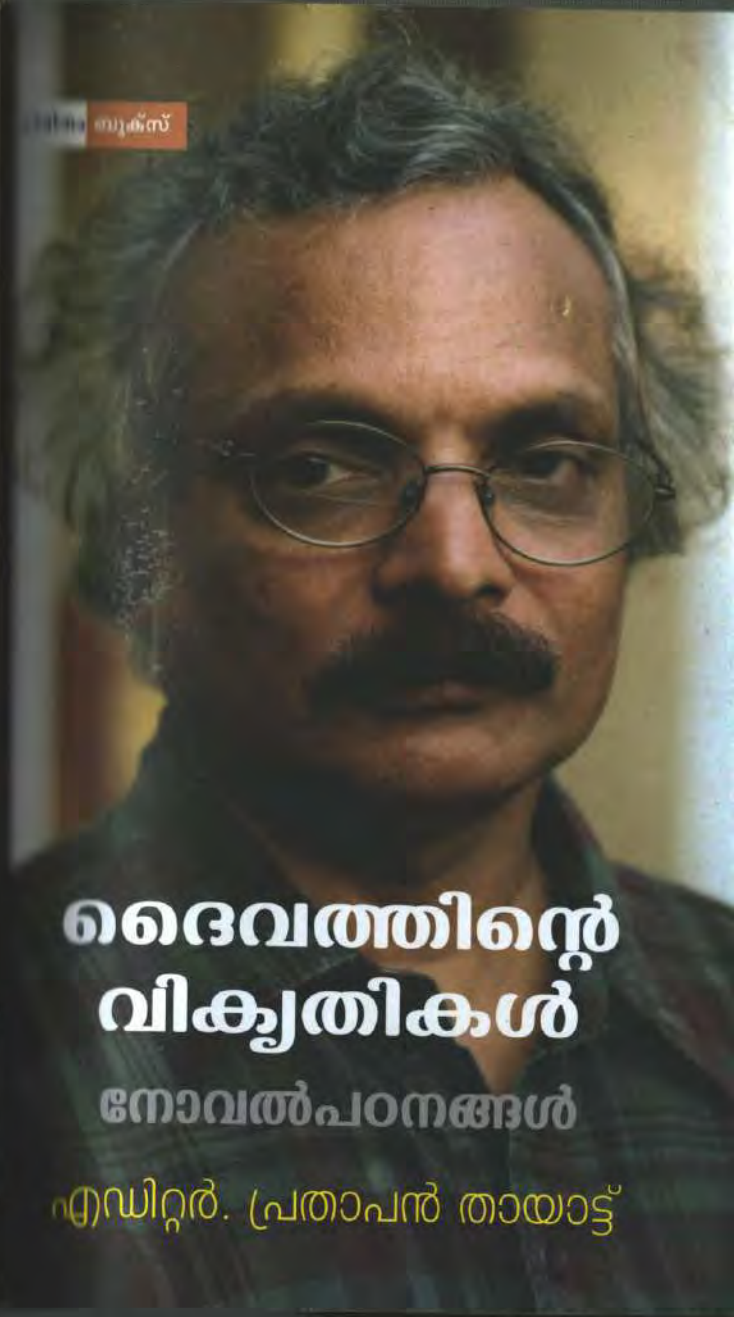
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# ദൈവത്തിന്റെ വികൃതികൾ നോവൽപഠനങ്ങൾ

എഡിറ്റർ. പ്രതാപൻ തായാട്ട്

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എഡിറ്റർ

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ളിലെ ഗദ്യം, മൂന്ന് വാളുകളിലായി, അക്കിത്തത്തിന്റെ തെരഞ്ഞെടുത്ത ലേഖനങ്ങൾ പ്രസിദ്ധീകരിച്ചു.

2014-ൽ ഒരഴുത്തുകാരനെക്കുറിച്ച് നമ്മുടെ പ്രിയങ്കമനായ എം.ടി.യെക്കുറിച്ച് 11 പുസ്തകങ്ങൾ ഒരേവേദിയിൽ വെച്ച് പ്രസിദ്ധീകരിച്ചു. ഇങ്ങനെ നീണ്ടുപോകുന്നു മലയാള പ്രസാധനത്തിലെ ഹരിതയാത്രകൾ.

ഇപ്പോൾ ഞങ്ങൾ ഒരു സ്വപ്നം കാണുന്നു. മലയാളിയുടെ പ്രിയങ്കമനായ എം. മുകുന്ദന്റെ 21 നോവലുകളെക്കുറിച്ച് 21 പഠനപുസ്തകങ്ങൾ, 21 മാസങ്ങളിലായി ഹരിതം ബുക്സ് പ്രസിദ്ധീകരിക്കുന്നു. മുകുന്ദം എന്നാണ് ഈ സാഹിത്യസംഭവത്തിന് നാമകരണം ചെയ്തിരിക്കുന്നത്. മലയാളത്തിലെനല്ല, ഭാരതത്തിലെനല്ല, ലോകസാഹിത്യത്തിൽ ഇത്തരമൊരു സംഭവം വേറെയില്ല. മുകുന്ദനെപ്പോലെ മലയാളിയുടെ അവബോധത്തിൽ ഇടപെടലുകൾ നടത്തിയ മറ്റൊരു സർഗാത്മക എഴുത്തുകാരൻ നമുക്കില്ല. പൂർവാധുനികതയിലും ആധുനികതയിലും ഉത്തരാധുനികതയിലും തിളങ്ങിനിന്ന മുകുന്ദൻ സാഹിത്യം തീർച്ചയായും ഇത്തരമൊരു പഠനം അർഹിക്കുന്നുണ്ട്.

രണ്ടുവർഷത്തിലേറെ നീണ്ടുനില്ക്കുന്ന സ്വപ്നതുല്യമായ ഈ പദ്ധതി ആരംഭിച്ചത് കൂട നന്നാക്കുന്ന ചോയി: നോവൽപഠനങ്ങൾ എന്ന പുസ്തകത്തിലൂടെയായിരുന്നു. മുകുന്ദത്തിന്റെ ഒൻപതാമത്തെ പുസ്തകമായ 'ദൈവത്തിന്റെ വികൃതികൾ: നോവൽപഠനങ്ങളിലേക്ക് ലേഖനങ്ങളും കുറിപ്പുകളും എഴുതിത്തന്ന എല്ലാവർക്കും നന്ദി.

പ്രതാപൻ തായാട്ട്

### ഉള്ളടക്കം

11	മുകുന്ദനെ നമിക്കുന്ന മജീഷ്യൻ ഗോപിനാഥ് മുതുകാട്
14	അൽഫോൻസച്ചന്റെ മുറിവുകൾ ഡോ. ജോബിൻ ചാമക്കാല
20	മായാത്ത അടയാളങ്ങൾ ഡോ. ആർ. ശ്രീലതാവർമ്മ
31	മയ്യഴിയുടെ സർഗാത്മക രേഖകൾ ഷാജി പുൽപ്പള്ളി
40	നവകൊളോണിയലിസത്തിന്റെ ഇതിഹാസം ഡോ. എ.എസ്. പ്രതീഷ്
49	ദൈവത്തിന്റെ വികൃതികൾ ഡോ. കെ. ദേവികൃഷ്ണൻ
58	മനസ്സിലെ കോളനികൾ ഡി.വി. അനിൽകുമാർ
64	മയ്യഴി; വ്യക്തിയും ദേശവും അധിനിവേശത്തിന്റെ വികൃതികൾ ഡോ. നസീറ എം.എസ്.
74	സുകൃതികളുടെ വികൃതികൾ ഡോ. ഷാജു വർഗീസ്
86	ചട്ടക്കാരുടെ ജീവിതചിത്രീകരണം കെ. കെ. ശിവദാസ്

## നവകൊളോണിയലിസത്തിന്റെ ഇതിഹാസം

ഡോ. എ.എസ്. പ്രതിപദ്

മിലയാള നോവലിന്റെ രൂപഭാവങ്ങളിൽ പുതിയ ചലനം സൃഷ്ടിക്കുകയും ആസ്വാദകഹൃദയങ്ങളിൽ ഒരു പുതിയ ഉണർവ്വുണ്ടാക്കുകയും ചെയ്ത എഴുത്തുകാരനാണ് എം. മുകുന്ദൻ. ദാർശനിക വ്യഥകളെ അക്ഷരങ്ങളുടെ തീയായി പടർത്തിയ അദ്ദേഹം ജന്മനാടായ മയ്യഴിയെ ഈ വിശാലലോകത്തിന്റെ പരിച്ഛേദമാക്കി വളർത്തി. ആധുനികവാദത്തിന്റെയും അസ്തിത്വവാദത്തിന്റെയും രചനകളായി അറിയപ്പെടുന്ന മുകുന്ദന്റെ രണ്ട് നോവലുകളാണ് മയ്യഴിപ്പുഴയുടെ തീരങ്ങളിൽ, ദൈവത്തിന്റെ വികൃതികൾ എന്നിവ. മയ്യഴിയുടെ വിമോചനവുമായി ബന്ധപ്പെട്ട ചരിത്രമാണ് മയ്യഴിപ്പുഴയുടെ തീരങ്ങളിലേതെങ്കിൽ മയ്യഴിയുടെ വിമോചനാനന്തര കാലത്തിന്റെ ചരിത്രമാണ് ദൈവത്തിന്റെ വികൃതികളിൽ പ്രത്യക്ഷപ്പെടുക.

മയ്യഴിയിലെ അധിനിവേശാനന്തര സമൂഹത്തിന്റെ കഥ പറയുന്ന ദൈവത്തിന്റെ വികൃതികളെ അധിനിവേശാനന്തര രചന (Post-Colonial Writing) എന്നു വിശേഷിപ്പിക്കാം. വിമോചനാനന്തര മയ്യഴിയിൽ പ്രത്യക്ഷപ്പെടുന്ന മാഷ്ട്രിയ, സാംസ്കാരിക, സാമ്പത്തിക പ്രതിസന്ധികളാണ് ഇതിൽ ആഖ്യാനം ചെയ്യപ്പെടുന്നത്. ശക്തമായ കോളനി വിരുദ്ധ നിലപാടുകൾ സ്വീകരിച്ചുകൊണ്ട് എഴുതപ്പെട്ട കൃതികുടിയാണ് ഇത്.

വെള്ളക്കാർ പോയതോടെ തകർന്നു നശിച്ച അൽഫോൻസച്ചന്റെയും മഗ്നിമദാമ്മയുടെയും കഥ മാറിയ ലോക യാഥാർത്ഥ്യങ്ങളുടെ പശ്ചാത്തലത്തിൽ മുകുന്ദൻ ആവിഷ്കരിക്കുമ്പോൾ അനുഭവതീവ്രതയാർന്ന മയ്യഴിയുടെ ചരിത്രമാണ് വായനക്കാരിൽ സന്നിവേശിക്കുക. വെള്ളക്കാരുടെ കാലത്ത് പ്രതാപികളായിരുന്ന അൽഫോൻസച്ചന്റെ കുടുംബത്തിലൂടെ കോളനിവാഴ്ച അവസാനിച്ചാലുള്ള അധിനിവേശകന്റെ ദുരന്തത്തെയും ഈ നോവൽ അടയാളപ്പെടുത്തുന്നു. കൊളോണിയലിസം നശിച്ചാൽ കൊളോണിയലിസ്റ്റ് എന്തായിത്തീരും എന്നതിന്റെ സൂചന കൂടി അൽഫോൻസച്ചന്റെയും കുടുംബത്തിന്റെയും ദുരന്തത്തിലുണ്ട്. അതേസമയം അയാൾ കൊളോണിയൽ മനോഭാവം പുലർത്തുന്നില്ല. എന്നാൽ ഉള്ളിൽ കണ്യാവുപുക ചെല്ലുമ്പോൾ, അയഥാർത്ഥ്യത്തിന്റെ തലത്തിലെത്തുമ്പോൾ അൽഫോൻസച്ചനിൽ ഉറഞ്ഞു കിടക്കുന്ന ആ കൊളോണിയൽ മനസ്സ് ഉണർന്നെന്നിരിക്കുന്നുണ്ട്.

മയ്യഴിയുടെ സ്രഷ്ടാവ് താനാണെന്ന് അൽഫോൻസച്ചൻ അവകാശപ്പെടുന്നു. മയ്യഴിയിലെ സകല പ്രജകളും തന്റെ സൃഷ്ടികളാണെന്ന് അദ്ദേഹം വിശ്വസിക്കുന്നു. അതുപോലെ മയ്യഴി രാജ്യത്തെ പശുക്കളും ആടുകളും കാക്കകളും വൃക്ഷലതാദികളും തന്റെ സൃഷ്ടിയാണെന്ന് അദ്ദേഹം വിശ്വസിക്കുന്നു. ഇത് തങ്ങളാണ് മയ്യഴി നാടിന്റെ ഉടമകളെന്ന, തങ്ങളാണ് ആധുനിക മയ്യഴി സൃഷ്ടിച്ചതെന്ന് കൊളോണിയൽ മനോഭാവത്തിന്റെ ബഹിർസ്ഫുരണം തന്നെയാണ്. യാഥാർത്ഥ്യത്തിൽ ഈ ബോധത്തെ അൽഫോൻസച്ചൻ തിരസ്കരിക്കുന്നുണ്ട്. അയാൾ കൊളോണിയൽ മനോഭാവം പുലർത്തുന്നില്ല. ഇതാണ് ആത്യന്തികമായി അയാളുടെ ദുരന്തത്തിന്റെ കാരണം. സായ്പ്പന്മാരും സങ്കര വർഗ്ഗക്കാര്യമടങ്ങുന്ന ചട്ടക്കോരുടെ ഈ പതനം ആഖ്യാനം ചെയ്യാനുള്ള ഒരു ഉപാധിയാണ് എൽസി.

മയ്യഴിയുടെ വിമോചനകാല സന്തതിയാണ് എൽസി. എൽസി ജനിക്കുന്നതോടെ വെള്ളക്കാർ എല്ലാം ഉപേക്ഷിച്ച് കപ്പൽ കയറി നാടുവിട്ടു പോകുകയാണ്. ഇത്തരത്തിൽ വിലയിരുത്തിയാൽ കൊളോണിയലിസം ഉപേക്ഷിച്ച ആധിനിവേശകന്റെ പതനമാണ് അൽഫോൻസച്ചന്റെയും കുടുംബത്തിലൂടെയും ആഖ്യാനം ചെയ്യപ്പെടുന്നത്. ധർമ്മപാലന്റെ വെപ്പാട്ടിയായി മാറിയ മഗ്നിയിൽനിന്നും

വേശ്യയായി മാറിയ എൽസിയിലേക്കെത്തുമ്പോൾ ഈ ദുരന്തം പൂർത്തിയാകുന്നു.

ദൈവത്തിന്റെ വികൃതിയിലെ മിക്ക കഥാപാത്രങ്ങളും (അൽ ഫോൻസച്ചൻ, മഗ്ഗിമദാമ്മ, എൽസി, മൈക്കിൾ, ഡക്കി) ക്ഷതം സംഭവിച്ച വർഗ പ്രതിനിധികളായാണ് നോവലിൽ പ്രത്യക്ഷപ്പെടുന്നത്. എന്നാൽ തദ്ദേശിയരായിട്ടുള്ളവർ (ധർമ്മപാലൻ, ഫൽഗുനൻ, മാധവൻ, ആറുപുരയിൽ കടുങ്ങൻ) ധനികരും സംസ്കാര സമ്പന്നരും ബഹുമാന്യരുമാണ്. വെള്ളക്കാരപ്പോയി, നാട് ഇരന്നുപോയി, വൈദ്യരേ എന്നു വിളിക്കുന്ന വണ്ണാത്തിയും ഒതേനത്തുമടങ്ങുന്ന ഒരു തലമുറയും ഈ നോവലിൽ കടന്നുവരുന്നു. വെള്ളക്കാരൻ പോയപ്പോൾ അവരുടെ ജീവിതത്തിൽ പ്രകടമായ ഉപരിവർഗ സ്വഭാവം നിമിത്തം അവർ ചെയ്യാതിരുന്ന ജോലികൾ ചെയ്തു ജീവിച്ചവർ നരകിക്കുന്നു. തദ്ദേശീയരാകട്ടെ, താന്താങ്ങളുടെ ജോലികൾ സ്വയം ചെയ്തു ജീവിക്കുന്നവരായാൽ ആശ്രിത ജോലികളിൽ മറ്റുള്ളവരെ പ്രവേശിപ്പിച്ചുതുടങ്ങി. വെള്ളക്കാരരുടെ ആധുനിക ജീവിതം സ്വപ്നം കണ്ട കുഞ്ഞാമൻ വക്കീലായിരുന്നു ഏക ആശ്രിത ജോലിദാതാവ്. അയാൾ ഫ്രാൻസിൽ പോയതോടെ കൃശിക്കാരനായ ഒതേനനും പട്ടിണിയിലായി. ഇങ്ങനെ വെള്ളക്കാരെ ആശ്രയിച്ചു ജീവിച്ച സമൂഹം മാത്രമാണ് അവർ പോയതിൽ കണ്ണീരും നിലവിളിയുമായി ദൈവത്തിന്റെ വികൃതികളിൽ കഴിയുന്നത്.

വെള്ളക്കാരെ കെട്ടുകെട്ടിച്ചതിൽ മനം നൊന്തുകഴിയുന്ന കുഞ്ഞാമൻ വക്കീലിനെപ്പോലുള്ള പ്രമാണികൾ അടങ്ങുന്ന ഉപരിവർഗ സമൂഹ വ്യഥകൾകൂടി ദൈവത്തിന്റെ വികൃതികളിലുണ്ട്. എങ്കിലും ഇത്തരക്കാർ അപഹാസ്യരാവുന്നില്ല. അതേസമയം മയ്യഴിയിലെ ചട്ടക്കാരായ അൽഫോൻസച്ചനും കുടുംബത്തിനും തദ്ദേശീയരുടെ ദയാദാക്ഷിണ്യങ്ങളുടെ തണൽ യഥേഷ്ടം ലഭിക്കുന്നുണ്ട്. അധിനിവേശത്തിനു പകരം പാലായനത്വമാണ് ചട്ടക്കാരരുടെ വിധി എന്ന് അൽഫോൻസച്ചന്റെ കുടുംബത്തിന്റെ കഥയിൽനിന്നും വ്യക്തമാവുന്നുണ്ട്.

പാലായനം അൽഫോൻസച്ചന്റെ കുടുംബത്തിന്റെ പ്രത്യേകതയാണ്. അയാളുടെ പപ്പ ചുവന്ന മുടിയുള്ള അനോണി തൊണ്ണൂറാം വയസ്സിൽ ഓളിച്ചോടിപ്പോയി. അയാളുടെ മുത്തമകൾ പതി

നെട്ടാം വയസ്സിൽ ഒരു പോലീസുകാരന്റെ കൂടെ ഒളിച്ചോടിപ്പോയി. മൈക്കൽ ഫ്രാൻസിലേക്കും പോയി. ഇങ്ങനെ ഒരേയാർത്ഥിത്വ പാശ്ചാത്തലം ആ കുടുംബത്തിൽ കാര്യം നിറയ്ക്കുന്നുണ്ട്. കഴിഞ്ഞ തലമുറയിലെ അധിനിവേശം പുതിയ തലമുറയിൽ പാലായനത്വമായി മാറുകയാണ്. വേട്ടക്കാരൻ പിന്നീട് ഇരയായിത്തീരുന്ന കാലവിപര്യയം അൽഫോൻസിന്റെ കുടുംബ കഥയിലുണ്ട്.

കോളനി മനോഭാവത്തെ പ്രതിരോധിക്കുന്ന ശക്തമായ കഥാപാത്രങ്ങൾ ദൈവത്തിന്റെ വികൃതിയിലുണ്ട്. ആറുപുരയിൽ കടുങ്ങനും, കുഞ്ഞാമൻ വക്കീലിന്റെ മക്കളായ മിത്രനും ശ്രീനിവാസനും ഈ വിഭാഗത്തിൽപ്പെടുന്നു. പരിഷ്കാരിയും കൊളോണിയൽ മനോഭാവമുള്ളവരുമായ കുഞ്ഞാമൻ വക്കീലിന്റെ അപരതമാണ് ആറുപുരയിൽ കടുങ്ങൻ. ദുബായിൽപ്പോയി ധനികനായ മാധവനും ഒരിക്കലും തന്റെ ഭൂതകാലത്തെയോ സ്വന്തം നാടിനെയോ മറക്കുന്നില്ല. മയ്യഴി വിമാചന സമരത്തിലെ ആ കലാപകാരി "മയ്യഴി എന്റേതു കൂടാ ഞാനവിടെ ജനിച്ചു വളർന്നോനാ" എന്നു തിരിച്ചറിയുന്നുണ്ട്. ദുരിതകാലത്തെ തന്റെ സ്വന്തം വീട് എപ്പോഴും അയാൾ സ്വപ്നം കാണുന്നു. മയ്യഴിക്കാരെ ഏതെങ്കിലും തരത്തിൽ സഹായിക്കാൻ അയാൾക്കാവുന്നതും ഈയൊരു നിലപാടുകൊണ്ടാണ്.

കുഞ്ഞാമൻ വക്കീലിന് അപാതമായി മക്കളായ മിത്രനും ശ്രീനിവാസനും വർത്തിക്കുന്നതുപോലെ ആറുപുരയിൽ കടുങ്ങന്റെ അപരതമാണ് മകൻ രാഹുലൻ. കൊളോണിയൽ വ്യവസ്ഥ രൂപപ്പെടുത്തിയെടുത്ത പിൽക്കാല തലമുറയുടെ പ്രതിനിധിയാണയാൾ. കറുത്ത നിറത്തിനുപകരം അധിനിവേശകന്റെ വെളുത്ത നിറം ആഗ്രഹിക്കുന്നു അയാൾ. അധിനിവേശകന്റെ നിറം കറുത്തതായിരുന്നെങ്കിൽ കറുപ്പിനോടാകുമായിരുന്നു താൽപര്യം. രാഹുലന്റെ വെളുപ്പിനോടുള്ള ആഭിജാത്യം കൊളോണിയൽ മനോഭാവം തന്നെയാണ്. 'ഫ്രാൻസിൽ പോയാൽ വെള്ളക്കുമോ' എന്ന് അയാൾ ആരായുന്നുണ്ട്. കുമാരൻ വൈദ്യരുടെ നാട്ടുവൈദ്യത്തിനു പകരം അലോപ്പതി മരുന്നുതേടുന്നു. ഇന്ത്യയിൽ നിലനിന്നിരുന്ന വ്യത്യസ്തങ്ങളായ ചികിത്സാപദ്ധതികളെ നാട്ടുവൈദ്യത്തെയും ആയുർവേദത്തെയും മറ്റു ചികിത്സാരീതികളെയും

ഇല്ലാതാക്കി അലോപ്പതിയുടെ ആധിപത്യം പുർത്തിയാക്കിയത് അധിനിവേശ തന്ത്രം തന്നെയാണ്. അലോപ്പതിയുടെ അധിനിവേശം ആധുനികരണമെന്ന പേരിലായിരുന്നു. ആധുനികരണവും കോളനി വൽക്കരണവും ഒരുകൂട്ടലായി പ്രകീർത്തിക്കപ്പെട്ടു.

“പഠിപ്പും വിവരവും ഇല്ലാതെ കാട്ടാളന്മാരെപ്പോലെ കയീത്തോലാ ഇവിടുത്തെ തീയ്യന്മാർ? ഇപ്പോ തീയ്യന്മാരെ എടേല് ഡോക്ടർമാരും എഞ്ചിനീയർമാരുമാണ്. കൂട്ടിയച്ചന്റെ മൂത്തമോനിപ്പം അബാസഡറാ, ആരാ ഇതിനൊക്കെ കാരണം”- എന്ന കൃത്താമൻ വക്കീലിന്റെ ചോദ്യത്തിലും ഈ നിരീക്ഷണം തന്നെയാണുള്ളത്. പാരമ്പര്യമായ കളരിപഠനം രാഹുലൻ ഒഴിവാക്കുന്നതും കോളനിവൽക്കരണത്തോടൊപ്പം നടക്കുന്ന ഈ ആധുനികരണത്തിന്റെ ഭാഗംതന്നെ. അതുകൊണ്ട് ആധുനികരണങ്ങളെ ചെറുക്കുന്ന, വിശ്വാസ നഷ്ടത്തിൽ വിലപിക്കുന്ന കടുങ്ങൻ അതുകൊണ്ട്തന്നെ കൊളനി വിരുദ്ധനാണ് എന്ന് വ്യക്തം. അതിനാലാണ് ആദിതീയന്റെ കഥ പറയുന്ന മയ്യഴിയുടെ പ്രാഗ്ഭാതിതത്തിൽനിന്ന് ആദിതീയനെ ധ്യാനിച്ചു നിൽക്കുന്ന ആറുപുരയിൽ കടുങ്ങനിലേക്ക് ആഖ്യാനം മാറ്റുന്നതും, കോളനി രൂപവൽക്കരണത്തിനു മുമ്പുള്ള മയ്യഴി ദൈവവും അതിനെ ചെറുക്കുന്ന പിൽക്കാല മനുഷ്യനും ചേർന്നുനിൽക്കുകയാണ് ഇവിടെ.

“നാലും നമ്മളെ നാട്ടുമരുന്ന് തന്നെയാ നല്ലത്. കുമാരാ”, “മക്കൾക്ക് പഴയതിലൊന്നും വിശ്വാസില്ല, കുമാരാ.” “രാഹുലൻ കളരിയിൽപോക്ക് നിർത്തി, പയറ്റും തട്ടും പഠിക്കാത്ത ഒരാളും തറവാട്ടിലെ ഇന്നേവരെ ഉണ്ടായിട്ടില്ല.” എന്ന് വിലപിക്കുന്ന ആറുപുരയിൽ കടുങ്ങൻ “വെള്ളക്കാരുടെ മുമ്പിൽ ഒരിക്കലും തല കുനിച്ചിട്ടില്ല.” ക്ഷുഭിതനായി, “ല്ലാരും കൂടി വെള്ളക്കാരെ പറഞ്ഞയച്ചു. തൃപ്തിയായോ ഇനിക്ക്”- എന്നാണ് കടുങ്ങനോട് വെള്ളക്കാരുടെ പക്ഷപാതിയായ കൃത്താമൻ വക്കീൽ ചോദിക്കുന്നത്. ഇങ്ങനെ ബലിഷ്ഠനായ ഒരു കോളനിവിരുദ്ധ കഥാപാത്രമാണ് ആറുപുരയിൽ കടുങ്ങൻ.

ആറുപുരയിൽ കടുങ്ങനെ നിരൂപണം ചെയ്യുമ്പോൾ പ്രത്യക്ഷപ്പെടുന്ന കോളനി വിരുദ്ധപരമായ സമീപനങ്ങളിൽ ഒരു വൈരുദ്ധ്യമായിത്തോന്നുന്നത് വെളുപ്പിനോടുള്ള അയാളുടെ ആഭിമുഖ്യമാണ്. രാഹുലൻ വെളുപ്പിനോടുള്ള ആഭിമുഖ്യമാണ് കടുങ്ങനു

മെങ്കിൽ ആർ കോളനി മനോഭാവമായിത്തീരുമായിരുന്നു. എന്നാൽ കടുങ്ങന്റെ രാഹുലനിൽനിന്നു വിരുദ്ധവും തീർത്തും സ്വകീയവുമായ സാമ്പത്തിന്റെ ഭാഗവുമാണെന്നു കാണാം. മലയാളിയുടെ ബോധത്തിൽ വെൺമയ്യും ചന്ദനവർണ്ണവും മഞ്ഞൾ നിറവുമായി വടക്കൻപാട്ടിലടക്കം അനുഭവപ്പെടുന്നുണ്ട് ഈ വെൺമയ്യായൊരാളിനുവുമാണ് കടുങ്ങൻ. അത് പ്രാപിക്കാൻ കഴിയാത്തതന്റെ ആദ്യ ഭാര്യയോടുള്ള ഗൃഹാതുരത്വം കൂടിയാണ്. അതുകൊണ്ടുതന്നെ വെൺമയ്യോടുള്ള കടുങ്ങന്റെ ആഭിമുഖ്യം രാഹുലനെപ്പോലെ കോളനി മനോഭാവത്തിന്റെ ഭാഗമാവുന്നില്ല. പിൽക്കാലത്ത് “പണം കൂടുമ്പോൾ വെളുപ്പി താനേ വരും” എന്ന് മയ്യഴിക്കാർ മനസ്സിലാക്കുന്നുണ്ട്.

ഫ്രഞ്ച് സംസ്കാരത്തിൽനിന്നും ഇംഗ്ലീഷ് സംസ്കാരത്തിലേക്കുള്ള മാറ്റത്തിന്റെ സൂചന നോവലിലുണ്ട്. കൃത്താമൻ വക്കീലിന് ഫ്രാൻസിനോടുള്ള ആരാധനയുടെ ഫലമായി ഫ്രഞ്ച് സ്കൂളിൽ ചേർക്കപ്പെട്ട മിത്രവും ശ്രീനിവാസനും സഹപാഠികളായ മുക്കുവക്കുട്ടികളുടെ സംസ്കാരം ആഗിരണം ചെയ്യുന്നു. അവർ അവരുടെ സ്വത്വം വീണ്ടെടുക്കാനുള്ള ശ്രമത്തിലാണ്. അപ്പോൾ “കോൺവെന്റിൽ അയച്ചു പഠിപ്പിച്ചാൽ മതിയായിരുന്നു”- എന്ന് ദമയന്തി വിലപിക്കുന്നു. ഫ്രഞ്ച് സംസ്കാരം വ്യാപകമായപ്പോൾ സാധാരണ പൗരന്മാരും അത് സ്വീകരിച്ചപ്പോൾ അതിന്റെ ആഭിജാത്യം തകർന്നടിയുകയും അതൊരു സങ്കര സംസ്കാരമായി മാറുകയും ചെയ്യുന്നു. അധിനിവേശിത വർഗ്ഗം അതിന്റെതന്നെ സ്വഭാവം നിലനിർത്തുകയും അധിനിവേശക സംസ്കാരത്തിന് ശൈഥില്യം സംഭവിക്കുകയും ചെയ്യുന്നു. അത്തരം സന്ദർഭങ്ങളിൽ ഉപരിവർഗം തങ്ങളുടെ ആഭിജാത്യം നിലനിർത്താൻ കൂടുതൽ പ്രബലനായ അധിനിവേശകനെ ആരാധിക്കുകയും ചെയ്യുന്നു.

“വെള്ളക്കാർ പോയതോടെ രാഷ്ട്രീയപരമായ കോളനിവൽക്കരണം അവസാനിച്ചുവെങ്കിലും മതപരമായി അത് നിലനിന്നിരുന്നു” എന്ന് പറയുന്നുണ്ടെങ്കിലും നോവലിൽനിന്ന് അത്തരമൊരു സൂചനയും ലഭിക്കുന്നില്ല. മതപരമായ കോളനി വൽക്കരണമല്ല, സാംസ്കാരികപരമായതാണ് നിലനിന്നിരുന്നതെന്ന് നോവലിന്റെ മൊത്തം പഠനത്തിൽ തെളിയുന്നു. തന്റെ സാംസ്കാരിക സാമന്ത



മനസ്സിനെ, മതത്തെ ഉപാധിയാക്കി മാറ്റിക്കൊണ്ട് ന്യായീകരിക്കാനുള്ള ശ്രമമാണ് ഇവിടെ.

ദൈവത്തിന്റെ വികൃതികൾ ഒരു പുത്തൻ സാമ്പത്തിക വർഗത്തിന്റെ ആവിർഭാവത്തിന്റെ കഥ കൂടിയാണ്. ഫ്രാൻസ് ലോകത്തെക്കാളും വലുതാണ് എന്ന മനോഭാവത്തെ ഗൾഫ്കൊണ്ട് പകരംവെയ്ക്കുകയാണ് ദൈവത്തിന്റെ വികൃതികളിൽ. അങ്ങനെ ഫ്രാൻസിനു മപ്പുറത്ത് മറ്റൊരു ലോകമുണ്ടെന്ന് വെളിപ്പെടുത്തുകയാണ്. അങ്ങനെ കൊളോണിയലിസം പോയാൽ സർവ്വനാശമാണെന്ന വാദത്തെ ദൈവത്തിന്റെ വികൃതികൾ തിരുത്തുന്നു. ഈ പ്രക്രിയയ്ക്ക് ആരംഭം കുറിയ്ക്കുന്നത് മയ്യഴി വിമോചന പ്രവർത്തകനായ മാധവനാണ് എന്നതുകൂടിയാവുമ്പോഴാണ് ഇത് ശക്തമായ ഒരു പ്രതിപ്രവർത്തനമാണ് എന്ന് വ്യക്തമാവുന്നത്. ദൈവത്തിന്റെ വികൃതികളുടെ ആദ്യ പകുതിയെ നിർണ്ണയിക്കുന്നത് ഫ്രാൻസിസും തുടർന്നുള്ള ഭാഗത്തെ നിർണ്ണയിക്കുന്നത് ഗൾഫുമാണ്.

ദൈവത്തിന്റെ വികൃതികളിൽ വെളിപ്പെടുന്ന മറ്റൊരുതലം അധിനിവേശിത രാജ്യങ്ങൾക്ക് സാമ്പത്തിക മേധാവിത്വമുള്ള മറ്റൊരു രാജ്യത്തിന്റെ ആശ്രയത്തോടുകൂടിയെ നിലനിൽക്കാൻ കഴിയും എന്നാണ്. ഫ്രാൻസിന് ഗൾഫിനെ പകരം വെയ്ക്കുമ്പോൾ ഇതാണ് സംഭവിക്കുന്നത്. ഗൾഫ് പണത്തിന്റെ സ്വാധീനതയാണ് ഒരു പ്രദേശത്തെ നിലനിർത്തുന്നതും നിർണ്ണയിക്കുന്നതും മയ്യഴിയിലെ പഴയ പ്രതാപികൾ കഴിഞ്ഞുകയറ്റം പുതിയ പ്രതാപികൾ ഉയിർത്തുവരികയും ചെയ്യുന്നു. മയ്യഴിയുടെ സാമ്പത്തിക സാംസ്കാരിക ജീവിതത്തിന്റെ കടിഞ്ഞാൺ അവരുടെ കൈയ്യിലാണ്.

ഇങ്ങനെ രൂപപ്പെടുവരുന്ന നവലോകത്തിന്റെ ഉൽക്കണ്ഠകൾ ഈ നോവലിൽ ആവിഷ്കൃതമാവുന്നുണ്ട്. കോളനിക്കാലത്ത് വെള്ളക്കാരുടെ കൈയ്യിൽ മാത്രമായിരുന്നു സമ്പത്തേങ്കിൽ പിൽക്കാലത്ത് മയ്യഴിയിലെ തീയ്യന്മാർ സമ്പന്നരായിത്തീരുന്നു. ഇങ്ങനെ സമ്പത്തും ധനവും വർദ്ധി ക്കാവേ മറുവശം ദാരിദ്ര്യവും കഷ്ടപ്പാടും ഏറിവരികയാണ് എന്ന് നോവലിൽ പറയുന്നുണ്ട്. ഈ പുത്തൻ പണക്കാരുടെ ഉദയം ഒരു നവകോളനികാലത്തിന്റെ തുടക്കംതന്നെ. കൊളോണിയലിസത്തിനു പകരം തുറന്നതും സ്വതന്ത്രവുമായ വിപണിയുടെ ഭാഗമായി രൂപപ്പെടുവരുന്ന പുത്തൻ

ൻ സമ്പന്നവർഗം ഉപഭോഗത്യുഷ്ണയെ കൂടി രൂപപ്പെടുത്തിയെടുത്തു. ഭക്ഷണത്തിന് പകരം ടേപ്പ് റിക്കോർഡർ കൊടുത്തയച്ച മുസ ഈ വർഗത്തിന്റെ പ്രതിനിധിയാണ്. ആഗോള ഉപഭോഗവൽക്കരണം ഈ നവകോളനിവൽക്കരണം ഒതേനനെപ്പോലുള്ളവർ സ്വപ്നം കാണുന്നു. തന്റെ സ്വപ്നത്തിൽ ഒതേനൻ ഫ്രാൻസിനു പകരം ഗൾഫിനെ പകരംവെയ്ക്കുന്നു.

നവകോളനിയൽ വ്യവസ്ഥയെ നിയന്ത്രിക്കുന്നത് സമ്പത്ത്/ചരക്ക് ആണ്. കയറ്റിക്കുമതികളാണ്. രാഷ്ട്രത്തിനുപരി കൂത്തകകളാണ് മയ്യഴിയിൽ ഉയർന്നുവരുന്ന പുത്തൻ സാമ്പത്തിക വർഗം ഇക്കാര്യം വ്യക്തമാക്കുന്നു.

ഈ പുത്തൻ പണം മയ്യഴിയിലുണ്ടാക്കിയ പരിവർത്തനം അഗാധതരമാണ്. എന്തിനേയും വിലകൊടുക്കാൻ പറ്റുന്ന ഒരു പുത്തൻ വർഗം മയ്യഴിയിൽ വേദോടി. അത് ദേശീയ സംസ്കാരത്തെയും അദ്ധ്യാനത്തെയും പാടെ നിഷേധിക്കുന്ന ഒന്നുകൂടിയായിരുന്നു. ചാത്തുവിന് ആടിനെ പോറ്റുന്നത് നിഷിദ്ധമാകുന്നു. മാണിക്കത്തിന് തന്റെ അലക്കുജോലിയും വിലക്കപ്പെടുന്നു. അതേ സമയം ദാരിദ്ര്യത്തിൽ ഈ പുത്തൻ പണം ഒരു സ്വർഗാനുഭവം തന്നെയായിരുന്നു. "ഈട ബംഗ്ലാവുകൾ മാത്രമേ കാണാനുള്ളൂ"- എന്ന് കല്യാണി ചോദിക്കുന്നുണ്ട്. കാരണം തീരെ ഉൽപാദനപരമല്ലാത്ത വ്യവസ്ഥയായിരുന്നു അത്. ആർഭാടം മാത്രമായിരുന്ന അതിന്റെ അടിസ്ഥാന സ്വഭാവം. അതുകൊണ്ടുതന്നെ അത് തദ്ദേശീയമായി നിർമ്മാണ പ്രവർത്തനങ്ങളൊഴികെയുള്ള തൊഴിൽ സാധ്യതകൾ ഉണ്ടാക്കാൻ സഹായമായതുമില്ല. പുറം നാടുകളിൽ വിതരണപ്പെടുത്തിയവർ നാട്ടിൽ അലസരായിക്കഴിയുകയും അലസസമൂഹത്തെ രൂപപ്പെടുത്തുകയുമാണ് ചെയ്തത്. അതുകൊണ്ടാണ് ആർഭാടവും പൊങ്ങച്ചവും അവരുടെ ജീവിതത്തിന്റെ ഭാഗമായിത്തീർന്നത്.

ഇങ്ങനെ ഒരേ സമയത്ത് നവലോകത്തിന്റെ ഉൽക്കണ്ഠകൾ പങ്കുവെയ്ക്കുകയും അതേ സമയം നവകോളോണിയർ അധിനിവേശത്തെയും അതിന്റെ പ്രതിരോധത്തെയും ആവിഷ്കരിക്കുകയും ചെയ്യുന്നുവെന്നതാണ് ദൈവത്തിന്റെ വികൃതികളുടെ സവിശേഷത. ഗൾഫിനോടു തോന്നുന്ന ആശ്രിത മനോഭാവംകൊണ്ട് തദ്ദേശീയരെക്കൊണ്ട് പുതിയൊരു കോളനിവൽക്കരണത്തെത്ത

**ദൈവത്തിന്റെ വികൃതികൾ - നോവൽ പഠനങ്ങൾ**

നന്നായാണ് നോവലിസ്റ്റ് സ്വപ്നം കാണുന്നത്. ഇങ്ങനെ നോവൽ ആഖ്യാനം ചെയ്യുന്ന സംഘർഷത്തെ മുഴുവൻ റദ്ദ് ചെയ്യുകയും കോളനി മനസ്സുതന്നെ മുൻകൈയെടുക്കുകയും ചെയ്യുന്നുവെന്നതാണ് നോവലിന്റെ പരിമിതി.

**ഡോ. എ. എസ്. പ്രതീഷ്**  
അസി. പ്രൊഫസർ, മലയാളം വിഭാഗം  
ഫാത്തിമ മാതാ നാഷണൽ കോളേജ്, കൊല്ലം

# തൃടി

കണ്ണൂർ സർവ്വകലാശാല  
മലയാള വിഭാഗം

2018 ജൂലൈ - ഡിസംബർ വരെയും 6 ഭാഗം 3



# തുടി

നിസർച്ച് ജേർണൽ

23

2018 ജൂലൈ - സെപ്തംബർ  
വാല്യം-6, ലക്കം-3



മലയാളവിഭാഗം, കണ്ണൂർ സർവ്വകലാശാല,  
ഡോ. പി .കെ .രാജൻ മെമ്മോറിയൽ കാമ്പസ്, നീലേശ്വരം,  
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**പത്രാധിപർ**

ഡോ.എ.എം. ശ്രീധരൻ

**പത്രാധിപ സമിതി**

ഡോ. ശിവദാസ് കെ.കെ.

ഡോ.റീജ വി.

സുനിത എ.വി.

നിഷി ജോർജ്ജ്

**ഉപദേശക സമിതി**

ഡോ.ഡി. ബഞ്ചമിൻ

ഡോ.ദേശമംഗലം രാമകൃഷ്ണൻ

ഡോ.ജി.പത്മനാഭു

ഡോ.സി.ആർ. പ്രസാദ്

ഡോ.പി.എസ്. രാധാകൃഷ്ണൻ

**ഇഷ്യൂ എഡിറ്റർ**

ഡോ.റീജ വി.

**കവർ**

രാജേഷ് അനാമിക്, നീലേശ്വരം

ലേ ഔട്ട് & പ്രീ പ്രസ്

അനിഷ്, കോഴിക്കോട്

**അച്ചടി**

ചിന്നുസ് ഓഫ്സെറ്റ് പ്രസ്, കോഴിക്കോട്

ഭാഷയേയും സാഹിത്യത്തേയും സംസ്കാരത്തേയും കുറിച്ചുള്ള പഠന ഗവേഷണങ്ങൾ ക്ക് പ്രാധാന്യം നൽകുന്ന പ്രസിദ്ധീകരണമാണ് തുടി. പ്രതിവർഷം നാല് ലക്കങ്ങൾ: ജനുവരി-മാർച്ച്, ഏപ്രിൽ-ജൂൺ, ജൂലൈ-സെപ്തംബർ, ഒക്ടോബർ-ഡിസംബർ. വില 200 രൂപ

**തുടി**  
**റിസർച്ച് ജേർണൽ**  
 2018 ജൂലൈ -സെപ്തംബർ, വാല്യം-6, ലക്കം-3

**ഉള്ളടക്കം**

പ്രൊഫ.(ഡോ.)അജിത്കുമാർ എൻ.	07	പുരാവൃത്തവും സാഹിത്യവും- ഇടശ്ശേരിയുടെകാവിലെപ്പാട്ടിൽ
ഡോ.ശിവദാസ് കെ. കെ.	14	പ്രവാസിക്വിത മലയാളത്തിൽ
ഡോ. റീജാ രവീന്ദ്രൻ	25	പെണ്ണിടങ്ങൾ:മലയാള നാടകങ്ങളിൽ
ഡോ.ജയലക്ഷ്മി താഴേവീട്ടിൽ	38	സംസ്കൃത നാടകങ്ങളിലെ നാടോടിസംസ്കൃതി
ഡോ. ഗംഗാദേവി എം.	48	അതീതയായ ദേവനായകി സുഗന്ധി എന്ന ആണ്ടാൾ ദേവനായകി
ഡോ. മുനീർ ശുരനാട്	54	പുതിയമനുഷ്യരുടെ പിറവികൾ
ചിത്ര ആർ.വി.	61	അമ്മദൈവരാധനയും കേരളീയ സംസ്കാരവും
പാർവ്വതി കെ. ജി.	75	തിരുവനന്തപുരം മുതൽ കടുത്തുരു ത്തിവരെ ഉണ്ണൂനീലി സന്ദേശത്തി ലൂടെ ഒരു യാത്ര
ഡോ.ദീപ്തി വി.എസ്.	84	ആഖ്യാനത്തിലെ നിഗൂഢതകൾ നോവലിൽ
സിജു. കെ.ഡി.	90	ഭരതൻ സിനിമകളിലെ സ്ത്രീ ലൈംഗികത:പ്രത്യക്ഷങ്ങളും അന്തർധാരകളും
സുധീഷ് പി.വാഴയൂർ	100	ചവിട്ടുകളി- കീഴാളസ്വത്വത്തിന്റെ സൗന്ദര്യാരമക മാതൃക
ഡോ. ആർ. എസ്. ജയ	108	ജൈവപ്പെരുളുകളുടെ അടയാളവാ ക്യങ്ങൾ
ഡോ. സുജ എസ്.	115	ശ്രീനാരായണഗുരുവിന്റെ ഭാഷാപരമായ സംഭാവനകൾ
ഡോ. റീജ വി.	120	ചുമരുകളില്ലാത്ത നാടകം
ഡോ.സേതുലക്ഷ്മി എം.എസ്.	126	ഭാഷാഭിമാനത്തിന്റെ വിളംബരഗാഥ- മെക്കാളെയുടെ മകൾ
ജ്യോതി ലക്ഷ്മി പി.	133	കീഴാളാവബോധം താജ് നാടക ങ്ങളിൽ
ആതിര എസ്.	144	കുട്ടനാട്ടിന്റെ ലാവണ്യശാസ്ത്രം രണ്ടിടങ്ങളിലായി

അനീഷ എസ്. ഇ.	151 പ്രണയപാചകത്തിലെ രൂപവിശേഷങ്ങൾ
രഞ്ജു ആർ.	159 ഉണ്ണി.ആറിന്റെ കഥകളിലെ നിശ്ശബ്ദസാന്നിധ്യങ്ങൾ
ബിന്ദു പി.	165 അസ്വസ്ഥതയുടെ ജീവിതക്കാഴ്ചകൾ വീരാൻ കുട്ടിയുടെ കവിതകൾ ഒരു പഠനം
ഡോ. ദീപു പി. കുറുപ്പ്	169 ചിലപ്പതികാരവും ഭദ്രകാളിപ്പാട്ടും
ജൂബി അലക്സ്	176 നങ്ങൂർകുത്തിലെ സീത മാർഗ്ഗി സതിയിലൂടെ
ഇന്ദു പി.നമ്പൂതിരി	189 കാമനയുടെ ആത്മലോകങ്ങൾ സ്ത്രീരചനകളിലെ ജന്തുലോകരാഷ്ട്രീയം
ഡോ. നിത്യ പി. വിശ്വം	199 മലയാളത്തിലെ ഹാസ്യസാഹിത്യചരിത്രനിർമ്മിതി;പ്രശ്നങ്ങളും സാധ്യതകളും
അഞ്ജന എ.	207 ദ്രാവിഡ സ്ത്രീ കഥാപാത്രങ്ങൾ-സി.എൻ.ന്റെ രാമായണ നാടകത്രയത്തിൽ
✓പ്രൊഫീഷ്യ ജോൺ ജസ്ന കെ.പി.	216 രതി മലയാളസാഹിത്യത്തിൽ
രേഷ്മ കെ.ആർ.	228 കൊരുവാനത്തിലെ പുതങ്ങളിലെ ഹരിതരാഷ്ട്രീയം
ഡോ.ദീപേഷ് കരിമ്പുങ്കര	241 സിനിമയിലെ പെണ്ണിടങ്ങൾ
	246 സമതാദർശകന്റെ ലോകായനങ്ങൾ വള്ളത്തോൾക്കവിതയിലെ ലോകബോധത്തെക്കുറിച്ച് ഒരന്വേഷണം
ഡോ. അജിത് എം.എസ്.	257 രാഷ്ട്രീയാധുനികത, കാൽപനികത-കലർപ്പിന്റെ രാഷ്ട്രീയം യു.പി. ജയരാജിന്റെ കഥകളിൽ

## പുരാവൃത്തവും സാഹിത്യവും- ഇടശ്ശേരിയുടെ കാവിലെപ്പാട്ടിൽ

പ്രൊഫ.(ഡോ.)അജിത്കുമാർ എൻ

പ്രകൃത്യതീതശക്തികളെ മനോഘടനയ്ക്കിണങ്ങും വിധം പൗരാണികർ വ്യാഖ്യാനിച്ചിതിന്റെ നേർരേഖകളായി പുരാവൃത്തങ്ങൾ നിരീക്ഷിക്കപ്പെട്ടിട്ടുണ്ട്. ആധുനികജീവിതപരിസരങ്ങളിൽപ്പോലും വിനിമയസാഹചര്യം നിലനിൽക്കുന്ന പുരാവൃത്തങ്ങൾക്കു മനുഷ്യന്റെ സാംസ്കാരികവീക്ഷണങ്ങളെ രൂപപ്പെടുത്തുന്നതിലും നിർണ്ണായക പങ്കുണ്ട്. ഭാരതത്തിന്റെ സാംസ്കാരികവൈവിധ്യം പതിനെട്ടിലേറെ പുരാണങ്ങളിലായി പകർന്നു കിടക്കുന്ന ദേവസങ്കല്പങ്ങളുമായി ഏറെ ബന്ധപ്പെട്ടിരിക്കുന്നു. ഈ ദേവസങ്കല്പങ്ങളെ ഒന്നിലേയ്ക്കാവാഹിക്കാനുള്ള മനോഘടനയിലാണ് ഭാരതീയസംസ്കാരത്തിന്റെ പഴുതുകൾ നിർമ്മിക്കപ്പെട്ടിട്ടുള്ളത്. അതിൽനിന്നു മുക്തമായ യാതൊന്നും ഇന്ത്യൻ പശ്ചാത്തലത്തിൽ രൂപപ്പെട്ടിട്ടുമില്ല. കലയിൽ പ്രത്യേകിച്ചും. സാംസ്കാരികമായ ഏകീകരണത്തിന്റെ ഈ സ്വാഭാവം കേരളീയപശ്ചാത്തലത്തിലും പ്രസക്തമാണ്. മലയാളിയുടെ സാംസ്കാരിക ജീവിതത്തെ സവിശേഷമായും സജീവമായും നിലനിറുത്തുന്നതിൽ കാളീപുരാവൃത്തങ്ങൾക്കു വലിയ സ്ഥാനമുണ്ട്. ആ നിലയിൽ നിന്നുകൊണ്ടു സാഹിത്യരൂപങ്ങളെ പഠിക്കുന്നത് രസകരവുമായിരിക്കും.

പുരാവൃത്തം പൗരാണികരുടെ മനോഘടനയുമായി ബന്ധപ്പെട്ടിരിക്കുന്നുവെന്നു സൂചിപ്പിച്ചുവല്ലോ. അതുകൊണ്ടുതന്നെ പുരാവൃത്തം നാടോടി വഴക്കങ്ങളുടെ സവിശേഷസാഹചര്യങ്ങളുമായി ഇണങ്ങും. സമഷ്ട്യാധിഷ്ഠിതമായ നില, അജ്ഞാതകർത്തൃകത, പ്രാകൃതനത, പാരമ്പര്യം, പ്രാദേശികത, പാഠഭേദം തുടങ്ങി നാടോടിവഴക്കങ്ങളുടെ സവിശേഷസ്വാഭാവമായി കണ്ടെത്തുന്നവയെല്ലാം പുരാവൃത്തങ്ങളെയും സ്വാധീനിക്കുന്നുണ്ട്. പുരാവൃത്തത്തിലെ മനോഘടന സാമൂഹികപ്രസക്തം കൂടിയാണ്. വ്യക്തിയിൽ സമരാംഭിക്കുന്ന ആശയങ്ങൾക്കു ഇതരവ്യക്തികളുടെ അംഗീകാരം കിട്ടുമ്പോഴുള്ള കൂടുതലാദിതത്വം പുരാവൃത്തങ്ങളുടെ ഘടനയ്ക്കു ജൈവസ്വഭാവം നൽകുന്നു. ഈ അംഗീകാരത്തിനു ലംബതലത്തിലും തിരശ്ചീനതലത്തിലും പ്രസക്തിയുണ്ട്. തിരശ്ചീനതലത്തിൽ അതു സാമൂഹികാംഗീകാരമാണ്. എന്നാൽ ലംബതലത്തിൽ ഇതിനുണ്ടാകുന്നത് കാലികാംഗീകാരമായിരിക്കും. ഇതിനെ നാം പരിണാമം എന്നും വിളിക്കും. തലമുറകളിലേയ്ക്ക് കൈമാറ്റം ചെയ്യപ്പെടുമ്പോൾ സംഭവിക്കുന്ന ആയവ്യയങ്ങൾ ഇവിടെ പുരാവൃത്തത്തെ ജൈവസ്വാഭാവത്തോടെ ചലനാത്മകമാക്കും. സാഹിത്യത്തിൽ പുരാവൃത്തം മൊഴിമാറുമ്പോഴും സംഭവിക്കുന്നതിനുതന്നെ.



### രതി മലയാളസാഹിത്യത്തിൽ

#### പ്രൊഫ. ജോൺ

രമിപ്പിക്കുക അഥവാ സന്തോഷിപ്പിക്കുക എന്നതാണ് രതി എന്ന പദത്തിന്റെ അർത്ഥം. ഭൗതികജീവിതത്തിൽ ഒരു ജീവിക്ക് ലഭിക്കുന്ന ആത്യന്തികമായ ആനന്ദാനുഭൂതിയെയാണ് രതി എന്ന പദംകൊണ്ട് അർത്ഥമാക്കുന്നത്. 'രമി' ധാതുവിൽ നിന്നാണ് രതി എന്ന പദത്തിന്റെ നിഷ്പത്തി. ഏതെങ്കിലും ഒന്നിനോട് സ്നേഹം തോന്നുമ്പോൾ അനുഭവവേദ്യമാവുന്ന ആനന്ദകരവും വികാരജനകവുമായ മാനസികാവസ്ഥയെ ഈ പദം സൂചിപ്പിക്കുന്നു. കലകളിലും സാഹിത്യത്തിലും ആവിഷ്കരിക്കുന്ന ഒൻപത് ഭാവങ്ങളിൽ ഒന്നാണ് രതി. കലയിൽ ചിത്രീകരിക്കുന്ന സ്നേഹമസൃണമായ മാനസികാവസ്ഥയാണ് രതിഭാവം. ഇത് വികാരജനകമായ ഒരു അവസ്ഥയായിട്ടാണ് ഭരതൻ മുതലായ കലാചിന്തകന്മാർ നിർവചിച്ചിട്ടുള്ളത്. പ്രണയം മുലമുണ്ടാവുന്ന മാനസികാവസ്ഥ തന്നെയാണ് രതി.

പാശ്ചാത്യപൗരസ്ത്യ മതസാഹിത്യങ്ങളിലെ രതിസങ്കല്പം വ്യത്യസ്തമാണ്. ഭാരതത്തിലെ പുരുഷാർത്ഥസങ്കല്പത്തിൽ കാമത്തിന് പ്രധാനസ്ഥാനം നൽകിയിട്ടുണ്ട്. കാമത്തെ ഒരു ശാസ്ത്രമായിത്തന്നെ ഭാരതം അംഗീകരിച്ചിട്ടുള്ളത് ഇതിന് തെളിവാണ്. കാമകലയെ ശാസ്ത്രീയമായി അപഗ്രഥിക്കുന്ന കൃതിയാണ് കാമസൂത്രം. പൗരാണിക സാഹിത്യത്തിൽപ്പോലും രതിയെ നിഷിദ്ധമായി കരുതുന്നില്ല. വിരതിയെ അകറ്റിനിർത്തുന്നുമില്ല. ഈ ദന്ധസമന്വയത്തിന്റെ മാർഗ്ഗം പൊതുവെ ആദരിക്കപ്പെട്ടുപോന്നതിനാൽ ഹൈന്ദവ സങ്കല്പങ്ങളിൽ രതിയേയും ലൈംഗികതയേയും പാപമായി ഗണിക്കുന്നില്ല. ജീവിവർഗത്തിന്റെ നിലനില്പ്തന്നെ ആരോഗ്യകരമായ രതിയിൽ അധിഷ്ഠിതമാണ്. ഭാരതത്തിലും പ്രാചീനഗ്രീസിലും ലിംഗാരാധന ഒരു അനുഷ്ഠാനമായിത്തന്നെ നിലനില്ക്കുന്നു.

മധ്യകാലഘട്ടത്തിൽ പാശ്ചാത്യചിന്തകളിൽ സ്വാധീനം ചെലുത്തിയ പൗരോഹിത്യ മേധാവിത്വവും ക്രൈസ്തവവീക്ഷണവും രതിസങ്കല്പത്തെ പാപമായിക്കണ്ടു. അതിനാൽ യഹൂദക്രൈസ്തവ ദർശനങ്ങളിൽ രതി വിലക്കപ്പെട്ട കനിയായി. ജീവിതാസക്തികളെ വിമലീകരിക്കാനും ഉദാത്തവർത്തിക്കാനുമാണ് മതപൗരോഹിത്യം പ്രചാരണം നടത്തിയത്. എന്നാൽ ഇങ്ങനെയുള്ള മതസദാചാരങ്ങളെ ക്രിയാത്മകമായി ലംഘിച്ചുകൊണ്ട് ചില സാഹിത്യപ്രതിഭകൾ രംഗത്തുവന്നു. അതുകൊണ്ട് തന്നെ സാഹിത്യത്തിൽ ലാവണ്യാത്മകമായ ഒരനുഭൂതിയായി രതി ആവിഷ്കരിക്കപ്പെട്ടു. ശ്ലേഷ്മായും പച്ചയായും കാമത്തെയും രതിയെയും ആവിഷ്കരിച്ചിട്ടുണ്ട് എന്നത് വിസ്മരിക്കുന്നില്ല.

കണ്ണൂർ സർവ്വകലാശാല  
മലയാള വിഭാഗം റിസർച്ച് ജേണൽ

എന്നാൽ അനുഭൂതിജനകവും ഉദാത്തവുമായ രത്യാവിഷ്കാരങ്ങൾ സാഹിത്യ കൃതികളെ ശ്രേഷ്ഠവും സൗന്ദര്യാത്മകവുമാക്കിമാറ്റി എന്നത് ശ്രദ്ധേയമാണ്.

ആധുനിക മനുഷ്യനിൽ സങ്കീർണ്ണമായ അസ്വസ്ഥതയായിത്തീരുന്ന ലൈംഗികതയുടെ വിമലീകരണമാണ് സാഹിത്യത്തിലും സംഭവിക്കുന്നത്. രതിവൈകൃതങ്ങൾ പോലും പ്രതിഭാധനൻമാരുടെ തൂലികയിൽ നിന്ന് പിറക്കുമ്പോൾ രത്യാവിഷ്കാരം സാത്വികവിശുദ്ധമായ ഒരു തലത്തിൽ എത്തിപ്പെടുന്നത് കാണാം.

മധ്യകാലഘട്ടത്തിനൊടുവിലുണ്ടായ നവോത്ഥാനചിന്തകൾ കാല്പനികതയ്ക്ക് വഴിവച്ചു. യൂറോപ്പിലുണ്ടായ കാല്പനികവസന്തം ആവിഷ്കാരസാമ്രാജ്യത്തിന്റെ പുതിയ മേഖലകൾ കണ്ടെത്തി. പിന്നീട് കല കലയ്ക്ക് വേണ്ടി എന്ന വാദം കാല്പനിക പ്രസ്ഥാനത്തെ ദുർബലമാക്കി. സഭ്യത കൈവിട്ട സാഹിത്യം, ലൈംഗിക അരാജകത്വത്തിന്റെ സന്ദേശങ്ങളായി സംശയിക്കപ്പെട്ടു. സാങ്കല്പികമായ രതിലോകങ്ങളുടെ ചക്രവർത്തിമാരായി നോവൽ വായനക്കാർ മാറിയ കാലമുണ്ടായിരുന്നു. ഭാവുകത്വപരിണാമം നോവലിന്റെ ഘടനയിൽ വളരെയധികം മാറ്റമുണ്ടാക്കി. ലോകത്തെ മുഴുവൻ സ്വാധീനിച്ച മാർക്സിസം, മനോവിജ്ഞാനീയം, പരിണാമസിദ്ധാന്തം എന്നീ ദർശനങ്ങൾ മലയാളിസമൂഹത്തെയും ആഴത്തിൽ സ്പർശിച്ചു. സംഘകാലം മുതൽ ആധുനിക ഉത്തരാധുനികപരിസരങ്ങൾ വരെയും ഇത് പ്രകടമാണ്.

**സംഘകാലകൃതികളിലെ രതി**

നവ്യമായ ദർശനങ്ങൾക്ക് വഴി തുറക്കുന്നതിന് മുൻപ് ഉണ്ടായിട്ടുള്ള പ്രാചീന സംഘകാല കൃതികളിൽപ്പോലും രതിയുടെ സജീവവും മനോഹരവുമായ ചിത്രണം കാണാം.

അകനാനൂറിൽ നായികനായകന്മാർ അനുഭവിക്കുന്ന കാമാതുരമായ അവസ്ഥാവിശേഷങ്ങൾ നിരവധിയാണ്. തിരുക്കുറളിലെ മൂന്നാം അധികാരത്തിൽ കാമപദ്ധതിയാണ് വിശദീകരിച്ചിട്ടുള്ളത്. മാനുഷികമായ രതിമോഹങ്ങളുടെ മൗലികമായ ആവിഷ്കരണം ഈ കൃതികളിൽ കാണാം. കവിയുടെ സർഗ്ഗശേഷി ശാസ്ത്രീയമായി പ്രകടിപ്പിക്കുന്ന കർമ്മപദ്ധതിയെ ഇവിടെ ആവിഷ്കരിച്ചിരിക്കുന്നു. ധർമ്മികവിശുദ്ധിയുടെ രേഖയായ തിരുക്കുറൾ കാമത്തെ പ്രാധാന്യവൽകരിച്ചുതന്നെയാണ് അവതരിപ്പിച്ചിട്ടുള്ളത്. അക്കാലത്തെ സ്തോത്രകൃതികളിൽപ്പോലും രതിയുടെ മാഹാത്മ്യം വർണ്ണിച്ചിട്ടുള്ളത് കാണാം. പ്രാചീനകവികൾ പോലും രതിയ്ക്ക് ജീവിതത്തിലുള്ള സ്ഥാനം വിളംബരം ചെയ്യുകയാണ് ഇവിടെ.

**രതി പിൻക്കാലകൃതികളിൽ**

മലയാളസാഹിത്യത്തിന്റെ ആരംഭം മുതൽ തന്നെ കാവ്യസൃഷ്ടാക്കൾ രതിയെ ആദരപൂർവ്വമായാണ് കണ്ടിരുന്നത്. പ്രാചീനപാട്ടുകൃതിയായ രാമചരിതം പോലും ശിവപാർവതീബന്ധത്തിന്റെ ഊഷ്മളത പകർന്നുകൊണ്ടാണ് ആരംഭിക്കുന്നത്.

കാനനങ്കളിലരൻ കളിറുമായ് കരിണിയായ്  
കാർന്നെടുങ്കണ്ണുമ തന്നിൽ വിളയാടിനടന്റേൻ്റ്

കണ്ണൂർ സർവ്വകലാശാല  
മലയാള വിഭാഗം റിസർച്ച് ജേണൽ

എന്നാൽ അനുഭൂതിജനകവും ഉദാത്തവുമായ രത്യാവിഷ്കാരങ്ങൾ സാഹിത്യ കൃതികളെ ശ്രേഷ്ഠവും സൗന്ദര്യാത്മകവുമാക്കിമാറ്റി എന്നത് ശ്രദ്ധേയമാണ്.

ആധുനിക മനുഷ്യനിൽ സങ്കീർണ്ണമായ അസ്വസ്ഥതയായിത്തീരുന്ന ലൈംഗികതയുടെ വിമലീകരണമാണ് സാഹിത്യത്തിലും സംഭവിക്കുന്നത്. രതിവൈകൃതങ്ങൾ പോലും പ്രതിഭാധനന്മാരുടെ തൂലികയിൽ നിന്ന് പിറക്കുമ്പോൾ രത്യാവിഷ്കാരം സാത്വികവിശുദ്ധമായ ഒരു തലത്തിൽ എത്തിപ്പെടുന്നത് കാണാം.

മധ്യകാലഘട്ടത്തിനൊടുവിലുണ്ടായ നവോത്ഥാനചിന്തകൾ കാല്പനികതയ്ക്ക് വഴിവച്ചു. യൂറോപ്പിലുണ്ടായ കാല്പനികവസന്തം ആവിഷ്കാരസാഹിത്യത്തിന്റെ പുതിയ മേഖലകൾ കണ്ടെത്തി. പിന്നീട് കല കലയ്ക്ക് വേണ്ടി എന്ന വാദം കാല്പനിക പ്രസ്ഥാനത്തെ ദുർബലമാക്കി. സഭ്യത കൈവിട്ട സാഹിത്യം, ലൈംഗിക അരാജകത്വത്തിന്റെ സന്ദേശങ്ങളായി സംശയിക്കപ്പെട്ടു. സാങ്കല്പികമായ രതിലോകങ്ങളുടെ ചക്രവർത്തിമാരായി നോവൽ വായനക്കാർ മാറിയ കാലമുണ്ടായിരുന്നു. ഭാവുകത്വപരിണാമം നോവലിന്റെ ഘടനയിൽ വളരെയധികം മാറ്റമുണ്ടാക്കി. ലോകത്തെ മുഴുവൻ സാധിനിച്ച് മാർക്സിസം, മനോവിജ്ഞാനീയം, പരിണാമസിദ്ധാന്തം എന്നീ ദർശനങ്ങൾ മലയാളിസമൂഹത്തെയും ആഴത്തിൽ സ്പർശിച്ചു. സംഘകാലം മുതൽ ആധുനിക ഉത്തരാധുനികപരിസരങ്ങൾ വരെയും ഇത് പ്രകടമാണ്.

**സംഘകാലകൃതികളിലെ രതി**

നവ്യമായ ദർശനങ്ങൾക്ക് വഴി തുറക്കുന്നതിന് മുൻപ് ഉണ്ടായിട്ടുള്ള പ്രാചീന സംഘകാല കൃതികളിൽപ്പോലും രതിയുടെ സജീവവും മനോഹരവുമായ ചിത്രണം കാണാം.

അകനാനുനിൽ നായികാനായകന്മാർ അനുഭവിക്കുന്ന കാമാതുരമായ അവസ്ഥാവിശേഷങ്ങൾ നിരവധിയാണ്. തിരുക്കുറളിലെ മൂന്നാം അധികാരത്തിൽ കാമപദ്ധതിയാണ് വിശദീകരിച്ചിട്ടുള്ളത്. മാനുഷികമായ രതിമോഹങ്ങളുടെ മൗലികമായ ആവിഷ്കരണം ഈ കൃതികളിൽ കാണാം. കവിയുടെ സർഗ്ഗശേഷി ശാസ്ത്രീയമായി പ്രകടിപ്പിക്കുന്ന കർമ്മപദ്ധതിയെ ഇവിടെ ആവിഷ്കരിച്ചിരിക്കുന്നു. ധാർമ്മികവിശുദ്ധിയുടെ രേഖയായ തിരുക്കുറൾ കാമത്തെ പ്രാധാന്യവൽകരിച്ചുതന്നെയാണ് അവതരിപ്പിച്ചിട്ടുള്ളത്. അക്കാലത്തെ സ്തോത്രകൃതികളിൽപ്പോലും രതിയുടെ മാഹാത്മ്യം വർണ്ണിച്ചിട്ടുള്ളത് കാണാം. പ്രാചീനകവികൾ പോലും രതിയ്ക്ക് ജീവിതത്തിലുള്ള സ്ഥാനം വിളംബരം ചെയ്യുകയാണ് ഇവിടെ.

**രതി പിൻക്കാലകൃതികളിൽ**

മലയാളസാഹിത്യത്തിന്റെ ആരംഭം മുതൽ തന്നെ കാവ്യസൃഷ്ടാക്കൾ രതിയെ ആദരപൂർവ്വമായാണ് കണ്ടിരുന്നത്. പ്രാചീനപാട്ടുകൃതിയായ രാമചരിതം പോലും ശിവപാർവതീബന്ധത്തിന്റെ ഊഷ്മളത പകർന്നുകൊണ്ടാണ് ആരംഭിക്കുന്നത്.

കാനനങ്കളിലരൻ കളിറുമായ് കരിണിയായ്  
കാർന്നെടുങ്കണ്ണുമ തന്നിൽ വിളയാടിനടന്റേന്റ്

കണ്ണൂർ സർവ്വകലാശാല  
മലയാള വിഭാഗം റിസർച്ച് ജേണൽ

ഈ വിളയാട്ടത്തെ ഭക്ത്യോദാഹര്യം ആവിഷ്കരിക്കുവാനും തനിയുടെ നിശ്ചിത സുഖതയാണ് വെളിവാക്കപ്പെടുന്നത്. മതിപ്രവൃത്തിസാഹിത്യം സമ്പന്നമാക്കാനും മതിശ്യാപാഠങ്ങളുടെ കേന്ദ്രബന്ധപങ്ങളാണ്. വൈശികത്വം മുതൽ ചരതാത്മ്യം വരെ പരന്നുകിടക്കുന്ന മലയാളത്തിലെ എല്ലാവിധ ശക്തമായ കാവ്യശാഖയുടെ ഭൂമിക തന്നെ തരിയെന്നു കാണാം.

മലയാളചിന്താധാരയിൽ ശാസ്ത്രാധിപ്തിയായി രൂപപ്പെട്ട കൃതികളുടെ സാധനം മലയാളത്തിലും അഭേദമായികൾ സൃഷ്ടിച്ചു. മലയാളത്തിലെ ആദ്യത്തെ സാമ്പ്രദായപ്രസാദമായ ലീലാതിലകവും തന്ത്രസുഖങ്ങളുള്ള മറ്റാകങ്ങളുടെ കോമാമണ്ണി.

വീർത്താളാട്ടു വിതർത്താൾ, വിവശമുതൊടൊടയെന്ന വിവരണിനാടം എഴുതാൻപോന്നു, വിണ്ണപ്പുരികുഴലകമേ താഴികിന്നാളുണ്ണിനാടം (ലീലാതിലകം)

മതിപ്രവൃത്തിനു ശേഷമുണ്ടായ ഭക്തിസാഹിത്യകൃതികളിലും തനിയുടെ മനോഹാരിത കാണാം. ഉദ്യോഗികളുടെ ആവിഷ്കാരം കൊണ്ട് ശ്രദ്ധയോടെ കൃഷ്ണസഹായം പ്രകൃതിവർണ്ണനകളും കൃഷ്ണലീലകളും തനിയുടെ അനവധിയായ ആവിഷ്കാരമാണ്.

കാമന്റെ കാമിനി തന്നുടെയുള്ളിലും കാമധാരങ്ങൾ അച്ഛ മേമന്തൾ (കൃഷ്ണസഹായം) ഭക്തിപ്രവൃത്തിന്റെ ഉപഭോഗസാഹായ എഴുത്തച്ഛന്റെ കൃതികളിലും മത്യാവിഷ്കാരത്തിന്റെ മനോഹരങ്ങളായ അടയാളങ്ങൾ സൃഷ്ടിച്ചു.

കോകില കോക കേകീപാതകശ്യാകാദി സംഭോഗഭേദങ്ങൾ കണ്ടു മെപ്പിച്ചു (ഭാരതം കളിപ്പാട്ട്) മേതികാസരത്തിൽ മൃഗ്യകുന്ന ലോകത്തെക്കുറിച്ച് ഭക്താസ്പാനയിൽ പുയാനം പ്രതിപാദിക്കുന്നു. മേൽപ്പത്തുവരിന്റെ നാരായണീയം എന്ന ഭക്തികാവ്യം പോലും മതിപ്രവൃത്തിയിൽ നിന്നും മുക്തമല്ല എന്നതിൽ ശ്രദ്ധയോടെ. നളചരിതത്തിലെ ഉദ്യാനവർണ്ണന ഉണ്ണായിവാദ്യം മതിപ്രവൃത്തിയോടാണ് നിർവ്വഹിച്ചിരിക്കുന്നത്. വസന്തം കാമദേവന്റെ കീർത്തിയെ വാഴ്ത്തുന്നവനെ ഉണ്ണായി എഴുതി. കോട്ടയത്തു തമ്പുരാന്മാരുള്ളവർ കഥകളിപ്പുടങ്ങളിൽ തനിയുടെ സത്ത പകർന്നുവന്നു.

പന്തലിത്ത കുമ്പുരുകൊങ്കരണ്ടു- മിടതിങ്ങി കാഞ്ചന കുലുങ്ങിയും പന്തടിച്ചു ഗിരിശന്നു നേരമെന്തൊരു മനമോ ഗതിവിലാസവ്യം (നിവാരകവചകാലകേതവധം)

കാളിമാസന്റെ വേലുതും, കൂടാമസംഭവം, ഉണ്ണുസംഹാരം എന്നീകൃതികളിൽ തനിയുടെ ഉൽകൃഷ്ടമായ സാന്നിധ്യം പ്രകടമാണ്. മേല ശങ്കരനഴിക്ക് രണ്ടുനടക- യാലവന്റെ മിഴിപൊത്തിയുറിയ ഹാമഗന്ധനമാടയാഞ്ഞു പാഴിലും മേലമന്താർത്തു വിജ്ഞ കൃഷ്ണിനാൾ

(കൃമാസംഭവം : എ ആറിന്റെ പരിഭാഷ) കണ്ണൂർ സർവ്വകലാശാല മലയാള വിഭാഗം റിസർച്ച് ഭേണൽ

മേലമന്താർത്തയിൽ സന്ദേശകാരന്റെ യാത്രയിൽ തിമ്പിഷ്കരങ്ങളുടെ സമഗ്രശോഭകാണാം.

ആരോമൽ പ്രാണനാഥൻ പുണ്യമുഖവായു കരം പാതിരാമ്കൊന്നഴിത്തൊ- ലോരോ തനംഗികാമർ തൻ തിസമുദിതമോ- മംഗസംഭരത... (മേലസന്ദേശം, വിവ: ലിശങ്കരക്കുറുപ്പ്)

എന്ന മാഗം തനിയുടെ സവിശേഷമായ ആവിഷ്കരണത്തിന് ഉദാഹരണമാണ്. മേലമന്താർത്തന്റെ ചുവടുപിടിച്ചു മലയാളത്തിൽ ഉണ്ടായിട്ടുള്ള സന്ദേശകൃതികളിലും മത്യാവിഷ്കരണത്തിന്റെയും ശൃംഗാരലാവണ്യത്തിന്റെയും മനോഹരങ്ങളായ വിവരണങ്ങൾ കാണാം.

വെണ്മണിപ്രസാദനത്തിലും തൊട്ടുപിന്നാലെയെന്ന പച്ചമലയാളസാഹിത്യത്തിലും മതിവർണ്ണനകളും സ്ത്രീയുടെ അംഗോപാംഗവർണ്ണനയും സുലഭമായിരുന്നു. കൊടുങ്ങല്ലൂർ കൃഷ്ണകുട്ടൻതമ്പുരാന്റെ പച്ചമലയാളകൃതിയായ നല്ലഭാഷയിൽ മാരസംസർഗമാണ് പ്രമേയം. കൃഷ്ണൻ നാരായണമേനോന്റെയും മറ്റുവിഷ്കരണകൃഷ്ണമേനോന്റെയും രചനകളിലും തനിയുടെ സ്പർശമുണ്ട്.

മലയാളകവിതയിൽ വഴിമാറ്റം സൃഷ്ടിച്ചു വീണപ്പുവിലും തനിയുടെ നിഗൂഢഭാവം പ്രകടമാണ്. മരണം ലൗകികതയെ ഇല്ലാതാക്കുന്നു എന്ന ജയം വീണപ്പുവിലുണ്ട് അത് മറ്റൊരുതരത്തിൽ പറഞ്ഞാൽ തിമ്പിഷ്കരണ പ്രവൃത്തിയായ ആകർഷണം തന്നെയാണ്. ശൃംഗാരകവിതകളിലൂടെ അമരേറ്റം കുമ്പിട്ടു ആശാൻ പിന്നീട് മതിപ്രവൃത്തിന്റെയും ശൃംഗാരലാവണ്യത്തിന്റെയും അതിപ്രസരത്തിനെന്നതായി പ്രതിരോധം സൃഷ്ടിച്ചു. ശ്രീനാരായണ ഗുരുവിന്റെ സാധനം, ആശാന്റെ ഈ ഭാവുകതപരിണാമത്തിന് വഴിയൊരുക്കിയിരിക്കണം. ശൃംഗാരശോഭകാ എഴുതുന്നതിനെ ഗുരു വിലക്കിയതായി പറയപ്പെടുന്നു.

ആശാൻകവിതയിലെ തിമ്പിഷ്കരണത്തിന്റെ പ്രകടനം തന്നെയാണ് നളിനിയും ലീലയും. കവിതയിലെ തനിയുടെ പച്ചയായ ആവിഷ്കരണത്തിനെന്നതായ പ്രതിരോധമായിരുന്നു, കരുണ . അതുവരെ അനുഭവിച്ചറിയാത്ത ആശാൻ ഭാവതലത്തിലേക്ക് അനുരാഗത്തെ, തിമ്പിഷ്കരണമെന്തൊരു മനമോ ഗതിവിലാസവ്യം മതിപ്രവൃത്തിയോടാണ് നിർവ്വഹിച്ചിരിക്കുന്നത്. വസന്തം കാമദേവന്റെ കീർത്തിയെ വാഴ്ത്തുന്നവനെ ഉണ്ണായി എഴുതി. കോട്ടയത്തു തമ്പുരാന്മാരുള്ളവർ കഥകളിപ്പുടങ്ങളിൽ തനിയുടെ സത്ത പകർന്നുവന്നു.

അനുവിന്നു തുടയുന്ന വാസനാ മന്ദമിങ്ങുടലുവീഴുവോളവും (നളിനി) എന്ന് ഉത്തമമനോഹര്യങ്ങളായിരുന്ന ആശാൻ വാസനാമന്ദമിങ്ങു സാമസംകാരിക ഭൗനതൃപ്തോടുകൂടിയല്ലാതെ അവതരിപ്പിച്ചിട്ടില്ല. ശൃംഗാരവർണ്ണനകളിലും തിമ്പിഷ്കരണത്തിലും സമുഖമാണ് വളളത്തൊൾ കവിതകൾ

വെണ്ണമേലിങ്ങുമുടലിൽ സുഗന്ധിയാമെണ്ണ തേച്ചുമേൽ ഒറ്റുകുണ്ടുമാൽ തിണ്ണമേലമുരാനതാഗി (ഗിഷ്യന്തം മകനും) യാമ പാർവതിയെ വള്ളത്തൊൾ അവതരിപ്പിക്കുന്നു.

കണ്ണൂർ സർവ്വകലാശാല മലയാള വിഭാഗം റിസർച്ച് ഭേണൽ







രണ്ടുതരം ചാത്തിന്റെയും മുക്കട്ടുഗന്ധം (ആകാശത്തിനു ചുവട്ടിൽ), മാനകീയുടെ ഗന്ധം എന്നിവ ഉദ്ധരിക്കേണ്ടതുമാണ്.

മുകുന്ദന്റെ നോവലുകളായ നമ്മിനി, കൂട്ടം തെറ്റിയെന്നവർ, ആവിലായിലെ സുര്യോദയം, മയ്യഴിപ്പുഴയുടെ തീരങ്ങളിൽ എന്നിവയിലെല്ലാം തന്നെ തൊഴിലാളികളുടെ പ്രകമ്പനങ്ങൾ കാണാം. കർമ്മരതിസങ്കല്പം പ്രകൃതികാമനയിലേക്കുള്ള ഉൾവിളികളായി ഗന്ധബിംബങ്ങളിലൂടെ തെളിയുന്നതിൽ ആകാശത്തിനു ചുവട്ടിൽ എന്ന നോവലിൽ കണ്ടെത്താം. പൊതുസമൂഹം നിർമ്മലജലമായി ചർച്ച ചെയ്യാനിടയാക്കുന്നതിനെക്കുറിച്ചും വിഷയത്തെ നോവലുകളിലൂടെ കാട്ടിയെന്ന എഴുത്തുകാരൻ എന്ന നിലയിൽ മുകുന്ദൻ ഒരു സർഗാത്മക വിപ്ലവകാരിയാണ്. അദ്ദേഹത്തിന്റെ നോവലുകളിലെ തത്യാവിഷ്കരണത്തിൽ തൊഴിലാളികളുടെ സൗന്ദര്യവും ഉപഭോഗപ്രവണതയും താഴ്ന്നിരുന്നതായും വിവര്യമുണ്ട്. കൊല്ലംനിരയ്ക്കുകൾ സൃഷ്ടിക്കുന്ന സാങ്കല്പികലോകത്തിൽ വിദഗ്ദ്ധരാണ് സന്ദേശംകൊടുക്കുന്ന പെൺകാമനകളുടെയും ശിഥിലീകരണം സംഭവിച്ച പൂർവ്വകാമനകളുടെയും കഥ പറയുന്ന മയ്യഴിപ്പുഴയുടെ തീരങ്ങളിലും ഉപഭോഗ പ്രവണതയും താഴ്ന്നിരുന്നതും ദർശിക്കാം.

ഇങ്ങനെ മനുഷ്യാവസ്ഥകളുടെ പരിണാമങ്ങളെ ക്രൈമികളിലൂടെയല്ല തന്നെയാണ് മുകുന്ദൻ എന്ന നോവലിസ്റ്റിന്റെ തിര്യക്കനവും വികസിച്ചത്.

എം.ടി.വാസുദേവൻനായർ, പുന്നത്തിൽ കൃഷ്ണമണിമുളള, സേതു എന്നിവരുടെ നോവലുകളിലും സങ്കലിതയുടെ ചെറുകഥകളിലും തൊഴിലാളികളുടെ പ്രതിരോധ നഷ്ടം കണ്ടെത്താം. കെ.പി.അപ്പൻ, വി.രാജകൃഷ്ണൻ, ആലോമനോൻ, നാമ സുപ്രസാദ് തുടങ്ങിയ നിരൂപകർ ആധുനികതയുടെ പ്രധാന വക്താക്കളായി നിലകൊള്ളുകയും സാഹിത്യകലയിലെ സൗന്ദര്യമെങ്കിലും മനോഹരമായ കലാപത്തിന് നേതൃത്വം നൽകുകയും ചെയ്തവരാണ്.

വാസ്തവത്തിന്റെ കാമസ്യതയിലെ സ്ത്രീപക്ഷത്തിന്റെകാരണങ്ങളെ തുറന്നുകാട്ടിക്കൊണ്ട് സ്ത്രീയുടെ തൊഴിലാളികളുടെ സങ്കല്പങ്ങളും വ്യക്തിത്വം നൽകുന്ന കെ.ആർ.ഇന്ദ്രിയയുടെ സിന്ധുതലകാമസ്യതയും തൊഴിലാളികളുടെ ശാസ്ത്രീയതയെ വിശകലനം ചെയ്യുന്നു. ഇതിനു സമാനമായ മറ്റൊരു കൃതിയാണ് വാസ്തവകാമസ്യതയിലെ സ്ത്രീവിരുദ്ധതയെക്കുറിച്ചുള്ള സി.എസ്.ചന്ദ്രികയുടെ പ്രണയകാമസ്യതയും, ആതിരം ഉമ്മകുട്ടി, വിജയ.വി.നായരുടെ തൊഴിലാളികളുടെ സമൂഹത്തിന്റെ സൈദ്ധാന്തികത തന്നെയാണ് വെളിവാക്കുന്നത്.

ഇത്തരത്തിൽ പരിവർത്തിക്കുന്നവർ എന്തൊരുപരിവർത്തിയും മൗലികവും കണ്ടെത്തുന്നതിനുള്ള നിലനില്പിന് ആധാരമായ കാര്യം തൊഴിലാളികളുടെ സാഹിത്യത്തിന് അനുഭവിക്കേണ്ടതാണ്. ചലച്ചിത്രസാഹിത്യത്തിലെ തൊഴിലാളികളുടെ പരിവർത്തിക്കുന്നവർ എന്തൊരു നിരീക്ഷണവും ഈ യാഥാർത്ഥ്യം നോക്കി വെച്ചിട്ടുണ്ട്. അത്തരമൊരു അന്വേഷണമാണ് ഈ പ്രബന്ധത്തിൽ നിർവ്വഹിച്ചിട്ടുള്ളത്. മേൽപ്പറഞ്ഞ സാഹിത്യത്തിന്റെ ആരംഭം മുതൽ ഇന്നുവരെയുള്ള ചേനകളിൽ എഴുത്തുകാരുടെ സർഗാത്മകതയെക്കുറിച്ച് അനുസ്മരണമായി തിരഞ്ഞെടുത്ത സമൂഹങ്ങളിൽ അന്വേഷിച്ചിട്ടുണ്ട്. ചിലപ്പോൾ അത് പ്രത്യക്ഷമായും ചില സന്ദർഭങ്ങളിൽ പരോക്ഷമായും മറ്റു ചിലപ്പോൾ ബിംബങ്ങളായും ആവിഷ്കരിച്ചിട്ടുണ്ട്.

കണ്ണൂർ സർവ്വകലാശാല  
മേൽപ്പറ വിഭാഗം നിരൂപിച്ചു മേനോൻ

തയ്യാറാക്കുന്നതിനോടൊപ്പം എങ്ങനെയാണെന്നും സത്യമായ തയ്യാറാക്കലും സാഹിത്യത്തിന്റെ ഉപരിലോകം കരുതണം തന്നെയാണ്.

**കൃതിപ്പട്ടികൾ**

1. പ്രഭാവർമ്മ, തൊഴിലാളികളുടെ കാവ്യപദം, ഡി.സി.ബുക്സ്, കോട്ടയം, 2013, പുറം.57
2. കെ.പി.അപ്പൻ, കെ.പി.അപ്പന്റെ തെങ്ങത്തടത്തു കൃതികൾ (വാല്യം 1), ഹരിതം ബുക്സ്, കോഴിക്കോട്, 2002, പുറം.57
3. അമൃത പുസ്തകം പുറം.38
4. ശരത്ചന്ദ്രൻ കെ.പി., കേവലസൗന്ദര്യം എന്ന തീമ്യ, ഡി.സി.ബുക്സ്, കോട്ടയം, 2009, പുറം.92
5. അർജുനകുമാർ, സർഗസമീക്ഷ , ഡി.സി.ബുക്സ്, കോട്ടയം, 2008, പുറം.379
6. രാജശങ്കരൻ പി.കെ., അന്ധനായ ദൈവം-മേലാളനോവലിലെ ന്യൂനതകൾ, ഡി.സി.ബുക്സ്, 2007, പുറം.222
7. സുനിൽ.പി.ഇളയടം, അജ്ഞാതവ്യക്തിയുടെ അഭിമുഖങ്ങൾ, എൻ.ബി.എസ്, കോട്ടയം, 2001, പുറം.97
8. അപ്പൻ കെ.പി., ചരിത്രത്തിന്റെ കാര്യം നിറഞ്ഞ വസ്തുതകൾ (ലേഖനം), (അനുബന്ധം, ധർമ്മപുരം), ഡി.സി.ബുക്സ്, കോട്ടയം, 2004, പുറം.70

**സഹായകഗ്രന്ഥങ്ങൾ**

1. തൊഴിലാളികളുടെ കാവ്യപദം, പ്രഭാവർമ്മ, ഡി.സി.ബുക്സ്, കോട്ടയം, 2013.
2. കെ.പി.അപ്പന്റെ തെങ്ങത്തടത്തുകൃതികൾ (വാല്യം 1), ഹരിതംബുക്സ്, കോഴിക്കോട്, 2002.
3. ടി.വി.വിജയൻ്റെ ഓർമ്മയുസ്മതകം, പി.കെ.രാജശങ്കരൻ(എ ഡി) ഡി.സി.ബുക്സ്, കോട്ടയം, 2008.
4. തൊഴിലാളികളും, നാലപ്പാട്ട് നാരായണമനോൻ, മാതൃഭൂമിബുക്സ്, കോഴിക്കോട്, 2013.
5. കേവലസൗന്ദര്യം എന്ന തീമ്യ, ശരത്ചന്ദ്രൻ കെ.പി., ഡി.സി.ബുക്സ്, കോട്ടയം, 2009.
6. അജ്ഞാതവ്യക്തിയുടെ അഭിമുഖങ്ങൾ, സുനിൽ.പി.ഇളയടം, എൻ.ബി.എസ്, കോട്ടയം, 2001
7. നാട്യശാസ്ത്രം, മേനോൻ (വി.വ.കെ.പി.നാരായണപ്പിള്ളി), മൃഗ്യം, 1997.
8. കാമസ്യതയും, വാസ്തവതയും (എഡി.ഡെ.കെ.അപ്പൻപിള്ളി), ഡി.സി.ബുക്സ്, കോട്ടയം, 2014.
9. സൈബറോപോലിറ്റിക്കും, കെ.ആർ.ഇന്ദ്രിയ, ഡി.സി.ബുക്സ്, കോട്ടയം, 2012.
10. തൊഴിലാളികളുടെ സർഗാത്മകതയെക്കുറിച്ച്, ഡി.സി.ബുക്സ്, കോട്ടയം, 2013.
11. തൊഴിലാളികളുടെ സർഗാത്മകതയിൽ, വിജയ.വി.നായർ, മാതൃഭൂമിബുക്സ്, കോഴിക്കോട്, 2017.
12. പ്രണയകാമസ്യതയും ആതിരം ഉമ്മകുട്ടി, സി.എസ്.ചന്ദ്രിക, ഡി.സി.ബുക്സ്, കോട്ടയം, 2001.

കണ്ണൂർ സർവ്വകലാശാല  
മേൽപ്പറ വിഭാഗം നിരൂപിച്ചു മേനോൻ



ലേഖകപരിചയം

- പ്രൊഫ. (ഡോ.) അജിത്കുമാർ എൻ  
വകുപ്പദ്ധ്യക്ഷൻ, മലയാളവിഭാഗം, കേരള കേന്ദ്ര സർവ്വകലാശാല,  
കാസർഗോഡ്
- ഡോ.ശിവദാസ് കെ.കെ.  
അസി.പ്രൊഫസർ, മലയാളവിഭാഗം, കണ്ണൂർസർവ്വകലാശാല, നീലേശ്വരം
- ഡോ. റീജ രവീന്ദ്രൻ  
അസിസ്റ്റന്റ് പ്രൊഫസർ, മലയാളവിഭാഗം, എൻ.എസ്.എസ്. വനിതാ  
കോളേജ്, നിറമൺകര.
- ഡോ.ജയലക്ഷ്മി താഴേവീട്ടിൽ  
സംസ്കൃതവിഭാഗം, കോഴിക്കോട് സർവ്വകലാശാല, തേഞ്ഞിപ്പലം.
- ഡോ. ഗംഗാദേവി എം.  
അസി.പ്രൊഫസർ, മലയാള വിഭാഗം, ഗവ.വിമൺസ് കോളേജ്,  
തിരുവനന്തപുരം.
- ഡോ. മുനീർ ശൂരനാട്,  
കോടം വിള, തെക്കേമുറി, ശൂരനാട് നോർത്ത് പി.ഒ., കൊല്ലം 690561.
- ചിത്ര ആർ.വി.  
എച്ച്.എസ്.എസ്.റ്റി., മലയാളം, ഗവ. മാനവേദൻ ഹയർ സെക്കന്ററി  
സ്കൂൾ, നിലമ്പൂർ, മലപ്പുറം.
- പാർവ്വതി കെ. ജി.  
ഗസ്റ്റ് ഫാക്കൽറ്റി, മലയാള വിഭാഗം, യു.ഐ.ടി.കല്ലറ, കൊല്ലം.
- ഡോ.ദീപ്തി വി.എസ്.  
ഗസ്റ്റ് ലക്ചറർ, (ഡിപ്പാർട്ട്മെന്റ് ഓഫ് മലയാളം), എസ്.എൻ.കോളേജ്,  
കൊല്ലം.
- സിജു കെ.ഡി.  
അസി. പ്രൊഫസർ, മലയാള വിഭാഗം, സികെജിഎം ഗവ.കോളേജ്,  
പേരാമ്പ്ര, 944699050.
- സുധീഷ് പി.വാഴയൂർ  
ഗവേഷകൻ, മലയാള-കേരള പഠനവിഭാഗം, കാലിക്കറ്റ് സർവ്വകലാശാല
- ഡോ. ആർ. എസ്. ജയ  
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കോളേജ്, കൊല്ലം.
- ഡോ.സുജ എസ്.  
അസിസ്റ്റന്റ് പ്രൊഫസർ, വിദൂരവിദ്യാഭ്യാസകേന്ദ്രം, കേരള സർവ്വകലാ  
ശാല, തിരുവനന്തപുരം.
- ഡോ.റീജ വി.  
അസി.പ്രൊഫ., മലയാള വിഭാഗം, കണ്ണൂർ സർവ്വകലാശാല, ഡോ. പി.  
കെ. രാജൻ മെമ്മോറിയൽ കാനാസ്, കാസർഗോഡ്, നീലേശ്വരം 671314

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അസി.പ്രൊഫസർ, മലയാളവിഭാഗം, ടി.എം.ജെ.എം.ഗവ.കോളേജ്, മണിമലകുന്ന്,കുത്താട്ട്കുളം,എറണാകുളം.

**ജ്യോതി ലക്ഷ്മി പി.**

മഹാദേവം, തെക്കേവീട്, പരശുവയ്ക്കൽ. പി.ഒ,പാറശ്ശാല, പിൻ: 695508.

**ആതിര എസ്.**

വലിയതോട്ടം, അരുമാനൂർ,പുവാർ പി.ഒ പിൻ - 695525.

**അനീഷ എസ്. ഇ.**

ഗവേഷക, കേരള യൂണിവേഴ്സിറ്റി,ലൈബ്രറി, പാളയം, ഫോൺ : 9544914912.

**രഞ്ജു ആർ.**

ഗവേഷക, കേരളസർവ്വകലാശാല, തിരുവനന്തപുരം.

**ബിന്ദു പി.**

PRDS,കോളേജ് ഓഫ് ആർട്സ് & സയൻസ്,അമര, ചങ്ങനാശ്ശേരി, മൊബൈൽ: 9995619872.

**ഡോ. ദീപു പി. കുറുപ്പ്**

അസിസ്റ്റന്റ് പ്രൊഫസർ,മലയാളവിഭാഗം,എൻ.എസ്സ്.എസ്സ്.കോളേജ്, നിലമേൽ.

**ജൂബി അലക്സ്**

ഗവേഷക,മലയാളവിഭാഗം,ഗവ.വിമൺസ് കോളേജ്,തിരുവനന്തപുരം.

**ഇന്ദു പി.നമ്പൂതിരി**

ഗവേഷക,മലയാളവിഭാഗം,ശ്രീ ശങ്കരാചാര്യ സംസ്കൃത സർവകലാശാല കാലടിഫോൺ: 9048688694.

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അസിസ്റ്റന്റ് പ്രൊഫസർ, മലയാളവിഭാഗം, ശ്രീനാരായണ കോളേജ്, ശിവ ഗിരി, വർക്കല ഫോൺ; 9446914648.

**അഞ്ജന എ.**

ഗവേഷക ,കേരള യൂണിവേഴ്സിറ്റി,ലൈബ്രറി, പാളയം,തിരുവനന്തപുരം

**പെട്രീഷ്യ ജോൺ**

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**ജസ്ന കെ.പി.**

റിസർച്ച് സ്കോളർ, മലയാളവിഭാഗം,കണ്ണൂർ സർവ്വകലാശാല, നീലേശ്വരം, 671314.

**രേഷ്മ കെ.ആർ.**

ഗവേഷക, മലയാളവിഭാഗം, യൂണിവേഴ്സിറ്റി കോളേജ്, തിരുവനന്തപുരം

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അസി.പ്രൊഫസർ,മലയാളവിഭാഗം, എസ്.എൻ.ജി.കോളേജ്, ചേളന്നൂർ, കോഴിക്കോട്.

**ഡോ.അജിത് എം.എസ്.**

അസി.പ്രൊഫസർ,മലയാളവിഭാഗം,ഗവ.അർട്സ് ആന്റ് സയൻസ് കോളേജ്,മീഞ്ചന്ത,കോഴിക്കോട്.

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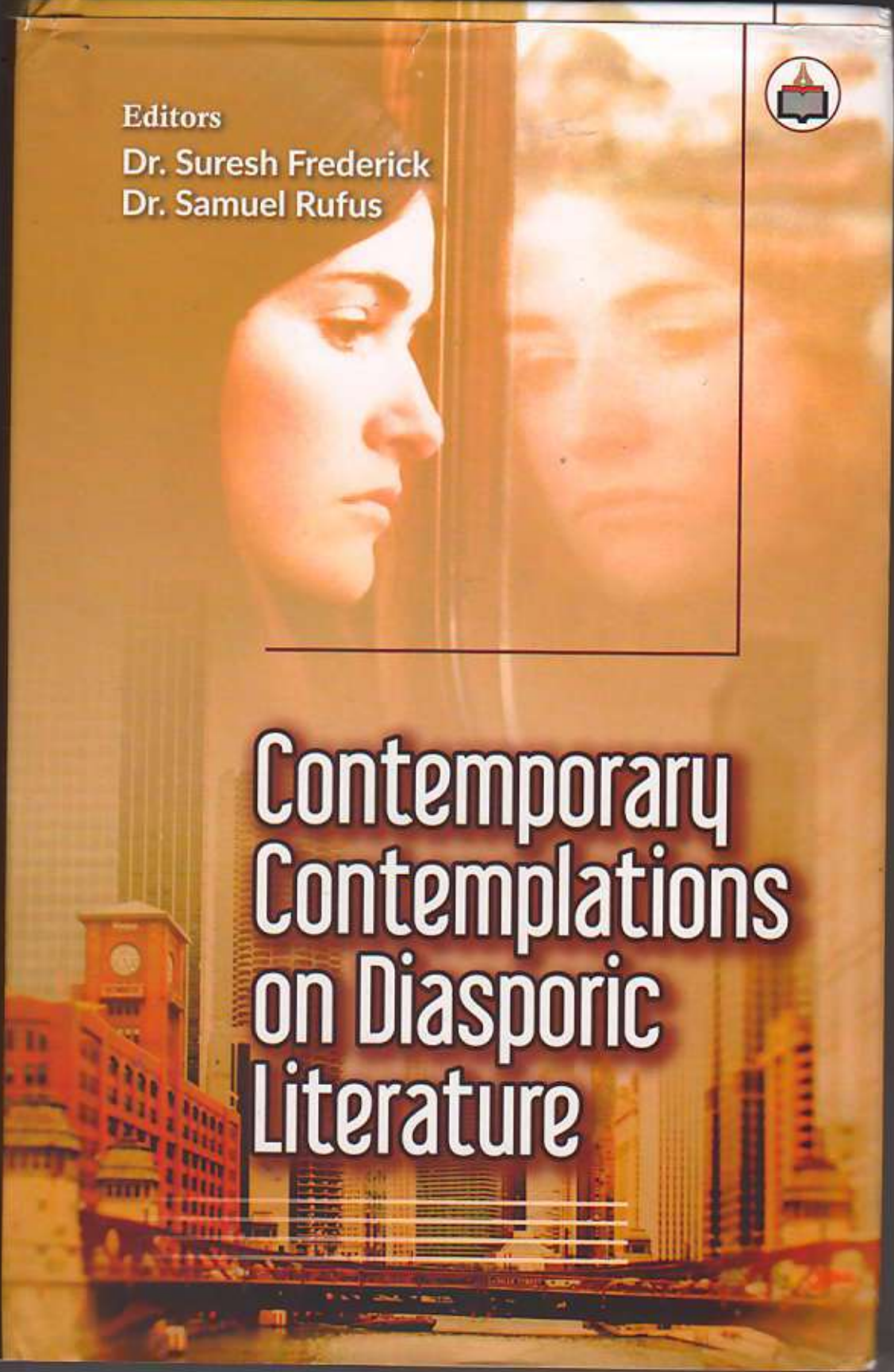
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Contemporary  
Contemplations  
on Diasporic  
Literature

# Contemporary Contemplations on Diasporic Literature

Editors

Dr. Suresh Frederick

Dr. Samuel Rufus



AUTHORS P R E S S

8 • Contemporary Contemplations on Diasporic Literature	
8. The Voice of Others in <i>The Lives of Others</i> of Neel Mukherjee <b>Dr. Y. Mercy Famila</b>	151
9. Narrative Mode and Perception of Self in Chitra Banerjee Divakaruni's <i>Arranged Marriage</i> <b>Dr. R. Madhavi</b>	169
10. The Search for the Self in an Alien World – Women Protagonists in the Short Stories of Chitra Banerjee Divakaruni <b>Dr. Shubha Mukherjee</b>	192
11. "Doors" Open to Freedom – The Indian Diasporic Feminist Discourse: An Analysis of Divakaruni's Short Stories <b>Dr. Jyothirmai Dakkumalla and M Sirisha Sangamitra</b>	216
12. Polarities of Pollen Culture: A Study of the Select Works of Diasporic Women Writers: Manju Kapur, Jhumpa Lahiri and Kiran Desai <b>Dr. N. Velmani</b>	242
13. Who am I? Where do I belong? – Postcolonial, Diasporic Tension in Kiran Desai's <i>The Inheritance of Loss</i> <b>Dr. Abraham Panavelil Abraham</b>	260
14. The Angst of the Double Bind in the Linguistic Domain: A Study of Select Contemporary Diasporic Discourse <b>Dr. Samuel Rufus</b>	276
15. 'Between Worlds': In Search of Homelands – <i>Reflections on Rohini Mohan's the Seasons of Trouble: Life Amid the Ruins of Sri Lanka's Civil War</i> <b>Dr. Etienne Rassendren</b>	293
Bibliography	332
Notes on Contributors	335
Index	340

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**The Voice of Others in *The Lives of Others* of Neel Mukherjee**

**Dr. Y. Mercy Famila**

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Neel Mukherjee is one of the prominent writers of Indian Writing in English in the Modern era. Mukherjee, within a short span of his literary career attained worldwide recognition with his artistic intelligence and creative writing. He is a London based English writer born in the eastern Indian State of West Bengal and is praised for his clarity, subtle and precise writing. Mukherjee works with daunting control over his subject and he writes wryly and wonderfully. He summons place and character brilliantly and unflinchingly in pages redolent with detail. All his works have contributed to enrich the genre of diaspora literature. Instead of the cloying nostalgia that fills diaspora writing we have a different experience in Mukherjee's novels. According to him, "Nostalgias is a particular affliction of immigrant fiction and it's led to a kind of sclerosis of the form. I hate nostalgia and I feel it's good to be aware of the politics of these genres.

Indian diasporic writing has been attributed through different labels such as 'Trishanku' image from the Indian mythology, which suggests a dangling, uncertain identity, characterised by a neither here nor there. It also used to define people who live the in-between space or more precisely the

immigrant. Further, diasporic writers expose themselves as migrants, plural, hybrid, expatriate and immigrant to invest these words with personal experiences. Salman Rushdie in *Imaginary Homelands* exclusively explores the migrant writers as endowed with a double/plural, insider/ outsider perspective, whose hybrid predicament can be universalised into art.

History becomes the major preoccupation of the writings of recent Indian writers in English. There is a view that many contemporary novelists writing in English are overburdened with history. Amitav Ghosh explores the relationship between human destiny and historical events. In his novel *The Shadow Lines*, he deliberately interweaves personal history with a nation's destiny, giving a poignant story of the partition. In the diasporic writing, the recurrent theme of comparing 'home' culture with that of 'new' culture is found. Though the term diaspora was originally associated with the dispersal of Jews from their homeland, now the term has been widely used as the synonym for expatriates, emigrants and exiles in the colonial period. When we look at the history, we find that 'diaspora' cannot be separated from 'colonialism' because it made people displaced across the world both physically and emotionally as well.

Migration has become a universal phenomenon in the current world. Immigrants, the people who come to live permanently in a foreign land play a significant role in this process. A diaspora is the group of people who are living away from their original homeland and share common experiences. Diasporic literature or immigrant literature is generally referred to the literary work done by immigrants. Diasporic Indian English literature in the universal diasporic literature has gained much credit during the last few decades. There is a significant place for diasporic Indian English fiction in portraying man. The reader would generally expect a diasporic writer to be an

immigrant but soon that the particular as long as he or experiences and diaspora in a wide

In general, the present the term of clear-cut definition collective memory location, history diaspora can be be reasons of their m started by the end colonisation. The mid twentieth cent by the end of the these times, people for the sake of educ

Diaspora litera identity and a sense everyday experience works talk about th they face in the ca cannot assure that available in all the theme of writing, di writers whose works works talk about th locates their work in to portray their ho locates their works if they undergo or to a



immigrant but some critics emphasise that it is not compulsory that the particular writer to be an immigrant himself or herself as long as he or she occupies the themes regarding actual experiences and mentalities of a diasporan about Indian diaspora in a wide span.

In general, the term diaspora denotes displacement, but at present the term diaspora has various meanings and there is no clear-cut definition to understand it. It can be stated as a collective memory and myth about the homeland, including its location, history and achievements. The history of Indian diaspora can be broadly divided into three phases, based on the reasons of their movement. The first phase of migration had started by the end of the nineteenth century, during the British colonisation. The second phase of migration occurred in the mid twentieth century. The third phase of migration took place by the end of the beginning of twenty-first century. During all these times, people's movement to the developed nations was for the sake of education and employment.

Diaspora literature focuses on discrimination, nostalgia, identity and a sense of belonging. Diaspora writers register their everyday experiences and plights in their works. Also, their works talk about their isolation in the new land, the problems they face in the new society, and their in-betweenness. One cannot assure that these common characteristics of diaspora are available in all the works of diasporic writers. Based on the theme of writing, diaspora writers can be divided into two types: writers whose works focus on their homeland and writers whose works talk about the settled country. The first type of writers locates their work in their home country in order to criticise it or to portray their home country. The second type of writers locates their works in the settled countries to reflect the changes they undergo or to tear the mask of multicultural nations. Neel

Mukherjee belongs to the first category, who strives hard to present the lives of downtrodden, poor, neglected ones of the society and their real problems.

Technological innovation and economic development have brought great wealth to a few parts of India, but they have further marginalised the country's adivasis, or tribes, the aboriginal communities of forest dwellers and farmers who live outside of mainstream society. These groups were systematically victimised under colonial rule, when the British Raj passed legislation that classified them as criminals. The British-Indian government subjected adivasis to police brutality, herded them into reformatory settlements and forced them to perform hard labour. Multinational corporations and government agencies have displaced them to build dams and extract valuable minerals, without providing adequate compensation. Their protests are often ignored, and in some cases have been met with violence. Some frustrated tribes have embraced India's Maoist uprising, which seeks to overthrow the government.

A few Indian writers like Mahasweta Devi and Arundhati Roy have written passionately about the suffering of the tribes and the rise of Maoism in rural India. Their work has provided invaluable correctives to prevailing narratives that cast adivasis as simpletons or savages and the Maoists as ruthless killers.

Neel Mukherjee's *A Life Apart* is an elegant and accomplished debut, a novel of many shades. It blends the poignancy of a coming-of-age story with the rawer excitements of an urban thriller laced with sex and violence. It tells two stories, the first is of Ritwik's, a story of a 22-year-old recently orphaned boy's escape from a blighted childhood of squalor and abuses in Calcutta to England where he considers he has a chance to start all over again. But Oxford holds little of the

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salvation Ritwik is looking for. Instead, he moves to London, where he drops out of official existence into a shadowy hinterland of illegal immigrants. The story that Ritwik writes to stave off his loneliness begins to find ghostly echoes in his own life. And, as present and past of several lives collide, Ritwik's own goes into free fall. The second thread of the story can be considered as the one he is writing himself, the story of an Englishwoman in the old world of Bengal on the eve of India's first partition or it could be the story of the eighty-six-year old Anne Cameron, fragile and damaged, who gives shelter to Ritwik in London in exchange of the care that she needs.

Neel Mukherjee attempts to inject more complexity into these issues in his haunting novel *The Lives of Others*. Mukherjee's work has always highlighted the connections between power, poverty and injustice. Neel Mukherjee was born in 1970; three years after the eastern Indian state of West Bengal began trembling with Naxalism, India's revolutionary Maoist movement.

The novel begins in 1966 with a harrowing account of impoverished wage labourer Nital Das, unable to feed his starving wife and children, killing them in a horrific burst of violence before committing suicide. This intimate atrocity, born of deprivation and acute despair, is juxtaposed with the comparatively petty concerns of the bourgeois Ghosh family, making a profound point about struggles for equality in the world's largest democracy during the long aftermath of empire.

Mukherjee's concern is not on the lives of those people who have all the luxuries of life but on those who struggle hard to move forward in the journey of life. However the writer has skilfully blended these two worlds in this novel. More than a family saga, one strand of this novel is about the struggle of a

boy named Supratik, the eldest grandson of the Gosh family to make changes in the world through actively involving in the naxalite movement.

The four-storied building, which houses the Ghosh family, is a miniature form of the larger society, which is hierarchised on the basis of class, caste, money etc. Four stories of the building are symbols of the levels of discrimination at work among the family members. Growing irritated with the attitudes of his family, Supratik left home to pursue his idealistic desire to amend the world. Before leaving home, he left a note for his mother, which is expressive of his state of mind.

Ma, I feel exhausted with consuming, with taking and grabbing and using. I am so bloated that I feel I cannot breathe any more. I am leaving to find some air, some place where I shall be able to purge myself, push back the life given me and make my own. I feel I live in a borrowed house. Its time to find my own...forgive me... (25)

The only signs of his continued existence are of two postcards. In a series of letters written (but never sent) to his young aunt Purba with whom he is in love, Supratik details his Naxalite activism. He writes "Being a Bengali, one is surprised when all the endless spume and forth of talk suddenly reveals itself to be the front of a gigantic wave of action." (126) Supratik is possessed by a single-minded moral horror at the lives of the starving and the helpless. This feeling is strengthened by the teachings of Mao.

One of the most powerful sociological explanations of social conflict is that given by Karl Marx. According to Marxists, even literature itself is a social institution and has a specific ideological function, based on the background and ideology of the author. Karl Marx's studies have provided the basis for much in socialist theory and research. Marxism aims to revolutionise the concept of work through creating a classless

society built on control and ownership of the means of production. Marx believed that Economic Determinism, Dialectical Materialism and Class Struggle were the three principles that explained his theories. The Bourgeois (Dominant class who control and own the means of production) and Proletariat (Subordinate class: Don't own and control the means of production) were the only two classes who engaged in hostile interaction to achieve class consciousness. Marx believed that all past history is a struggle between hostile and competing economic classes in state of change. Marx and Friedrich Engels collaborated to produce a range of publications based on capitalism, class struggles and socialist movements. Karl Marx in his book *Communist Manifesto* argues that 'the history of all hitherto existing societies is the history of class struggle'. As class struggle is the engine room of history, to understand the course of history, one must analyse the class relations that typify different historical epochs, the antagonisms and forms of class struggle embodied in such class relations. This involves the development of class-consciousness and follows the revolutionary movements that challenge the dominant classes. It extends to rating the success of these revolutions in developing new modes of production and forms of social organisation.

Although Marx and Friedrich Engels detailed theories of Socialism in the mid-nineteenth century, it was not until the 1920s that Marxist Literary Theory was systematised. The greatest drive for this standardisation came after the October Revolution of 1917 in Russia. The event instigated a change in belief around socialist ideals in government and society. While these ideals developed, socialist realism was accepted as the highest form of literature – a theory based on an art movement that depicted and glorified the proletariat's struggle towards societal progress. These ideas guided both literary creation and

official literary criticism in the Soviet Union, where works focused on the lives of the different classes. In the years since then, the beliefs of some Marxist schools regarding literary theory have been modified to acknowledge that literary creation is a result of both subjective inspiration and the objective influence of the writer's surroundings. This system of belief relies on the social classes as well as the economic and political development of society. Thus, Marx's theories intertwined with the emerging ideologies of the new Russian movement and spread throughout the world.

Class struggle appeared in some forms. First, there is an economic form. The proletariat struggle with the bourgeoisie through their labourer's organisation in this form. Second, there is a political form. In this form, the proletariat has their party and, through democracy, they try to change the system. And the last, there is an ideological struggle. In this form, the proletariat try to adapt the old governing system to new social situations. There are other forms of struggle, too. These forms are not exclusive, but exist at the same time.

Class struggle appeared all throughout history. At first, people lived in small communist societies. Then, they took property from the Earth for themselves and started to use slaves. They then had feudalism, which meant one person owned an entire area of land and used soldiers and workers to help them make money, and only gave their workers land, but they had some freedom that slaves didn't. Finally, in Karl Marx's time, people in some countries were becoming workers and bosses during the industrial revolution. The bosses owned the machines that the workers used to make things, but they did not help using the machines. Instead, they made money by buying the time and energy of the workers to make things. Marx believed that the workers weren't making the money they

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Shadows of the discrimination that society exercises towards some sections of the society are also visible in the Ghosh family. This is evident through the treatment of purba (youngest daughter-in-law, widow of Somnath) and her two children Sona and Kalyani by the family. Except them other members occupy the upstairs in order to get rid of the cacophony of the streets. This is enough to prove their indifference towards the lives of poor. They don't even want to acknowledge the existence of others. As Supratik says Ghosh family lives in a cushioned vacuum. Purba and her children occupy the lowest rung of the family hierarchy and are relegated to a storage room on the ground floor of the house. They are also prevented from entering the upstairs and mingling with other members. Since her husband Somnath's death, Purba has been little more than an unpaid servant suffering her tyrannical mother-in-law's caustic tongue. She is under the strict control of her mother in law who finds fault with her in every matters and the latter even accuses her of having an illicit relationship with their neighbour. Purba and her children have been growing up on left overs. People in the upstairs send those used clothes and other stuffs. Seeing the plight of Purba the house maid Malati has empathised with her by surreptitiously giving some food or other stuffs from the upstairs. Even though there are a small fleet of servants to do the household chores Purba has been instructed to do those jobs by her mother in law. Charubala and Prafullanath shower varying degrees of fondness towards their children (four sons and one daughter). This is clear from the allotment of different floors to each of them. Adinath, the eldest son occupies the top floor with his parents. Downstairs was occupied by Priyonath, Bholonath, Chaya and the servants.

The Ghosh family had been a true urban middle class family both in money and in their attitude to the lower class people. The children of the family had shown this attitude from the childhood. From the time of a toddler Somnath, the youngest son of the family had found immense delight in torturing small insects and flies. This behaviour grew along with him and the poor people became the victims of his evil spirits. One day, two starving beggars (a man and his stick-thin daughter) turned up at their door begging for some food. The servant Madan brought them some cooking water. Somnath who was standing near the beggars snatched the bowl out of the girl's hands and dripped the remaining cloudy liquid onto the rags the girl was wearing. Then he said 'Wring your clothes and drink what comes out'. This is a true reflection of the evil nature of the urban people which is carried onto the generations to come.

The partition of India in 1947 had made the life of Indians miserable. People remain shut inside their houses due to the Hindu – Muslim riots and the threat from Japan for series of bomb blasts and explosions in the country. Even in these circumstances, the urban people got better lives because they did not have to fear for deprivation like the country people. Death out of hunger was a far-away reality for the urbans. What they fear most is the looming threat of epidemics. Prafullanath made a remark, "People like us don't die of starvation, but no one is immune to Cholera". The country people have been suffering from poverty all over the places of India. To worsen their situation more this poverty has led to its severe form 'famine'. As a survival instinct, the people have set out in groups to the city begging for food in an attempt to escape the famine of their countryside. Mukherjee presents a frightening picture of the famine-struck people. He writes –

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Bombed-out buildings and Africans were not the only frightening sights. Thick clusters of famine struck people sat or lay on the roads dying like insects. A boy may be six years old, may be ten, it was difficult to tell, for extreme malnourishment had simultaneously added to and subtracted from the real number of years, leaned against a wall eight or ten feet away from the scavenged woman, a stone in his hand, perhaps in the process of aiming at the bird, but the arc of the action had been frozen at its starting point; he had no energy to fling the stone. He sat there a fossil within his own life, helpless in the face of the intrepid crow's desecration of his mother. (245)

There is also a shameful history behind the Ghoshes became the owners of the four storied house at Basantabose Road. Prafullanath acquired the large house cheaply from people who went out of business overnight sometimes in the mid-twenties. He had exploited them at their weakest moment, agreeing to save them from bankruptcy and ruin by giving them money with the house as collateral. There is also some tactics involved in the way Ghoshes run their business – planting lumpens within unions to spark off violence so that all the union workers could be sacked, an old story of buying off a business from a friend's widow for a fraction of its real value, using the Hindu-Muslim riots to shut down mills, regardless of how many workers were deprived of their livelihoods and buying up factories in areas emptied by the migration. All these immorality and opportunism is what characterised them.

All the affluences that the Ghoshes have built through their false means have begun to crumble as a result of the partition and trade union conflicts in the mill. All the tension in their business began with the decision to modernize their mills at Bali and Memari. A lot of money has gone in that way. They have pledged all the jewellery owned by Charubala for taking loans from the bank. The Ghoshes have channelised a large sum of money for bribing the officials for importing the machines. The

factory started working with the imported new machines, but they didn't get the profit as they have expected. After a few months union trouble began at the factory in Bali and after that the factory was shut. The workers laid a siege in front of the factory shouting their demands: "We're fighting for unfairly dismissed Sujan, we'll keep fighting; Owners, answer why you shut down a profit making factory! The pending salaries of the fired workers must be paid without any delay" (376).

Dulal, Madan's son is the mastermind behind this union agitation in the factory, whom the Ghoshes has appointed as the manager of the mill at Bali out of Madan's request. But he turned against them as he becomes aware of the rights of the workforce and intolerant of the mistreatment of the workforce. It was Dulal who made the workers fight for their rights. The workers felt the dismissal of Sujan Hazra after the man has lost his hand in an accident unfair. Even his health is weak. Prafullanath is ready for a direct confrontation with the workers. Ever since he has come to know of Dulal's mischief in the factory, he wanted to use the most aggressive strategies to silence him – having him beaten up, even eliminated by goons, firing his father Madan etc.

Prafullanath attitude shows that he is such an inflexible man even though he lost his past glory. When the workers demanded 'when will we get our salaries? We haven't been paid for a year. What will we live on?' he said with the tone of a man of his class preserved for pestering beggars 'I'm not going to negotiate with you'. At last, the Ghoshes have to retreat when a group of raging workers confronted them. Later Prafullanath has no other option but trotting out the old Mantra: "one generation builds; the next generation sits on it and consumes it to nothing" (382). The labourers become conscious of their situation and they start to protest. Here the working class is

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conscious that another class (the bourgeois class) has created the conditions of labour and living for their own class (the proletariat). This consciousness leads them to engage in collective action, like protest.

Supratik, unlike his family members is an amiable, sensitive gentleman, who shows much affection and caring for the proletariat class and neighbourhood. At the young age, he was a country-loving, patriotic: "Ma, Ma, it's Independence Day next week, I'm going to play the bugle and lead the Balak Sangha boys in a procession down the streets..." (73). He is a social activist who believes in egalitarian society, refuses to eat lavishly, I have "one dal, one fry, one vegetable dish, a bit of fish," to eat and thousands of people are dying by starvation. "Gagan, Madan-da, Malati-di, the other people who work for us, do they eat like this?" (74), they should eat like we are eating. Perturbed by the imbalance of the society, Supratik was a communist activist from his early days at the Presidency College. Then he realised that there is a large gap between being an activist out of ideals that come from books and being one with the poor through the depredations that life throws at them. Out of a self-reflection he asks, "What did I know of such lives, sheltered, bourgeois boy that I was, living in the cushioned vacuum created by my grandfather's temporary boom of minor-mode prosperity-four storied house, cars, many servants?" Supratik presents us a very good portrait of the lives of the poor through his unposted letters to his aunt. He begins his letters with an account of the large gap between the lives of the poor and those who have all the luxuries of life. The hardships of the unprivileged, oppressed, and downtrodden people of the streets are alien to those who occupy in big houses.

Supratik says in his letters that there lays life unnoticed in the grandeur of the city. It is entirely different from the life that

we see inside the mansions and big hotels. There are many situations that shaped in Supratik an inclination to work for the poor. Once on his way to college he witnessed a riot outside a ration shop. It was because that the poor people were denied of their ration and the shopkeeper had hoarded the food supplies to sell in the black market. Another incident was the expulsion of students from the Hindu hostel in Presidency College. Then onwards he was an active member of the student politics. Being a member of the high class family he received several criticisms from his fellow comrades. Some taunted him about how safe he was, how unbloodied his hands were, how full his stomach when others had to eat their meal in the slums. Supratik was disillusioned with the life his family had been leading totally ignorant of their poor fellow human beings. More than these reasons the inequalities inside his family and the power-on-top-ruling-people-below kind of hierarchy might be the reason for his revulsion. He thought family as the primary unit of exploitation. Later he realised the power politics of the party and decided to leave the party for a higher cause – to work with the landless peasants, the sharecroppers, wage-labourers and impoverished tenants and organise them into armed struggle against the landlords. His fellow comrades were Samir and Dhiren both from a poor family unlike Supratik. Their places of action were those villages where feudalism was still the order of the day, where the exploitation of farmers by money-lenders and landowners was at its human worst. They worked along the Bengal-Bihar-Orissa borderlands where this feudalism was supplemented by the plight of the people whose lands had been grabbed and who had been demoted to slaves. Some villagers have mistaken them as the volunteers of the party who have come for the peoples' votes. One elder man of the village Mukunda Mashan said accusing them that even after Independence their lives haven't changed. It reminded the same

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and has become worse than it had before. Earlier the Britishers had been exploiting them by taking their lands and crops, stealing their possessions. The exploiters are still there in the guise of land owners and money-lenders. Only thing is that their colour has changed.

The landlords have exploited the labourers in whatever possible ways. There have been bad times with droughts, starvation and crop failure. But the landlords use this as an opportunity to lower the labourers wages and not giving them their daily meal when they work on the land. Actually the landlords are using this shortage of food grains to hoard it in their barns and warehouses, and then sneak it out in lorries and trucks in the night to the cities where it's sold at a huge profit on the black market.

Supratik, towards his journey to a Naxalite has gone through the different phases – cut all his ties with the outer world of rich, bourgeoisie people, become one with the peasants by sharing their work, food and shelter. Like all the revolutionaries Supratik's life is also doomed. He has to gone through severe torture from the police for engaging in naxalism. Policemen taunted, abused and beaten him up with sticks letting the blow fall anywhere on his body. This external force is identified in the novel as Naxalism. It is called so because it originated in the regions of Naxalbari. Most of the members in the Naxalite group come from very poor families as this movement promises to be of the poor, for the poor, by the poor. As an exception to this there are boys from the city like Supratik (Charu Madumdar call them "the urban intelligentsia") who come from well-off, middle class homes. In the case of Supratik he comes from an upper middleclass family who owns a huge four storied house and various paper mills. The question that arises is that 'Why Supratik left his home and all the

comforts to risk his own life'. His transformation into serious seeming important apparatchik is amazing. Supratik has been drawn by the romance of the revolution. Naxalbari uprising and the peasant revolution of 1967 has drawn many youths like Supratik towards it. It is the word Naxalbari which inspired many youths to set out on the path of revolution. To annihilate the caste based feudal superstructure has been the aim of all the peasant revolution. The peasants were fed up of this Jotedari system referring to the feudal land holding and taxation policies that prevailed in rural India then. Most of the crops they produced would go to the landlords as a tax. The entire peasant uprising has built on this principle to put an end to this Jotedari system and to overthrow the democratic, capitalist Indian government which supports the Jotedars.

As we look at the history, it is clear that Naxalism emerged not on account of a lack of developments or from economic causes, but from humiliation and injustices. Neel Mukherjee has set his novel *The Lives of Others* in the background of 1967-72, the period in which Calcutta was convulsed by the naxalite uprising. Neel's portrayal of Supratik and his Naxalite comrades is based on the urban student radicalism of that time which was in large part a response to the stifling repressiveness of Bengali family life. In the epilogue of the novel dated September 2012 Mukherjee chronicles the naxalite uprising in the forest of northern India, which shows that Naxalism is not wiped out with the death of Supratik and his comrades. Many youths even women have drawn towards the movement by the romance of the revolution born out of injustices in the society. Neel Mukherjee does not want his young men and women to lose their future by indulging in such anti-national/ anti-social activities. Though the writer is living in another country, he is

disturbed by the anti-social elements that are functioning in his country. He has voiced this aspect in his novel fervently.

Diasporic writings are invariably concerned with the individual's or community's attachment to homeland but this attachment is countered by a yearning for a sense of belonging to the current place of domicile. Diasporans are considered by sociologists as transitional beings or luminal personae, who are in the process of moving from one cultural state of existence to another. In this state of transition, some respond ambivalently to their dual, often antithetical, cultures or societies. Some attempt to assimilate and integrate. The attachment to the ancestral homeland varies considerably among the diasporans. Some individuals and communities willingly assimilate or integrate with their new environment whereas some others remain wedded to ancestral customs and traditions, religious and languages. Those who move towards assimilation are less concerned with sustaining ancestral ties than with coming to terms with their new environment and acquiring a new identity. The conflict between traditionalists and assimilationist in immigrant communities is a recurring theme in the fictional works of many Indian American writers.

Neel Mukherjee is a traditionalist diasporian. He has not simply expressed his bond or his sense of yearning in this novel. Instead he has voiced the real problems of his people in this novel. In this way he is a different diasporian, who has voiced the problems of voiceless from a foreign country. The problems that the present century youth face, like unemployment, discrimination, low wages etc. and which provokes them into revolutionary movements is explicitly stated in this *Lives of Others*. Being in another country, Neel Mukherjee is worried and disturbed by the problems of his own homeland and he wants that to be addressed. Traditionalist diasporians are those who

being in a foreign country, keep voicing the problems of his own people. In this sense, Neel Mukherjee is a true traditionalist diasporian. Ultimately, however, the diasporic experience need not be reduced to either a simple-minded rejection of the homeland and acceptance of the home country, or vice-versa. What happens, especially to the writers in the third category, is a more complex process of confluence.

#### WORKS CITED

- Narayan, Manjula. "In Conversation with Neel Mukherjee" *Hindustan Times*. [www.hindustantimes.com](http://www.hindustantimes.com). Web. 27 Sep. 2014.
- Nelson, Emmanuel S. *Reworlding: The Literature of the Indian Diaspora*. New York: Greenwood Press, 1992. Print.
- Marx, Karl. Friedrich Engels. *The Communist Manifesto*. London: Penguin, 2002. Print.
- Mukherjee, Neel. *The Lives of Others*. London: Random House, 2014. Print.
- Singharoy, Debal. *Peasant's Movements in Post-Colonial India*. New Delhi: Sage Publications, 2004. Print.
- Singh, Prakash. *The Naxalite Movement in India*. New Delhi: South Asia Books, 1996. Print.

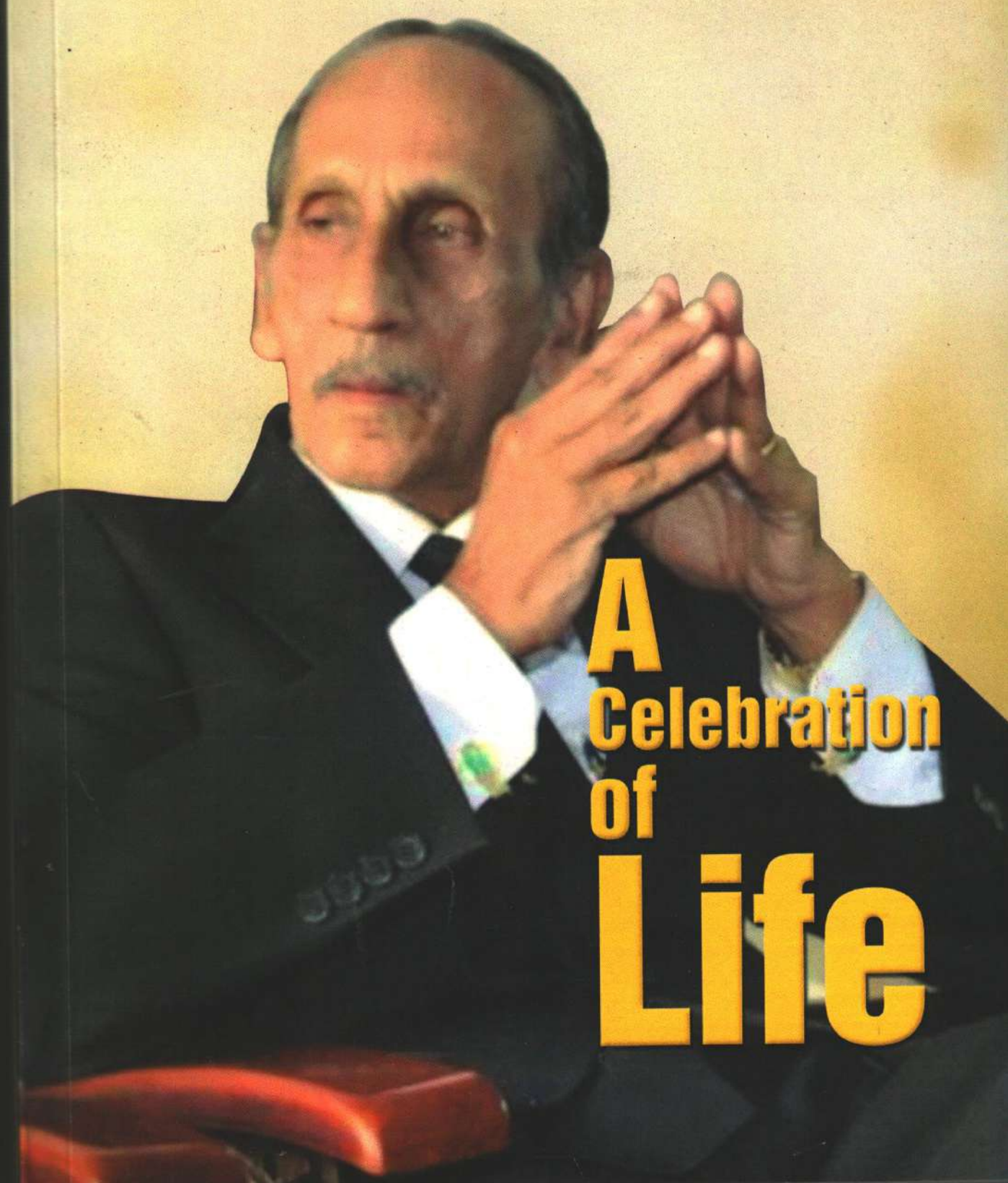
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K. BHASKARAN

A portrait of K. Bhaskaran, an elderly man with a mustache, wearing a dark suit, white shirt, and dark tie. He is seated in a red chair, with his hands clasped together in front of him. The background is a plain, light-colored wall.

**A  
Celebration  
of  
Life**

**A Celebration of Life**  
*Memoirs*

By  
K. Bhaskaran  
(A Former Military Contractor with the British)

*As told to Suku Palkulangara*

*Translated from Malayalam*  
by  
Radhika P. Menon



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*Dedicated to the memory of my father*  
**Ayurveda Bhooshanam Thinavila Kunjuraman Vaidyan**

Lord Ayyappa of Sabari Hills and of the Chirappanchira kalari.

Shri Bhaskaran records that he had a devil-may-care attitude, and states that he led a life of luxury from the 1940s, purchasing expensive cars as and when he willed. However, the loss of an opportunity to buy a fighter plane from the British as they were leaving India continues to be a source of regret.

Thinavila Kunjuraman Vaidyan who had an extraordinary opportunity to give medical treatment to Sree Narayana Guru is the central figure in Shri Bhaskaran's memories. But the memoir moves into an international arena when he mentions the Second World War and the people who played important roles during that time - Hitler, Winston Churchill, Maugham and others. His lifestyle too was on par with international standards, given his love for horse riding, polo and use of expensive cars.

When I was asked to write an introduction to his memoirs, I had no inkling about the sheer range of this historical account. I am delighted to present this to the readers of Kerala and the world.

**M. N. Gunavardhanan, IAS (Retd)**  
Ex-Commissioner  
State Information Commission

## Table of Contents

### Book One: My Formative Years

1. The Story of an Era	17
2. A Family Blessed by Sree Narayana Guru	22
3. Lakshmi Vilasam Blessed by the Touch of Guru's Feet	32
4. Kumaran Asan, Mulloor and the Mahatma	39
5. My Salad Days	46
6. Our Bond with C. V. Kunjuraman and C. Kesavan	59
7. Father's Success as a Physician	64
8. Religious Labels	70
9. Hedonism of the Rich	74
10. Padmanabhan Contractor	77
11. Riding out the Storm	88
12. Father's Illness and Eventual Cure	93
13. Father's Social Commitment	98
14. M. N. Govindan Nair's Sojourn	104
15. Father's Bungalow at Chenthitta	108
16. Tiger Meat	113

**Book Two: The World Beyond**

1. Bengali Swami and the Story of Palm-Leaf Manuscripts 121
2. The Travancore Maharaja's First Car 126
3. Lord Ayyappa and the Chirappanchira Kalari 129
4. Entry of British Goods and Liquor in Travancore 136
5. Workers' Movement in Kollam and their Leaders 141
6. Businessmen of the Old Order - Role Models for the New 147
7. The Second World War 152

**Book Three: Life On My Own Terms**

1. On Striking Friendship with the British 157
2. My Ambition 163
3. A Trip to Kariyil to Purchase a Car 168
4. My First Love 175
5. Blood Relations 181
6. Love Lost on Horseback 185
7. My Co-passenger 193
8. My First Trip to Bombay 197
9. At the Taj 201
10. Back into the Family Fold 205
11. A Keeper of Royal Treasure 211
12. Polo, the King of Sport 214

**Book Four: Domestic Affairs**

1. My Wedding 217
2. Conjugal Bliss 225
3. Trivandrum 230
4. Passions and Habits 235
5. The Power of Destiny 244
6. Of Matters Earthly and Supernatural 250

**Book Five: Amazing People In My Life Journey**

1. Moments with Somerset Maugham 255
2. Guest House Parameswaran 260
3. A Train Journey with Rajagopalachari 265
4. Patel and Netaji - Leaders who Inspired Me 268
5. A Spiritual Watch-Repairer 272
6. A Rare Human Being 275
7. Kunnikott Thangal's Magical Powers 281
8. The Sorcerer's Powers 288

Epilogue: Contentment 291

**Book Six: Appendices** 296



## Book One My Formative Years

### I The Story of an Era

*Thinavila N. Kunjuraman Vaidyan was a man of impressive personality who stood like a tall and majestic tree, its rich canopy spreading out far and wide. As early as in the 1920s, he made a mark in many fields such as Ayurvedic medical treatment, cashew business, manufacture and sale of Ayurvedic medicines and so on. Kunjuraman Vaidyan was a medical practitioner who overcame the threats of the British colonial rule that hung like the sword of Damocles above the people of those times, and achieved enviable accomplishments in life. Adherence to ideals and the gift of foresight were inherent in him, and he always walked the straight path of truth, righteousness and justice. Small wonder that he could put his projects and ambitions into action and attain success in all his endeavours.*

*What this narrative sketches is the life as well as experiences of K. Bhaskaran, the eldest son of Kunjuraman Vaidyan. Call the book by any name – an autobiography, an account of unique experiences, or a collection of slivers of history – that is left to the generosity of the readers!*

*Bhaskaran's uniqueness lay in the fact that he never wished to follow in his father's footsteps, preferring instead to plough his own furrow and be his own man. "Father has his path and I have mine" – this was his credo,*

# A Celebration of Life

## memoirs

The memoir *A Celebration of Life* tells the story of K. Bhaskaran who, despite being born with the proverbial silver spoon in the mouth, used his adventurous nature and enormous capacity for industry to take up challenging projects and win success in life. What is uncommon about him is that his *joie de vivre* and love of luxury accentuated his piety, and gave him a unique gift of contentment that at once fed his impish spirit and sharpened his respect for human goodness.

\*\*\*\*\*

The narrative is replete with many interesting anecdotes of Bhaskaran's mischievous acts and romantic escapades. New dreams blossom in place of old memories but recollections of the past events do not fade away from his mind!... The book truly encases the life of a man and the portrait of an era. The flaming torch of Bhaskaran's life will surely light up the minds of his readers.

**Dr George Onakkoor**

\*\*\*\*\*

The memoirs of Shri K. Bhaskaran, son of the famous Thinavila Kunjuran Vaidyan who had the rare fortune of being blessed by Sree Narayana Guru, gives a portrait of his life, and simultaneously sketches certain significant moments in the history of a hundred years of Kerala, India and the world at large. We are able to see how Shri Bhaskaran, born in 1923, experienced the good as well as the bad aspects of British rule in India.

**M. N. Gunavardhanan, IAS (Retd)**

Ex-Commissioner

State Information Commission

Memoirs

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# ചിഹ്നശാസ്ത്രം

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ചിഹ്നശാസ്ത്രം  
സിദ്ധാന്തവും പ്രയോഗവും

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(Malayalam)

**Chihna shasthram: Sidhanthavum Prayogavum**  
Study

by

Arun J.G

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ഭാഷാശാസ്ത്രം, ഇതരസാഹിത്യ-ശാസ്ത്രമേഖലകളിൽ നിർണ്ണായകമായ സ്വാധീനം ചെലുത്തുന്നതിനാണു പോയ നൂറ്റാണ്ടു സാക്ഷ്യം വഹിച്ചത്. ഫെർഡിനാന്റുസൊസ്യൂർ മുന്നോട്ടുവച്ച പരികല്പനകളിലൂടെ വികസിച്ചു വന്ന ഘടനാവാദം, ഭാഷാ ശാസ്ത്രപഠനത്തിന്റെ അനന്തരഫലമാണെങ്കിലും സാഹിത്യം, നരവംശ ശാസ്ത്രം, മന:ശാസ്ത്രം തുടങ്ങിയവയോടുബന്ധപ്പെട്ടും അതു വളരെ വേഗം വികാസം പ്രാപിച്ചു വന്നു. Structuralism അഥവാ ഘടനാവാദം പിന്നീടു നിരവധി ഭാഷാ-സാംസ്കാരിക സങ്കല്പങ്ങൾക്കു തുടക്കം കുറിച്ചുവെന്നതു നിസ്തർക്കമായ വസ്തുതയാണ്. അത്തരത്തിൽ, സൊസ്യൂറിയൻ ചിന്താധാരയിൽ നിന്ന് ഉരുത്തിരിഞ്ഞുവന്ന ചിഹ്നശാസ്ത്രം അഥവാ Semiotics നു മനുഷ്യന്റെ സാംസ്കാരികവ്യവസ്ഥിതികളുടെയും ആശയ പരികല്പനകളുടെയും ബഹിർസ്ഫുരണം എന്ന തലത്തിലേക്ക് അതി വേഗം മാറുവാൻ കഴിഞ്ഞു. മാനുഷികമായ എല്ലാ സാംസ്കാരികവ്യവസ്ഥകളെയും പ്രതീകങ്ങളായി അഥവാ ചിഹ്നങ്ങളായി അപനിർമ്മിക്കുന്നുവെന്നതാണ് ചിഹ്നശാസ്ത്രത്തിന്റെ കാതലായ വസ്തുത.

"The Science of communication studied through the interpretation of signs and symbols as they operate in various field, especially language" എന്ന് ഓക്സ്ഫോർഡ് ഇംഗ്ലീഷ് ഡിക്ഷണറി നൽകുന്ന നിർവ്വചനം. ഒരേ സമയം ചിഹ്നശാസ്ത്രത്തിനു ഭാഷാപഠനത്തിലുള്ള അനിഷേധ്യതയെയും അതിന്റെ വ്യാപാരമേഖലാവൈപുല്യത്തെയും പ്രതിനിധാനം ചെയ്യുന്നു. ഭാഷയെയും അതിന്റെ വ്യവഹാരപരിധികളെയും ചിഹ്നവ്യവസ്ഥയിലൂടെ വിശകലനം ചെയ്യുന്ന ഈ ശാസ്ത്രീയ സമീപനം പിൻക്കാലത്തു സാഹിത്യപഠനത്തിന്റെ അനിവാര്യമായ ഘടകമായിത്തീർന്നു. സാഹിത്യത്തിൽ ആവിഷ്കൃതമാകുന്ന മനുഷ്യജീവിതത്തെയും ചിഹ്നവ്യവസ്ഥയിലൂടെ പുനർവായിക്കാനുള്ള ശ്രമങ്ങൾ, ഇന്ന് ഏറെ സാധാരണമാണ്. അവ്ശിയാമുള്ള ഒരു പുനർവായനയുടെ സാംഗത്യത്തെക്കുറിച്ച് പരിചിന്തിക്കുവാനുള്ള, ചില ചോദ്യങ്ങളുണർത്തുവാനുള്ള ഒരു എളിയ ശ്രമമാണ് ശ്രീ.അരുണിന്റെ 'ചിഹ്നശാസ്ത്രം സിദ്ധാന്തവും പ്രയോഗവും' എന്ന പുസ്തകം. ചിഹ്നശാസ്ത്രത്തിന്റെ വെളിച്ചത്തിൽ എൻ.എസ്.മാധവന്റെ ലത്തൻബത്തേരിയിലെ ലുത്തിനിയകളെയാണ് അരുൺ പഠനവിധേയമാക്കുന്നത്.

## ചിഹ്നശാസ്ത്രം

മനുഷ്യൻ ഒരു സമൂഹജീവിയാണ്. സാമൂഹ്യജീവിതത്തിന്റെ അനിവാര്യതയാണ് ആശയവിനിമയം. ജന്തുവർഗ്ഗത്തിനും സസ്യവർഗ്ഗത്തിനുമെല്ലാം അതതിന്റേതായ ആശയ വിനിമയോപാധികളുണ്ട്. മനുഷ്യനെ സംബന്ധിച്ചിടത്തോളം ഭാഷയാണ് അതിനുള്ള ഏറ്റവും സഹജമായ, സ്വാഭാവികമായ ഉപാധി. ഭാഷയ്ക്കു പുറമേ ഒട്ടനവധി ചിഹ്നവ്യവസ്ഥ (Signifying system)കളെ മനുഷ്യൻ രൂപപ്പെടുത്തിയിട്ടുണ്ട്. ഇത്തരം ആശയവാഹക ചിഹ്നങ്ങളെപ്പറ്റിയുള്ള പഠനമാണ് ചിഹ്നവിജ്ഞാനീയം അഥവാ ചിഹ്നശാസ്ത്രം. എന്താണ് ചിഹ്നം, എങ്ങനെയാണ് ചിഹ്നങ്ങൾ പരസ്പരം ബന്ധപ്പെട്ടു നിൽക്കുന്നത്, എങ്ങനെയാണ് ചിഹ്നങ്ങൾ അർത്ഥമാല്പാദനത്തെ സാധ്യമാക്കുന്നത് തുടങ്ങിയ കാര്യങ്ങൾ ഈ വിഷയത്തിന്റെ പരിധിയിൽപ്പെടും.

സാഹിത്യദികളെ ഭാഷാകേന്ദ്രിതമായി പഠിക്കാമെന്നും എഴുത്തുകാരൻ (Writer) കണ്ടെത്തുന്ന ചിഹ്നങ്ങൾക്ക് (Sign) ഒട്ടനവധി അർത്ഥതലങ്ങളെ ഉൽപ്പാദിപ്പിക്കാൻ കഴിയും എന്നുമുള്ള കണ്ടെത്തലുകൾ കലാസാഹിത്യരംഗത്തെ പുത്തനുണർവ്വായിരുന്നു. ചിഹ്നവിജ്ഞാനം (Semiology) ചിഹ്നശാസ്ത്രം (Semiotics) എന്നൊക്കെ വ്യവഹരിക്കപ്പെടുന്ന ചിഹ്നപഠനങ്ങൾ ഭാഷാ-സാഹിത്യപഠന മേഖലകളിൽ അഭ്യുതപൂർവ്വമായ പരിവർത്തനങ്ങൾ സൃഷ്ടിച്ചു. സാഹിത്യവിമർശനരംഗത്തെന്നപോലെ തന്നെ കലാ-സാഹിത്യ-സാംസ്കാരിക പഠനമേഖലകളിലൊക്കെയും പ്രസക്തിയുള്ള ഒന്നായി ഇന്ന് ചിഹ്നപഠനം അറിയപ്പെടുന്നു. വാചികവും വാചികേതരവുമായ ചിഹ്നങ്ങളെ വിശകലനം ചെയ്യാനും അവയുടെ അർത്ഥപ്രതീതി നിർണ്ണയിച്ചുകൊണ്ട് പുതിയൊരു വായനാനുഭവം ഉയർത്തിക്കൊണ്ടുവരാനും ഈ പഠനമേഖലയ്ക്കു കഴിഞ്ഞു. അതുകൊണ്ടുതന്നെ ഉത്തരാധുനിക സാഹിത്യപരിസരത്തിലെ ശ്രദ്ധേയമായ ഏടായി ചിഹ്നപഠനങ്ങൾ മാറി.

### ചിഹ്നശാസ്ത്രത്തിന്റെ പിറവി

ചിഹ്നശാസ്ത്രം എന്ന പഠനമേഖല പെട്ടെന്നൊരുനാൾ പൊട്ടിമുളച്ചതല്ല. അത് ഒരു തുടർച്ചയുടെ ഫലമാണ്. നവനിരൂപണത്തോടെ (New criticism)യാണ് ചിഹ്നശാസ്ത്രം ആരംഭിച്ചതെന്നു പറയാം. എഴുത്തുകാരനെയും എഴുതപ്പെട്ട കാലഘട്ടത്തെയും മാറ്റി നിർത്തിക്കൊണ്ട്

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അരുൺ ജെ. ജി



ചിഹ്നങ്ങളെ സംബന്ധിച്ച സാമാന്യമായ സിദ്ധാന്തങ്ങളെ അഥവാ ചിഹ്നങ്ങളെക്കുറിച്ചുള്ള പഠനങ്ങളാണ് ചിഹ്നശാസ്ത്രം (Semiotics). മനുഷ്യജീവിതത്തിന്റെ ഭാഗമായ സകല സാംസ്കാരിക വ്യവസ്ഥകളും പഠനവിഷയമാകുന്നതിനാൽ ചിഹ്നശാസ്ത്രം കേവലം ഭാഷയുടെയോ സാഹിത്യത്തിന്റെയോ മാത്രം മേഖലയല്ല. വിശാലാർത്ഥത്തിൽ ചിഹ്നശാസ്ത്രം സാംസ്കാരിക പഠനമാണ്. ഇന്ന് ഏറെ വികസിച്ച ഒരു പഠനമേഖലയാണിത്. ചിഹ്നശാസ്ത്രത്തിന്റെ സിദ്ധാന്തവും പ്രയോഗവും എങ്ങനെയെന്ന് കാട്ടിത്തരുന്ന ഗ്രന്ഥമാണ് അരുൺ .ജെ. ജി യുടെ 'ചിഹ്നശാസ്ത്രം സിദ്ധാന്തവും പ്രയോഗവും.' എൻ.എസ്.മാധവന്റെ 'ലത്തൻബത്തേരിയിലെ ലൂത്തിനിയകളി'ലെ ക്രിസ്തുമത ചിഹ്നങ്ങളെയാണ് ഇവിടെ അരുൺ പഠനവിധേയമാക്കുന്നത്. സാഹിത്യ വിദ്യാർത്ഥികളെ സംബന്ധിച്ചിടത്തോളം ഏറെ ഉപകാരപ്പെടുന്ന ഒരു ഗ്രന്ഥമായിരിക്കും ഇത്.

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നവമാധ്യമങ്ങളുടെ ആഖ്യാനരീതികൾ ഡോ. ടി. ജിതേഷ്	7
അനുഭവങ്ങളുടെ ലിങ്കുകൾ ഡോ. ഒ.കെ. സന്തോഷ്	13
നവമാധ്യമങ്ങൾ : വിനിമയ ജനാധിപത്യത്തിന്റെ തുറസ്സുകൾ ഡോ. ആർ.എസ്. ജയ	21
സിനിമ : വിവർത്തനത്തിന്റെ നവമാധ്യമധർമ്മം ഡോ. വത്സലൻ വാതുശ്ശേരി	25
ഇ-വായനയുടെ ഇടങ്ങൾ മലയാളസാഹിത്യത്തിൽ ഡോ. എം.എസ്. സുചിത്ര	36
സിറ്റിസൺ ജേണലിസം : സാധ്യതകളും പരിമിതികളും ഡോ. ആർ. രാജേഷ്	42
നവമാധ്യമങ്ങൾ : ഒരു രാഷ്ട്രീയ പ്രചരണോപാധി ഡോ. എസ്. ജയൻ	47
സൈബറും ഫിക്ഷനും ഡോ. ഡി. വി. അനിൽകുമാർ	51
ഫെയ്സ്ബുക്ക് : ആത്മരതിയുടെ വെളിയിടം ഡോ. എസ്. അജയശ്ലോഷ്	58
എസ്.എം.എസ് : ഭാഷയുടെ പാരമ്പര്യനിഷേധം കിരൺ മോഹൻ എം.	65
അധികാരത്തിന്റെ പ്രയോഗവും സംസ്കാരവും നവമാധ്യമങ്ങളിൽ രമ്യ ആർ.	72
നവമാധ്യമങ്ങളും മൂല്യസങ്കല്പങ്ങളും ജോൺ എം.പി.	77

✓ നവമാധ്യമങ്ങളിലെ ഭാഷാസമീപനം <u>പെട്രീഷ്യ ജോൺ</u>	82
നവമാധ്യമങ്ങളുടെ സ്വാധീനം മലയാളകവിതയിൽ ആര്യാജ് ആർ.	86
സാംസ്കാരികവിമർശനം ബ്ലോഗുകവിതകളിൽ രഞ്ജുദേവി ആർ.	90
ഇ-മെയിൽ : വ്യവഹാരത്തിന്റെ സ്വരൂപവും വിനിമയരീതിയും ശ്രീല എസ്.	95
നവമാധ്യമസംസ്കാരവും പരസ്യങ്ങളും ശരജ ആർ.	98
നവമാധ്യമങ്ങളും കേരളീയരുടെ സംസ്കാരവും മെർലിൻ ജോൺ	102
✓ മലയാളം ബ്ലോഗുകവിതകൾ : എഴുത്തിന്റെ നൂതനതലങ്ങൾ <u>രാജി ജെ.</u>	108
ഇ-വായനയുടെ ഇടങ്ങൾ മലയാളസാഹിത്യത്തിൽ രാഖി ആർ.	113
സൈബർ വ്യവഹാരത്തിലെ മലയാളസാന്നിധ്യം ലത വി.	118
മതേതരത്വം സൈബറിടത്തിൽ സജി കരിങ്ങോല	123

## മലയാളം ബ്ലോഗുകവിതകൾ: എഴുത്തിന്റെ നൂതനതലങ്ങൾ

രാജി ജെ.

വിവരസാങ്കേതികവിദ്യയുടെ ഏറ്റവും പുതിയ ഉൽപ്പന്നമായ ബ്ലോഗുകൾ ഉള്ളടക്കങ്ങൾ പലതാണ്. അന്താരാഷ്ട്രതലത്തിൽ ബ്ലോഗുകൾക്ക് വാർത്താമാധ്യമങ്ങൾ എന്ന നിലയിൽ വലിയ ചലനങ്ങൾ സൃഷ്ടിക്കാൻ സാധിച്ചിട്ടുണ്ട്. എന്നാൽ മലയാളം ബ്ലോഗുകൾ പ്രധാനമായും സാഹിത്യ സംബന്ധിയായ വിഷയങ്ങളാണ് കൂടുതലായും കൈകാര്യം ചെയ്യുന്നത്. മലയാളം ബ്ലോഗുകളിൽത്തന്നെ ഏറ്റവുമധികം വികാസം പ്രാപിച്ച ശാഖയാണു കവിത. മലയാളം ബ്ലോഗ് കവിതകൾക്ക് സാഹിത്യമേഖലയിൽ തങ്ങളുടേതായ ഇടങ്ങൾ സ്ഥാപിക്കാൻ ഇതിനോടകം കഴിഞ്ഞിരിക്കുന്നു. ആവിഷ്കാരത്തിന്റേതായ ഒരു പുതിയ തലമാണു ബ്ലോഗിലൂടെ സൃഷ്ടിക്കപ്പെടുന്നത്. ഭാഷ, ഉള്ളടക്കം, സ്വാതന്ത്ര്യം, ഘടന, ദൈർഘ്യം എന്നിങ്ങനെ പല മേഖലകളിലാണ് ബ്ലോഗ് കവിതകൾ ആവിഷ്കാരത്തിന്റെ നൂതനതലങ്ങൾ സൃഷ്ടിക്കുന്നത്. ആരുടെയും സഹായമില്ലാതെ, കടമകൾക്കുടമപ്പെട്ട് അംഗവൈകല്യം സംഭവിക്കാതെ, പറയാനുള്ളത് പറയാൻ സ്വാതന്ത്ര്യമുള്ള ഒരു വേദിയാണു ബ്ലോഗ്. എന്തും എഴുതാം, ആരോടും ചോദിക്കാതെ തന്നെ പോസ്റ്റ് ചെയ്യാം എന്നുള്ള കാരണങ്ങൾ കൊണ്ടുതന്നെ വളരെ ബാലിശമായ ധാരാളം കവിതകൾ ബ്ലോഗിൽ കയറിപ്പറ്റുന്നുണ്ട്. അതോടൊപ്പം തന്നെ മലയാളത്തിലെ ഇന്നുള്ള നല്ല കവികൾക്കൊപ്പം നിൽക്കാൻ എന്തുകൊണ്ടും പ്രാപ്തിയുള്ള എഴുത്തുകാരാണ്. കെ.എം. പ്രമോദ്, കുഴൂർ വിത്സൻ, അബ്ദുൾ സലാം, പി.എ. അനീഷ്, വിശ്വാസ് ശങ്കർ തുടങ്ങി പ്രശസ്തരായ ബ്ലോഗ് കവികളുടെ നിര വളരെ നീണ്ടതാണ്.

### എഴുത്തിലെ സ്വാതന്ത്ര്യം

രചനകൾ അച്ചടിമഷി പൂരണ്ട് പ്രസിദ്ധീകരണയോഗ്യമാവണമെങ്കിൽ വളരെയേറെ കടമ്പകൾ പിന്നിടേണ്ടതുണ്ട്. പ്രത്യക്ഷപ്പെടുന്ന മാധ്യമങ്ങളുടെ നിക്ഷിപ്ത താൽപ്പര്യങ്ങൾക്കനുസരിച്ചുള്ളതായാൽ മാത്രമേ രചനകൾ വെളിച്ചം കാണുകയുള്ളൂ. എഴുത്തുകാരന്റെ രചനയിൽ എഡിറ്റർ എന്ന അധികാരസ്ഥാപനത്തിന്റെ ഇടപെടലും സാമ്പ്രദായിക അച്ചടിമാധ്യമങ്ങളിൽ ഉണ്ടാവുന്നു. എന്നാൽത്തന്നെയും അവ പ്രസിദ്ധീകരിച്ചുകിട്ടുന്ന

മെന്റലി അനന്തമായ കാത്തിരിപ്പും ഇതിനുപിന്നിൽ വേണ്ടി വന്നേക്കാം. നല്ലതിനെ കൊള്ളുകയും നിലവാരമില്ലാത്തവ തള്ളുകയും ചെയ്യുന്നുവെന്ന് സാമാന്യവിവക്ഷയുള്ള ഈ എഡിറ്റർ കർമ്മങ്ങൾ കഴിയുമ്പോൾ പല രചനകളുടെയും സ്വഭാവം തന്നെ മാറിപ്പോയേക്കാം. ഈയൊരവസ്ഥയിൽ വളരെ നല്ല കൃതികൾപോലും പലപ്പോഴും അവഗണിക്കപ്പെട്ടിട്ടുണ്ട്. അയ്യപ്പപ്പണിക്കരുടെ 'കുരുക്ഷേത്രം'വും കടമ്മനിട്ടയുടെ 'കുറത്തി'യും പ്രസിദ്ധീകരണയോഗ്യമല്ലാത്തതിന്റെ പേരിൽ മാതൃഭൂമി ആഴ്ചപ്പതിപ്പ് തള്ളിക്കളഞ്ഞതിനെപ്പറ്റിയുള്ള സച്ചിദാനന്ദന്റെ പരമാർശം ഇവിടെ സ്മരണീയമാണ്.

ബ്ലോഗ് എന്ന നവമാധ്യമത്തിൽ എഴുത്തുകാർ പൂർണ്ണസ്വതന്ത്രമാണ്. യാതൊരുവിധത്തിലുമുള്ള താൽപ്പര്യങ്ങളും അവരുടെ എഴുത്തിനെ ഹനിക്കുന്നില്ല. പ്രസിദ്ധീകരണം എന്ന സ്ഥാപനവൽകൃതരൂപത്തോടുള്ള പ്രതികരണമായിട്ടാണ് എഴുത്തുകാർ തങ്ങളെത്തന്നെ നിയന്ത്രിക്കുന്നതെങ്കിൽ ബ്ലോഗിൽ ആ ഭീതിയെ തള്ളിക്കളയാൻ പ്രാപ്തിയുള്ള ഒരു മാധ്യമമാണ്. എഡിറ്റർമാരുടെയോ ആനുകാലികങ്ങളുടെയോ നിക്ഷിപ്തതാൽപ്പര്യത്തിനൊത്ത് കവിതയിൽ ഒത്തുതീർപ്പുകൾ വരുത്തേണ്ട ഗതികേട് ഇവിടെ കവികളില്ല. അതീവ സ്വാതന്ത്ര്യത്തോടെ താൻ പറയാനാഗ്രഹിക്കുന്ന കാര്യങ്ങൾ, പറയാനാഗ്രഹിക്കുന്ന ഭാഷയിലൂടെ, രൂപത്തിലൂടെ അവതരിപ്പിക്കാൻ കവിക്ക് ബ്ലോഗിലൂടെ സാധിക്കുന്നു. 'പ്രതിഭാഷ', 'അച്ചടി മലയാളം' നാടകകൃതിയെ കവിതകൾ, 'കവിത പ്രസിദ്ധീകരിക്കാനാവാത്തതിനാൽ ഖേദിക്കുന്നു' തുടങ്ങിയ പ്രശസ്ത മലയാളം കവിതാബ്ലോഗുകളുടെ പേരുകളിൽ നിന്നുതന്നെ അച്ചടിലോകത്തിൽനിന്നും ബദലായ ഒരിടം സ്ഥാപിക്കുകയാണ് ബ്ലോഗുകൾ ചെയ്യുന്നതെന്ന് വ്യക്തമാണ്. മനസ്സിൽ തോന്നുന്ന കാര്യങ്ങൾ മറകൂടാതെ അവതരിപ്പിക്കാൻ സാധിക്കുന്നതുവഴി കവിതയുടെ സാധ്യതകളും ഇതിലൂടെ വികസിക്കുകയാണ്. വൈവിധ്യമാർന്നുള്ളടക്കം, ഘടന, രൂപം, ഭാവം എന്നിവയോടെ പ്രത്യക്ഷപ്പെടുന്ന ബ്ലോഗ് കവിതകൾ പുതിയൊരു ആവിഷ്കാരതലം സൃഷ്ടിക്കുന്നു.

എന്തും പ്രസിദ്ധീകരിക്കാം എന്നതിനാൽത്തന്നെ തന്റേതായ, സ്വതന്ത്ര ഭാഷയിലൂടെ കവിതയെഴുതാൻ കവിക്ക് സാധിക്കുന്നു. തന്റെ സ്വാതന്ത്ര്യം പരമാവധി പ്രയോജനപ്പെടുത്തുന്നതിനാൽ രചനകളിൽ നിസ്സാര സ്വഭാവത്തോടുകൂടിയതും ഗൗരവാംശം കലർന്നതുമായ കവിതകൾ കടന്നു വരുന്നു.

മനോജ് കുറുതിന്റെ 'നിർമലാ ടാക്കീസി'നെക്കുറിച്ച് ഒരു ക്ഷുദ്രകവിത എന്നത് മുൻപറഞ്ഞതരത്തിലുള്ള നിസ്സാര സ്വഭാവത്തോടുകൂടിയതാണ്. കവിതെന്ന പ്രസ്ഥാനകനാവുന്നു എന്നതിനാൽ ബ്ലോഗ് കവിതകൾ സ്വാതന്ത്ര്യത്തിന്റെ പുതിയ ആവിഷ്കാര സാധ്യതയാവുകയാണ്.

നിർമ്മല ടാക്കീസിൽ  
 മൂന്നുഷോ രാസലില  
 നൂൺഷോ വനക്രീഡ  
 തെങ്ങിൽ തൂങ്ങുന്ന പരസ്യവും  
 കോളാമ്പിയിൽ പതറുന്ന പാട്ടും  
 തെരുങ്ങിക്കരയുന്ന വാതിലും കടന്ന്  
 പാത്തും പതുങ്ങിയും ഉള്ളിലെത്തി.

ഹാസ്യംഗത്തിന് പ്രധാന്യം നൽകി തമാശ കലർന്ന കുറിപ്പുകളായി കവിത മാറുന്ന കാഴ്ചയാണിവിടെ കാണുന്നത്. എഴുതാനും പ്രസിദ്ധീകരിക്കാനുമുള്ള പൂർണ്ണ സ്വാതന്ത്ര്യം കൊണ്ടാണ് ഇത്തരത്തിലുള്ള രചനകൾ വ്യാപകമായി ബ്ലോഗിൽ പ്രത്യക്ഷപ്പെടുന്നത്.

സ്വാതന്ത്ര്യം എന്ന ഘടകം എഴുത്തിന്റെയും പ്രസിദ്ധീകരണത്തിന്റെയും മേഖലയിൽ വരുത്തുന്ന ചലനങ്ങൾ ചെറുതല്ല. യാതൊരു ചെലവുമില്ലാതെ പത്രാധിപരുടെ കനിവിന് കാത്തുനിൽക്കാതെ സ്വന്തം സ്വാതന്ത്ര്യമനുസരിച്ച് കവിതകൾ പ്രസിദ്ധീകരിക്കാൻ ബ്ലോഗിലൂടെ സാധിക്കുമ്പോൾ സ്വാതന്ത്ര്യം എന്ന ഘടകത്തിന്റെ പിൻബലത്തിൽ ബ്ലോഗ് കവികൾ ആവിഷ്കരണത്തിന്റെ പുതിയൊരു മേഖല വെട്ടിത്തെളിക്കുകയാണ്.

**തിരുത്തലുകളിലൂടെയുള്ള എഴുത്ത്**

അച്ചടിമാധ്യമങ്ങൾ ഉൾപ്പെടെയുള്ള സാമ്പ്രദായിക മാധ്യമങ്ങളിൽ ഒരു രചന പ്രത്യക്ഷപ്പെടുകഴിഞ്ഞാൽ പിന്നീട് അതിൽ മാറ്റങ്ങൾ വരുത്തുവാൻ എഴുത്തുകാർക്ക് സാധിക്കുന്നില്ല. തെറ്റുകൾ തിരുത്താനോ കൂട്ടിച്ചേർക്കലുകൾ നടത്താനോ ഉള്ള സാധ്യത ഇവിടെയില്ല.

എന്നാൽ ബ്ലോഗ് കവിതയിൽ അതു പ്രസിദ്ധീകൃതമായാൽതന്നെ ഏതുസമയത്തുവേണമെങ്കിലും കവിക്ക് അതിൽ കൂട്ടിച്ചേർക്കലുകൾ നടത്താനും അവ ഉൾപ്പെടുത്തി രചനയെ കൂടുതൽ സമഗ്രമാക്കാനും സുന്ദരമാക്കാനും ഇതുവഴി സാധിക്കുന്നു. മറ്റ് മാധ്യമങ്ങൾക്കില്ലാത്ത ഈ സാധ്യത ബ്ലോഗിലെ കവിതകളെ ആവിഷ്കരണത്തിന്റെ മറ്റൊരു നൂതന ഇടത്തിലേക്കെത്തിക്കുകയാണ്.

**പ്രതികരണങ്ങളുടെ സാധ്യത**

അച്ചടി മാധ്യമങ്ങളിൽ കവിത പ്രസിദ്ധീകരിച്ചുകഴിഞ്ഞാൽ അത് എത്ര വായനക്കാർ വായിച്ചു, അവർ ഏതുതരത്തിലാണ് അതിനെ വിലയിരുത്തിയത്, എന്നീ കാര്യങ്ങളെക്കുറിച്ച് എഴുത്തുകാരന് പൂർണ്ണമായും കൃത്യമായുള്ള അറിവുണ്ടാവുകയില്ല.

എന്നാൽ ബ്ലോഗ് കവികൾക്ക് ഈയൊരു അവസ്ഥയല്ല ഉള്ളത്. എത്ര പേർ കവിത വായിച്ചുവെന്നും അവർ രേഖപ്പെടുത്തിയ കമന്റുകളിലൂടെ

അവരുടെ വിലയിരുത്തലുകൾ കൃത്യമായി അറിയുവാനും ബ്ലോഗ് കവിക്ക് സാധിക്കുന്നു. കൂടാതെ വായനക്കാരുമായി കവിക്ക് നേരിട്ട് സംവദിക്കാനുള്ള ഒരു തലം കൂടിയാവുന്നു ഇത്. തന്റെ രചനയെക്കുറിച്ചുള്ള സാമാന്യ ധാരണ വായനക്കാരുടെ പ്രതികരണങ്ങളിലൂടെ കവിക്ക് മനസ്സിലാവുകയും ആവിശ്യമായ തിരുത്തലുകളിലൂടെ കവിതയെ പൂർണ്ണമാക്കാനുള്ള സാധ്യത ഇവിടെ ഉണ്ടാവുകയും ചെയ്യുന്നു. വായനക്കാർക്കും കവിക്ക് പരസ്പരം സംവദിക്കാനുള്ള സാധ്യത തുറന്നിടുന്നതു വഴി ആവിഷ്കരണത്തിന്റെ ഒരു പുതിയ ഇടം കൂടിയാവുകയാണു ബ്ലോഗ് കവിതകൾ.

**സാങ്കേതിക മുന്നേറ്റങ്ങളുടെ തലം**

സാങ്കേതികവിദ്യയുടെ സാധ്യതകളുടെ പാരമ്യത്തിലുള്ള മാധ്യമമാണ് ബ്ലോഗ്. അച്ചടിമാധ്യമങ്ങളിൽ പ്രത്യക്ഷപ്പെടുന്ന കവിതകൾക്കില്ലാത്ത സാങ്കേതികത്തികവ് ബ്ലോഗ് കവിതകൾക്കുണ്ട്. സാമ്പ്രദായികരീതിയിൽ കവിതകൾ അച്ചടിച്ചുവരുമ്പോൾ വായനയിലൂടെയുള്ള ആസ്വാദനം മാത്രമാണു നടക്കുന്നത്. വളരെ വിസ്താരം കുറഞ്ഞ വായനയാണ് ഇവിടെയുണ്ടാകുന്നത്, കവിയുടെ ആ ഒരു കവിതയിൽമാത്രം ഒതുങ്ങിനിൽക്കുന്നു അപ്പോൾ. എന്നാൽ ബ്ലോഗിലാണെങ്കിൽ ലിങ്കുകളിലൂടെ കവിയുടെ മറ്റ് രചനകളിലേക്കെത്താനും ദുർഗ്രാഹ്യമായവയ്ക്കുള്ള വിശദീകരണങ്ങൾ മനസ്സിലാക്കാനും അതുവഴി കവിയുടെ രചനാ സവിശേഷതകളിലൂടെ കവിതയെ വായിക്കാനും സാധിക്കുന്നു. വായനയുടെ വളരെ വലിയ ഒരു തലമാണ് ഇതുവഴി ബ്ലോഗ് കവിതകൾ സൃഷ്ടിക്കുന്നത്.

അച്ചടിമാധ്യമങ്ങളിൽ വരുന്ന കവിത നാം വായിച്ച് മാത്രം ആസ്വദിക്കുമ്പോൾ ബ്ലോഗിൽ പ്രത്യക്ഷപ്പെടുന്ന കവിത കവിയുടെ ശബ്ദത്തിൽത്തന്നെ കേൾക്കാൻ സാധിക്കുന്നു. ദൃശ്യാത്മകമായും നമുക്കവിടെ കവിതയാസ്വദിക്കാം. ആനുകാലിക കവിത, ബുലോക കവിത, തുടങ്ങിയ ബ്ലോഗ് കവിത കൂട്ടായ്മകളിൽ ഈ സൗകര്യം സാധ്യമാണ്. ആസ്വാദനത്തിന്റെ നൂതനതലം സൃഷ്ടിക്കാൻ ഇതുവഴി ബ്ലോഗ് കവിതകൾക്കാവുന്നു.

വ്യത്യസ്തമായ പ്രകൃതിയുടെയും സംസ്കാരങ്ങളുടെയും സാന്നിധ്യം ബ്ലോഗ് രചനകൾക്ക് പുതിയൊരു വേദി നൽകുന്നതായിക്കാണാം. മലയാളത്തിലെ മുഖ്യധാരാകവിതയിൽ കാണപ്പെടാത്ത ഒരു പുതിയ അനുഭവലോകം ഇത്തരത്തിൽ സൃഷ്ടിക്കുക വഴി ആവിഷ്കാരത്തിന്റെ പുത്തനീടമായി മാറുകയാണ് ബ്ലോഗ് കവിത.

## റഫറൻസ്

1. കെ.സച്ചിദാനന്ദൻ, 2010 ഓഗസ്റ്റ്, നാലാമിടം- ബ്ലോഗ് കവിതകളുടെ ലോകം, അകം മാസിക, പു. 48.
2. <http://www.manojkuroor2.blogspot.com>
3. <http://www.pramadam.blogspot.com>
4. പ്രമോദ് കെ.എം. 2000, ബാർബർ കണ്ണേൻ, അടിയന്തരാവസ്ഥ നഷ്ടപ്പെടുത്തിയ ആറു വർഷങ്ങൾ, തൃശ്ശൂർ, കറന്റ് ബുക്സ്, പു.13.
5. <http://www.lapuda.blogspot.com>
6. പ്രമോദ് കെ.എം. 2009, ലഘുഅടിയന്തരാവസ്ഥ നഷ്ടപ്പെടുത്തിയ ആറു വർഷങ്ങൾ, തൃശ്ശൂർ, കറന്റ് ബുക്സ്, പു.25.
7. സുധീഷ് കോട്ടേമ്പ്രം, 2010. ജൂൺ 18, ചെങ്കണ്ണിന്റെ സാധ്യതകൾ, മലയാളം വാരിക, പു. 57.

•

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by  
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## ഉള്ളടക്കം

നവമാധ്യമങ്ങൾ : സാഹിത്യം, സംസ്കാരം, രാഷ്ട്രീയം ഡോ. എ.എസ്. പ്രതീഷ്	1
നവമാധ്യമങ്ങളുടെ ആഖ്യാനരീതികൾ ഡോ. ടി. ജിതേഷ്	7
അനുഭവങ്ങളുടെ ലിങ്കുകൾ ഡോ. ഒ.കെ. സന്തോഷ്	13
നവമാധ്യമങ്ങൾ : വിനിമയ ജനാധിപത്യത്തിന്റെ തുറസ്സുകൾ ഡോ. ആർ.എസ്. ജയ	21
സിനിമ : വിവർത്തനത്തിന്റെ നവമാധ്യമധർമ്മം ഡോ. വത്സലൻ വാതുശ്ശേരി	25
ഇ-വായനയുടെ ഇടങ്ങൾ മലയാളസാഹിത്യത്തിൽ ഡോ. എം.എസ്. സുചിത്ര	36
സിറ്റിസൺ ജേണലിസം : സാധ്യതകളും പരിമിതികളും ഡോ. ആർ. രാജേഷ്	42
നവമാധ്യമങ്ങൾ : ഒരു രാഷ്ട്രീയ പ്രചരണോപാധി ഡോ. എസ്. ജയൻ	47
സൈബറും ഫിക്ഷനും ഡോ. ഡി. വി. അനിൽകുമാർ	51
ഫെയ്സ്ബുക്ക് : ആത്മരതിയുടെ വെളിയിടം ഡോ. എസ്. അജയശ്ലോഷ്	58
എസ്.എം.എസ് : ഭാഷയുടെ പാരമ്പര്യനിഷേധം കിരൺ മോഹൻ എം.	65
അധികാരത്തിന്റെ പ്രയോഗവും സംസ്കാരവും നവമാധ്യമങ്ങളിൽ രമ്യ ആർ.	72
നവമാധ്യമങ്ങളും മൂല്യസങ്കല്പങ്ങളും ജോൺ എം.പി.	77

✓ നവമാധ്യമങ്ങളിലെ ഭാഷാസമീപനം <u>പെട്രീഷ്യ ജോൺ</u>	82
നവമാധ്യമങ്ങളുടെ സ്വാധീനം മലയാളകവിതയിൽ ആര്യരാജ് ആർ.	86
സാംസ്കാരികവിമർശനം ബ്ലോഗുകവിതകളിൽ രഞ്ജുദേവി ആർ.	90
ഇ-മെയിൽ : വ്യവഹാരത്തിന്റെ സ്വരൂപവും വിനിമയരീതിയും ശ്രീല എസ്.	95
നവമാധ്യമസംസ്കാരവും പരസ്യങ്ങളും ശരജ ആർ.	98
നവമാധ്യമങ്ങളും കേരളീയരുടെ സംസ്കാരവും മെർലിൻ ജോൺ	102
✓ മലയാളം ബ്ലോഗുകവിതകൾ : എഴുത്തിന്റെ നൂതനതലങ്ങൾ <u>രാജി ജെ.</u>	108
ഇ-വായനയുടെ ഇടങ്ങൾ മലയാളസാഹിത്യത്തിൽ രാഖി ആർ.	113
സൈബർ വ്യവഹാരത്തിലെ മലയാളസാന്നിധ്യം ലത വി.	118
മതേതരത്വം സൈബറിടത്തിൽ സജി കരിങ്ങോല	123

# നവമാധ്യമങ്ങളിലെ ഭാഷാസമീപനം

പ്രൊഫ. ജോൺ

വാതു, ജലം, ഭാഷ എന്നിങ്ങനെയുള്ള മാധ്യമങ്ങളിൽ സംസ്കാര വാഹിയായ മാധ്യമമാണു ഭാഷ. സംസ്കാരത്തിന്റെ വിനിമയോപാധികളിൽ ഒന്നാണിത്. അച്ചടി മാധ്യമങ്ങളായ പത്രമാസികകൾ, ശ്രാവ്യമാധ്യമമായ റേഡിയോ, ദൃശ്യ-ശ്രാവ്യ മാധ്യമങ്ങളായ ടെലിവിഷൻ, സിനിമ, ഇന്റർനെറ്റ് എന്നിങ്ങനെ സംസ്കാരത്തിന്റെ നിലനിൽപ്പിനും പോഷണത്തിനും സഹായകമായവയിൽ ഭാഷ എങ്ങനെ കൈകാര്യം ചെയ്യുന്നു എന്നന്വേഷിക്കേണ്ടത് അത്യവശ്യമാണ്.

നവമാധ്യമങ്ങളിലെ ഭാഷ നിർമ്മിക്കുന്നതും ഉപയോഗിക്കുന്നതും മനുഷ്യനാണ്. ഭാഷ എന്നു പൊതുവായി പറയുമ്പോൾ ഈ ഭാഷയിൽ ആംഗലഭാഷയും വാചികഭാഷയും ഇലക്ട്രോണിക് ഭാഷയും ലിപിയാൽ നിബന്ധിക്കുന്ന ഭാഷയും ഉണ്ട്. ഇവ എല്ലാ മാധ്യമങ്ങൾക്കും ബാധകമല്ല. സാങ്കേതികവിദ്യ ഇന്നു വളരെയേറെ മുന്നോട്ടു പോവുകയും മനുഷ്യന്റെ സമസ്തമേഖലകളിലും മുദ്രപതിപ്പിക്കുകയും ചെയ്യുന്ന ഈ കാലഘട്ടത്തിൽ ഭാഷയ്ക്കും അതിൽ നിന്നും രക്ഷപ്പെട്ടു നിൽക്കാൻ സാധ്യമല്ല. ഐ.ടി രംഗത്തുണ്ടാകുന്ന ചലനങ്ങൾ ഭാഷയെ എങ്ങനെ നിർണയിക്കുമെന്നും തിരിച്ച് ഭാഷയുടെ ശരിയായ പ്രയോഗം ഐ.ടി.യുടെ പുരോഗതിക്ക് എങ്ങനെയാക്കെ നിർണായകമാണെന്നും മറ്റുമുള്ള കാര്യങ്ങളിൽ അക്കാദമിക് സമൂഹത്തിന്റെ സജീവമായ ഇടപെടലുകൾ ആവശ്യമായിരിക്കുന്നു.

ഭാഷയുടെ കണ്ടുപിടിത്തത്തോടെയാണു മനുഷ്യൻ ആശയങ്ങളെ വ്യവസ്ഥാപിതമായി ക്രോഡീകരിക്കാൻ ആരംഭിച്ചത്. ലിപിയുടെ കണ്ടുപിടിത്തത്തോടെയാണ് ഈ ശേഖരണം വിപ്ലവകരമായി പരിവർത്തനപ്പെട്ടത്. ഈ തലമുറയിലെ അറിവുകൾ സഞ്ചയിക്കുകയും രേഖപ്പെടുത്തുകയും മറ്റൊരു തലമുറയിലേക്ക് ലിപിയിലൂടെ പകർന്നുനൽകുകയും ചെയ്യുന്നതിലൂടെ സംസ്കൃതിയുടെ പ്രവാഹമാണു സംഭവിക്കുന്നത്. ഏതു ടെക്നോളജിയുടെയും ശാസ്ത്രീയ സിദ്ധാന്തങ്ങളുടെയും അടിസ്ഥാനങ്ങൾ നിർധാരണം ചെയ്യാനുള്ള ആശയപരവും അടയാളപരവുമായ മേഖലയൊരുക്കുന്നതു ഭാഷയാണ്.

ജനപ്രിയമായ മാധ്യമമായ ടെലിവിഷനിൽ ഭാഷ രണ്ടുവിധത്തിൽ പ്രേക്ഷകനോടു സംവദിക്കുന്നു. ആംഗലഭാഷയായും വാമൊഴിയായും. വേണമെങ്കിൽ ശരീരഭാഷ (Body language) എന്ന് മൂന്നാമതൊരു വിഭാഗം കൂടി കൽപ്പിക്കാം. ഇവയെല്ലാം കൂടിച്ചേർന്നുള്ള ഒരു അഭ്യോസമാണിവിടെ നടക്കുന്നത്. വാമൊഴിയിൽ ഒരു കാലഘട്ടം വരെ പ്രാധാന്യത്തോടെ നിലനിന്നിരുന്നുവുള്ളവനാടൻ ഭാഷയായിരുന്നു. ഇന്ന് ആ രീതിക്കു മാറ്റം വന്നിരിക്കുന്നു. ആകെ കുറുക്കിയും വലിച്ചുനീട്ടിയും ഒടിച്ചുടക്കിയും ഒരു സങ്കര ശരീരചലനങ്ങളും അകമ്പടി സേവിക്കുന്നു. വ്യത്യസ്തമായ വാമൊഴിയും എന്നാൽ ടെലിവിഷൻ ചാനലുകളിൽ അവതാരകരായ ആളുകളും നിർമ്മാതാക്കളും ഒരു നിർബന്ധം പോലെ, മുൻവിധിപോലെ പുതിയ പുതിയ പ്രയോഗങ്ങളും വാക്കുകളും അന്വേഷിച്ചു കണ്ടുപിടിക്കുന്നു. ചിലവ സ്വന്തമായി സൃഷ്ടിക്കുന്നു. ഇവിടെ വ്യത്യസ്തത (Variety)യാണ് പ്രധാനം. നാലു വയസുള്ള കുട്ടിയിൽ തുടങ്ങുന്നു ഈ വ്യത്യസ്തതയുടെ അന്വേഷണം. ടെലിവിഷൻ ചാനലുകളിൽ ഇങ്ങനെ ഭാഷാ കസർത്തുകൾ ഏറെയാണെങ്കിലും ദൂരദർശനിൽ അത്രകണ്ട് ഇത് വേരുന്നിയിട്ടില്ല (ഗവൺമെന്റ് സ്ഥാപനമായതിനാൽ ആയിരിക്കാം). ചാനലുകളിൽ പ്രൈം ടൈം പരിപാടികൾ അരങ്ങു തകർക്കുമ്പോൾ ദൂരദർശനിൽ അപ്പോഴും വീട്ടുവിശേഷമായിരിക്കും പ്രധാനപരിപാടി. ഉച്ചാരണത്തിലും പ്രയോഗത്തിലുമുള്ള ഭാഷ/ഭാഷണവൈകല്യങ്ങളെ വ്യത്യസ്തതയോടെ പ്രണേതാക്കൾ പ്രോത്സാഹിപ്പിക്കുന്നു. അതിനുശേഷം മാധ്യമങ്ങളിലെ ഭാഷാ പ്രശ്നങ്ങളെ സംബന്ധിക്കുന്ന ടോക്‌ഷോകൾ (Talk Show) ഇവർ തന്നെ സംഘടിപ്പിക്കുന്നു. മാത്രവുമല്ല ഇവർ തന്നെ മലയാളഭാഷയുടെ ശ്രേഷ്ഠ പദവിക്കായി വാദിക്കുന്നു. വിമർശനങ്ങൾ നടത്തുന്നു- ശിക്ഷിതാക്കളും രക്ഷിതാക്കളും ഒരേ വിഭാഗങ്ങൾ തന്നെ.

മാനകഭാഷയാണ് പത്രങ്ങളിൽ ഉപയോഗിക്കുന്നത് എന്നാണ് പൊതുവെയുള്ള വിശേഷണം. ഇതിലെ ഭാഷ വരമൊഴിയാണ്. അക്ഷരങ്ങളിലൂടെ വാർത്തകൾ ജനമനസ്സിലെത്തുന്നു. കാലോചിതമായ വ്യത്യാസങ്ങൾ പത്രമാധ്യമങ്ങളിൽ കടന്നുകൂടിയിട്ടുണ്ട്. ലിപിയിലും ഭാഷാഘടനയിലും ഇത് ദൃശ്യമാണ്. പുതിയ പുതിയ പ്രയോഗങ്ങളും ഭാഷയിൽ കടന്നുകൂടിയിരിക്കുന്നു. പുസ്തകച്ചന്ത, പെൺവാണിഭം, സ്ത്രീപിഡനം, പിഡനം എന്നിവ ഉദാഹരണങ്ങളാണ്. കർത്തരിപ്രയോഗമാണ് മലയാളഭാഷാ സ്വഭാവമെങ്കിലും പത്രഭാഷയിൽ 'ചെയ്യപ്പെട്ടു കൊടുക്കപ്പെട്ടു' എന്നിങ്ങനെയുള്ള കർമ്മനിപ്രയോഗവും കാണാൻ കഴിയും. അക്ഷരത്തരുകളും വാക്കുത്തരുകളും ഇന്ന് പുതുമയല്ലാതായിക്കഴിഞ്ഞിരിക്കുന്നു.

ഇന്റർനെറ്റിന്റെ വ്യാപനത്തോടെ വിവര-വിജ്ഞാന-മേഖലയിൽ വീച്വൽ തന്നെ സംഭവിച്ചിരിക്കുന്നു. വിവരവിനിമയ സാങ്കേതികവിദ്യ ആരംഭിച്ചുകാലത്ത് ഭാഷാപരമായ ആശങ്കകൾ ഏറെയായിരുന്നു. ഇന്റർനെറ്റിന്റെ ഭാഷയായി ഇംഗ്ലീഷ് വളർന്നുവന്ന് സാംസ്കാരിക സാമ്രാജ്യത്വം ഉണ്ടാക്കിയെടുക്കുമോ എന്ന് ഒരു കൂട്ടർ ഭയപ്പെട്ടു. എന്നാലും ലോകത്ത് വളരെക്കുറച്ച് ആളുകൾ മാത്രം സംസാരിക്കുന്ന മലയാളം പോലെയുള്ള ഭാഷകളും ഇന്റർനെറ്റിന്റെ ഭാഷകളിലൊന്നായി വളർന്നുവരുന്ന കാഴ്ചയാണിന്ന്. കാണുന്നത്. ബ്ലോഗിലൂടെയുള്ള ആശയവിനിമയത്തിന്റെ കാലമാണിത്. സ്വന്തം ഭാഷയിൽ എഴുതുമ്പോൾ ലഭിക്കുന്ന സംതൃപ്തിയും മാതൃഭാഷയോടുള്ള സ്നേഹവും ബ്ലോഗിൽ എഴുതുന്നവർ അനുഭവിക്കുന്നു. കുറച്ചു കാലം മുൻപുവരെ മലയാളത്തിലൂടെ കമ്പ്യൂട്ടറിൽ ആശയവിനിമയം നടത്തുകയെന്നത് നമ്മുടെ വെറുമൊരു ആഗ്രഹം മാത്രമായിരുന്നു. മലയാളം കമ്പ്യൂട്ടിങ്ങിലൂടെ മലയാളികൾക്ക് സ്വന്തം ഭാഷയിൽ കമ്പ്യൂട്ടർ ഉപയോഗിക്കുന്നതിനുള്ള പ്രാപ്തിയുണ്ടായിരിക്കുന്നു. സോഷ്യൽ മീഡിയ നെറ്റ് വർക്കുകളിലൂടെ ആളുകൾക്ക് സ്വന്തം ഭാഷയിൽ രചനകൾ നടത്തുവാനും ആവശ്യംപോലെ വിതരണം ചെയ്യുവാനും ഇന്ന് സാധിക്കും.

പ്രധാന പത്രമാധ്യമങ്ങൾക്കെല്ലാം ഇത്തരത്തിലുള്ള നെറ്റ് വർക്കുകൾ ഉണ്ട്. ഫെയ്സ്ബുക്കിലും മറ്റ് സോഷ്യൽ നെറ്റ് വർക്കുകളിലും കാണുന്ന തുപോലെയുള്ള ഭാഷയും പ്രയോഗവുമാണ് നമുക്ക് പത്രമാധ്യമങ്ങളുടെ സൈറ്റുകളിലും കാണാൻ കഴിയുന്നത്. ഇത് ആശയസംവേദനം വളരെ വേഗത്തിലാ (ചുരുക്കിയെഴുതിയും കോഡുകൾ ഉപയോഗിച്ചും) ക്കുന്നു. സോഷ്യൽ നെറ്റ് വർക്കുകളിൽ നിരവധി സൃഷ്ടികൾ ചേർക്കുന്നതുകൊണ്ട് ഭാഷയുടെ സ്വതന്ത്രവിഹാരത്തെ അത് പൃഷ്ടിപ്പെടുത്തുകയേ ചെയ്യുകയുള്ളൂ.

**ഉപസഹാരിം**

നവമാധ്യമരംഗം പാണ്ഡിത്യത്തിൽ നിന്നുമാറി സാധാരണക്കാരുടെ ഭാഷയിൽ സംവദിക്കാനുള്ള തീവ്രശ്രമമാണ് നടത്തുന്നത്. ലളിതമായ ഭാഷയിൽ ഇത് ആശയങ്ങളെ കൈകാര്യം ചെയ്യാനാണ് ശ്രമിക്കുന്നത്. എല്ലാതരം ആളുകളെയും നവമാധ്യമരംഗം ഉൾക്കൊള്ളിക്കാൻ (രൂപരേഖ പങ്കാളിത്തം) ശ്രമിക്കുന്നു എന്നതാണ് ഗുണം. എന്നാൽ മലയാളഭാഷയുടെ സ്വാഭാവികമായ സൗന്ദര്യം, പ്രൗഢമായ പദസമ്പത്ത്, ഗരിമ എന്നിവയെല്ലാം നഷ്ടപ്പെടാതെ നോക്കേണ്ടതുണ്ട്. നവമാധ്യമങ്ങൾ ഇംഗ്ലീഷിന് വളരെയധികം പ്രാധാന്യം കൊടുക്കുന്നു. അവ സാങ്കേതികവിദ്യയുടെ അതിപ്രസരണം കൊണ്ടും സാങ്കേതികപദങ്ങളുടെ ബാഹുല്യം കൊണ്ടും ഭാഷയെ നവീകരിക്കാൻ ശ്രമിക്കുന്നു. സോഷ്യൽ നെറ്റ് വർക്കുകളെപ്പോലെ നവമാധ്യമഭാഷയിലും എഡിറ്റർ ഇല്ല. അതുകൊണ്ടുതന്നെ ഏഴുത്തുകാർക്ക് സ്വതന്ത്രമായി തങ്ങളുടെ

സൃഷ്ടികൾ പോസ്റ്റ് ചെയ്യാൻ സാധിക്കുന്നു. മലയാളഭാഷയുടെ തനതു ചൈതന്യം/ശക്തിപ്രൗഢി എന്നിവയെല്ലാം കാത്തുസൂക്ഷിച്ചു കൊണ്ട് നവമാധ്യമരംഗം പുരോഗതിയിലേക്ക് കുതിച്ചു കൊണ്ടിരിക്കുന്നു.

**സഹായക ഗ്രന്ഥങ്ങൾ**

1. ആദർശ് വി.കെ. - ഇനിവായന ഇ-വായന, ഡി.സി. ബുക്സ് - 2011 (ഇക്ബാൽ ബി. ജനറൽ എഡിറ്റർ).
2. എ.ബി.പി. ജോയ് - പത്രപ്രവർത്തകനായ ഗാന്ധിജി (പാഠം) മാതൃഭൂമി ബുക്സ്, 2013.
3. കമൽനാമ സജീവ് - ആഞ്ഞുകൊത്തുന്ന അനുഭവങ്ങൾ, ഒലിവ് പബ്ലിക്കേഷൻ, 2013.
4. രാമചന്ദ്രൻ നായർ പന്ത പ്രൊഫ. - മാധ്യമ പഠനങ്ങൾ (പി.കെ. പരമേശ്വരൻ നായർ സ്മാരക ഗ്രന്ഥാവലി) കറന്റ് ബുക്സ്-2013.
5. സുനിത റ്റി.വി. (എഡിറ്റർ) - സൈബർ മലയാളം, കറന്റ് ബുക്സ്, തൃശ്ശൂർ-2010.

# നവമാധ്യമങ്ങൾ സാഹിത്യം • സംസ്കാരം • രാഷ്ട്രീയം



കേരള ഭാഷാ ഇൻസ്റ്റിറ്റ്യൂട്ട്

FOLLOW



ഡോ. എം.ആർ. കെ.കെ.



ഡോ. എ.എസ്. പ്രതീഷ്

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## ഉള്ളടക്കം

നവമാധ്യമങ്ങൾ : സാഹിത്യം, സംസ്കാരം, രാഷ്ട്രീയം ഡോ. എ.എസ്. പ്രതീഷ്	1
നവമാധ്യമങ്ങളുടെ ആഖ്യാനരീതികൾ ഡോ. ടി. ജിതേഷ്	7
അനുഭവങ്ങളുടെ ലിങ്കുകൾ ഡോ. ഒ.കെ. സന്തോഷ്	13
നവമാധ്യമങ്ങൾ : വിനിമയ ജനാധിപത്യത്തിന്റെ തുറസ്സുകൾ ഡോ. ആർ.എസ്. ജയ	21
സിനിമ : വിവർത്തനത്തിന്റെ നവമാധ്യമധർമ്മം ഡോ. വത്സലൻ വാതുശ്ശേരി	25
ഇ-വായനയുടെ ഇടങ്ങൾ മലയാളസാഹിത്യത്തിൽ ഡോ. എം.എസ്. സുചിത്ര	36
സിറ്റിസൺ ജേണലിസം : സാധ്യതകളും പരിമിതികളും ഡോ. ആർ. രാജേഷ്	42
നവമാധ്യമങ്ങൾ : ഒരു രാഷ്ട്രീയ പ്രചരണോപാധി ഡോ. എസ്. ജയൻ	47
സൈബറും ഫിക്ഷനും ഡോ. ഡി. വി. അനിൽകുമാർ	51
ഫെയ്സ്ബുക്ക് : ആത്മരതിയുടെ വെളിയിടം ഡോ. എസ്. അജയലോഷ്	58
എസ്.എം.എസ് : ഭാഷയുടെ പാരമ്പര്യനിഷേധം കിരൺ മോഹൻ എം.	65
അധികാരത്തിന്റെ പ്രയോഗവും സംസ്കാരവും നവമാധ്യമങ്ങളിൽ രമ്യ ആർ.	72
നവമാധ്യമങ്ങളും മൂല്യസങ്കല്പങ്ങളും ജോൺ എം.പി.	77

നവമാധ്യമങ്ങളിലെ ഭാഷാസമീപനം ചെട്ടിഷ്യ ജോൺ	82
നവമാധ്യമങ്ങളുടെ സ്വാധീനം മലയാളകവീതയിൽ ആര്യരാജ് ആർ.	86
സാംസ്കാരികവിമർശനം ബ്ലോഗുകളിലെ രഞ്ജിതദേവി ആർ.	90
ഇ-മെയിൽ : വ്യവഹാരത്തിന്റെ സ്വരൂപവും വിനിമയരീതിയും ശ്രീല എസ്.	95
നവമാധ്യമസംസ്കാരവും പരസ്യങ്ങളും ശരജ ആർ.	98
നവമാധ്യമങ്ങളും കേരളീയരുടെ സംസ്കാരവും മെർലിൻ ജോൺ	102
മലയാളം ബ്ലോഗുകളിലെ എഴുത്തിന്റെ നൂതനതലങ്ങൾ രാജി ജെ.	108
ഇ-വാചനയുടെ ഇടങ്ങൾ മലയാളസാഹിത്യത്തിൽ രാജി ആർ.	113
സൈബർ വ്യവഹാരത്തിലെ മലയാളസാന്നിധ്യം ലത വി.	118
മതേതരത്വം സൈബറിനടിയിൽ സജി കരിങ്ങോല	123

## നവമാധ്യമങ്ങൾ : സാഹിത്യം, സംസ്കാരം, രാഷ്ട്രീയം

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വിവരസാങ്കേതികപഠനങ്ങൾക്കും അറിവിനും വിനോദത്തിനും പ്രാധാന്യം നൽകുകയും അതിനായി ശ്രമം നടത്തുകയും ചെയ്യുന്നവരാണ് നവമാധ്യമങ്ങൾ. ഇതിൽ ഗാസ്ട്രസാങ്കേതികരംഗത്തെ അത്യുൽഭൃതകരമായ മാറ്റങ്ങൾ പ്രകടമാണ്. നവമാധ്യമങ്ങൾ സാഹിത്യത്തിലും സംസ്കാരത്തിലും രാഷ്ട്രീയത്തിലും സൃഷ്ടിച്ച ധാർമികതാബോധത്തെ കുറിച്ചും നിതിബോധത്തെ കുറിച്ചും നിരവധി ചർച്ചകൾ ഉണ്ടായിട്ടുണ്ട്. എന്നാൽ, ഇവയുമായി ബന്ധപ്പെട്ട സർഗാത്മകമായ വിമർശനങ്ങളൊന്നും കാര്യമായി ഉണ്ടായിട്ടില്ല. ഉള്ളവയാകട്ടെ, നവമാധ്യമങ്ങളെ കുറിച്ച് ഉപരിതല സ്പർശിയായ പഠനങ്ങളിൽ ഒതുങ്ങിപ്പോവുകയും ചെയ്തു. ഈ സാഹചര്യത്തിൽ ഇന്റർനെറ്റ്, മൊബൈൽഫോൺ തുടങ്ങിയ നവമാധ്യമങ്ങൾ സമൂഹത്തിന്റെ വ്യത്യസ്ത തലങ്ങളിൽ ചെലുത്തുന്ന സാധിനതകളെ കുറിച്ച് ഗൗരവമായി പഠനവിധേയമാക്കേണ്ടിയിരിക്കുന്നു. ബഹുജന മാധ്യമങ്ങൾ അധികാരത്തിന്റെ ഒരു പ്രസാതസ്ഥായി പരിണമിച്ചിരിക്കുന്ന വർത്തമാനകാലത്തിൽ അതിന്റെ പാഠപ്രശ്നം കൂടുതൽ സൂക്ഷ്മമായും വിമർശനാത്മകമായും നിർവഹിക്കപ്പെടേണ്ടതുണ്ട്. നവമാധ്യമങ്ങളുടെ സ്വാധീനത്തിൽനിന്നും ഉപയോഗത്തിൽനിന്നും അകന്നു നിൽക്കുന്നവർക്ക് വർത്തമാനകാലസമൂഹത്തിലും അവസ്ഥയിലും അസ്തിത്വം തന്നെ ഇല്ലാതാകുന്നു. അതിനാൽ പുതുതലമുറയുടെ ഈ മാധ്യമസ്വഭാവം മനസ്സിലാക്കേണ്ടത് വർത്തമാനകാലത്തിന്റെ ആവശ്യം കൂടിയായി മാറുന്നു.

ജീവിതത്തിന്റെ സമസ്തമേഖലകളുമായി ബന്ധപ്പെട്ടുനിൽക്കുകയാണ് നവമാധ്യമങ്ങൾ. ദീർഘസമയമാണ് പുതുതലമുറ ഇത്തരം മാധ്യമങ്ങൾക്കായി ചെലവഴിക്കുന്നത്. ഭൗതികചിന്തകളിലും സംവാദങ്ങളിലും നവമാധ്യമങ്ങളുടെ സ്വാധീനം നിർണായകമായിത്തീർന്നിരിക്കുന്നു. പത്രമാധ്യമങ്ങൾ വാർത്തകളുടെ സൃഷ്ടികളിലും അതിന്റെ വിനിമയത്തിലും തൃപ്തിപ്പെടുന്നതാണെങ്കിൽ നവമാധ്യമങ്ങൾ വാർത്തകളോടൊപ്പം ഒരു ആശയവിനിമയ മാധ്യമമെന്ന നിലയിൽ കൂടി വികാസം പ്രാപിച്ച ഒരു മാധ്യമരൂപമാണ്. ഈ സാഹചര്യത്തിലാണ് മാർഷൽ മക്ലൂഹന്റെ മാധ്യമം

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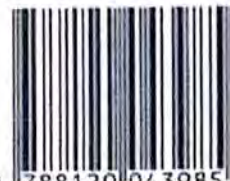
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# CONTENTS

<i>Preface</i>	<i>vii</i>
<i>Abbreviations</i>	<i>ix</i>
<i>Introduction</i>	<i>xv</i>
<b>Brain and Behaviour</b>	<b>1-34</b>
❖ Neuroscience – Techniques in neurophysiology – CT SCAN – Magnetic Resonance Imaging (MRI) – fMRI – Positron Emission Tomography (PET) – rCBF – EEG – Lesioning and stimulation – The Neuron – Function and type of neuron – Saltatory propagation – Nerve fibre – Nerve impulse – Action potential – All or none law – Synapse – Synaptic transmission – Properties of a synapse – Central Nervous System – Brain – Forebrain – Mid brain – Hind brain – Ventricles of brain – Functions of major parts of brain – Spinal cord – Anatomy of reflex – Physiology of reflex – The Reflex action – Blood brain barrier – Peripheral nervous system (PNS) – Autonomous Nervous System (ANS) – Sympathetic Nervous System (SNS) – Para Sympathetic Nervous System (PSNS) – Emergency theory – Para Sympathetic Nervous System effect (PNS effect) – Polygraph – Neurotransmitters and drug action – Neuropeptides – Psycho Active drugs – Types of drugs – Asymmetry in Human brain – The theory of localization – Wernicke's and Broca's area	
<b>Biological basis of Sensory Processes</b>	<b>35-93</b>
❖ Visual system – Hue, saturation, and brightness – Structure of eye – The retina – Functioning of eye – Visual pathways – Visual defects – Myopia (short sight) – Hyperopia (Long sight) – Astigmatism – Presbyopia – Transduction in the retina – Theories of colour vision – Auditory system – Ear – Coding of auditory information – Theories of audition – The Resonance or Place Theory – The Frequency Theory – Volley theory – Nature of sound – Intensity of sound – Loudness – Pitch – Frequency – Ultrasound – Infra sound – Amplitude – Receptor organs – Chemoreceptor – Gustatory receptors – Taste bud – Taste papillae – Taste reception – Neural pathway of coding for taste – Olfactory system – Olfactory receptors – Mechanism of olfactory coding and perception – Categorisation of odours – Interaction of olfaction and taste – Olfactory disorders – Cutaneous system – Ruffini's end organ (skin stretch) – End-bulbs of Krause (Cold) – Meissner's corpuscle (changes in texture, slow vibrations) – Pacinian corpuscle (deep pressure, fast vibrations) – Merkel's disc (sustained touch and pressure) – Free nerve endings – Thermoreceptor – Nociceptors – Proprioception - kinesthetics – Applications – NEURAL CODING – Types of pain – Stimulation produced analgesia (SPA) – Ascending and Descending Pain Suppression Mechanism	

**Physiology and Motivation**

94-145

- ❖ Types of Motives: – Biological Motivation and Homeostasis – I) Physiological Motives: – II) Social Motives: – III) Personal Motives: – Unconscious motivation: – Neural mechanism – Sleep disorders – Physiological Basis of eating – Feeding Centers in Brain – The Dual Center Hypothesis – Human digestive system – Digestive glands – Nervous and hormonal control and digestive activity – Regulation of food intake – Obesity – Mortality – Morbidity – Causes of obesity – Medical and Psychiatric illness – Not sleeping enough – Social determinants – Gut bacteria – Pathophysiology – Management – Dieting – Exercise – Weight loss programs – Medication – Surgery – SPECIFIC HUNGER – Physiological basis of drinking – OSMETRIC AND HYPOVOLEMIC THIRST – Increased osmolite concentration – REGULATING DRINKING BEHAVIOUR – Host Factors – Physiological Basis of Sexual Behaviour

**Physiology of emotion and cognition**

146-228

- ❖ Neural basis of emotion – Fear and rage – Aggression – The neural basis of feelings – Neural basis of pleasure – Frontal lobe – Hypothalamus – Thalamus – Amygdala – Hippocampus – Monoaminergic systems (serotonin, norepinephrine, dopamine) and emotions – Reticular activating system – FACIAL EXPRESSION AND RECOGNITION OF EMOTIONS – Bipolar disorder – Types of learning – Rote learning – Early learning discoveries – Functions of Corpus callosum – Physiology of memory – Retrospective and prospective memory – Chemical basis of Long Term Memory – Memory in brain damaged individuals – Anatomical stress – Physiology of stress – Adrenocorticotrophic hormone axis – Emotional arousal – Sexual arousal – Sexual arousal in woman – Sexual arousal in men – Perceptual arousal – Yerkes-Dodson Law (The Inverted-U Hypothesis) – Paradoxical sleep – Forgetting – Decay theory – Interference theory – Retrieval theory – Retrieval Failure Theory – Weak storage theory – Motivated forgetting – History – Amnesia – Types and causes of amnesia – Techniques to Improve Retention and Retrieval process – General techniques to improve memory – Healthy Habits that Improve Memory

**References**

229



## **BRAIN AND BEHAVIOUR**

Behaviour results from neural and chemical systems working together in the brain. Everything that goes on in the mind, the way we see, feel, remember and act, is constrained by the way the brain works. Mind, brain and behaviour focuses on the workings of the individual from a psychological perspective. It includes the details of neural components, constituting the brain, operation of sensory system, underlying interaction with the external environment and the cognitive processes that constructs the internal world experienced by the individual. Careful consideration will be given to the nature of the internal world and the importance of its relationship to the external world.

### **NEUROSCIENCE**

Neuroscience is the study of the brain and behaviour and it is a science and a practice. Neuroscience comprises the neuroanatomy, neurophysiology, brain functions and related physiological aspects. Neurobiological data provides physical evidence for a theoretical approach to the investigation of cognition. Behavioural neuroscience deals with the study of behaviour and its physiological correlation in the brain with the goal of understanding the neural mechanism. Neuroscientists studies on the behavioural mechanism techniques ranging from recording of activity in single neuron to imaging activity in the human brain. Psychological physiology is the branch of psychology concerned with the relationship with the physical functioning of the organism and its behaviour. It is a subdivision of behavioural neuroscience that studies the neural mechanism of perception and behaviour.

# PHYSIOLOGICAL PSYCHOLOGY

This text book, titled *Physiological Psychology*, covers the subject of 'brain and behaviour' which is a modular subject in many university courses. The authors attempt to help students to understand the biological concepts in other specialized fields that they will encounter in their studies—it is suitable for undergraduate college students as well.

The book is organised into four chapters. The first chapter covers the areas Brain and Behaviour, which includes techniques in neurophysiology, the neuron and its functions, Central Nervous System (CNS), Autonomous Nervous System (ANS), Sympathetic Nervous System (SNS), Para Sympathetic Nervous System (PSNS), neurotransmitters and drug action.

The second chapter deals with biological basis of sensory processes, which includes visual, auditory, gustatory, olfactory and cutaneous systems. The third chapter contains physiological basis of sleep, eating, drinking and sexual behaviour while the last chapter covers the areas of emotion, learning and memory.



**Sherly Williams E**

Sherly Williams E, Dean of Science and Associate Professor in Zoology, has a teaching experience of 20 years. The motive behind this book was her teaching involvement on the subject Physiological Psychology for the undergraduate Psychology students of the institution. She is an active researcher in the field of environmental toxicology, fish biology and aquaculture with a research experience of more than 25 years.

She has 75 publications in peer-reviewed journals, has undertaken and funded major research projects and is also the author of a book. She is an awardee of EET-CRS special mention award 2016 and Global Management Council – Adarsh Vidhya Rashtriya Puraskar 2017 for academic/research excellence.

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# വിവർത്തന താരതമ്യ പഠനത്തിലെ നൂതന പ്രവണതകൾ

ജനറൽ എഡിറ്റർ

ഡോ. ടി. അനിതകുമാരി

എഡിറ്റർ

ഡോ. മുഹമ്മദ് റാഫി എൻ. വി

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തുഞ്ചത്തെഴുത്തച്ഛൻ  
മലയാളസർവകലാശാല പ്രസിദ്ധീകരണം



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## ഉള്ളടക്കം

ആമുഖം	
വിവർത്തന - താരതമ്യ പഠനത്തിലെ നൂതന പ്രവണതകൾ - അവലോകനം	15 - 28
⇒ ഡോ. മുഹമ്മദ് റാഫി എൻ.വി	
താരതമ്യസാഹിത്യം: മൂലകങ്ങൾ, മനോധർമ്മങ്ങൾ	29 - 51
⇒ ഡോ. ദേശമംഗലം രാമകൃഷ്ണൻ	
സംവേദനവും മലയാളവും	52 - 62
⇒ ഡോ. സ്കറിയ സക്കറിയ	
താരതമ്യസാഹിത്യവും വിവർത്തനവും	63 - 70
⇒ ഡോ. ചാത്തനാത്ത് അച്യുതനുണ്ണി	
കാവ്യവും നാടകവും ചരിത്രവും ചലച്ചിത്രവും: ആശാനും ടാഗോറും അംബേദ്കറും അജയനും തേടുന്ന വിമോചനത്തിന്റെ പുതുപാതകൾ	71 - 82
⇒ ഡോ. അജയ് ശേഖർ	
താരതമ്യ- വിവർത്തന പഠനമേഖലയിലെ പുതിയ പ്രവണതകൾ	83 - 109
⇒ ഡോ. എം. ടി. അൻസാരി	

വിവർത്തനം മലയാളത്തിൽ ⇨ ഡോ. കെ എം ഷെറീഫ്	110 - 131
മറഞ്ഞിരിക്കുന്ന ഭാഷയിലും ആധുനിക ഭാഷയിലുമുള്ള രണ്ട് പുസ്തകങ്ങൾ ⇨ ഡോ. സൗമ്യദേവ്	132 - 150
താരതമ്യസാഹിത്യം, വിവർത്തനം: ചില സംസ്കാരവിമർശനചിന്തകൾ ⇨ ഡോ. അജു കെ. നാരായണൻ	151 - 167
പരിഭാഷകളിലെ കോളനി ⇨ ഡോ. ഉമർ തറമേൽ	168 - 177
തച്ചന്റെ കാവ്യാന്തരങ്ങൾ ⇨ ഡോ. സോമനാഥൻ പി.	178 - 199
ചിത്രവും ചലച്ചിത്രവും: ചില ചിഹ്നാന്തരതാരതമ്യവിചാരങ്ങൾ ⇨ ഡോ. ആർ. വി. എം. ദിവാകരൻ	200 - 215
അനുഭവങ്ങളുടെ സമാനതകൾ വ്യത്യസ്തതകൾ മലയാളത്തിലെയും തമിഴിലെയും ദളിത് കവിതകളെ അടിസ്ഥാനമാക്കി ചില നിരീക്ഷണങ്ങൾ ⇨ ഡോ. ഒ. കെ. സനോഷ്	216 - 225
കഥയിലെ നായയും ചേന്നപ്പറയനും ⇨ സജയ് കെ. വി	228 - 234
തിരക്കഥയുടെ ഭാഷാന്തരീകരണം ⇨ ഷിബു, ബി	235 - 248

വിവർത്തനവും ഡയർപൊറയുടെ ജീവിതവും ⇨ ഡോ. കെ. കെ. ശിവദാസ്	249 - 263
വൈജ്ഞാനിക സാഹിത്യവിവർത്തനം മലയാളത്തിൽ ⇨ ഡോ. സ്മിത കെ. നായർ	264 - 273
സുഫിസവും മലയാളസാഹിത്യവും ⇨ ഡോ. അബ്ദുൾ ഗഹ്ഫൂർ പി.	274 - 295
മതാധിനിവേശവും അനുഷ്ഠാനപാരമ്പര്യവും കുതിരയെടുപ്പ് അടിസ്ഥാനമാക്കി ഒരു താരതമ്യ അന്വേഷണം ⇨ സ്മിത ജി. നായർ	296 - 308
വിവർത്തനങ്ങളിലെ 'അഭിജ്ഞാനങ്ങൾ' ⇨ ഡോ. എം. ആർ. ഷെല്ലി	309 - 328
വിവർത്തനം- അധികാരം- കർതൃത്വം ജന്മാന്തരവാഗ്ദാനങ്ങളെ മുൻ നിർത്തിയുള്ള പഠനം ⇨ ധ്യാന വി.	329 - 343
മൂലപാഠം എന്ന സങ്കല്പനം: സ്വയംവിവർത്തനത്തിന്റെ വിഭിന്നധാരകളിൽ ⇨ ദിവ്യ ഒ. ഡി.	344 - 359
വിവർത്തനം: ഒരു സംക്ഷിപ്ത അവലോകനം ⇨ ഓബേദ് എബനേസർ എസ്.	360 - 372
മണിപ്രവാളകവിയും പ്രൊവാൻസാൽ കവിയും സമാന്തരതാപഠനം ⇨ അർച്ചന മോഹൻ	373 - 380

ആമുഖം

## വിവർത്തന - താരതമ്യ പഠനത്തിലെ നൂതന പ്രവണതകൾ - അവലോകനം

◆ മുഹമ്മദ് റാഫി എൻ.വി

താരതമ്യ- വിവർത്തന മേഖലകളിൽ നിലനിൽക്കുന്ന നൂതന പ്രവണതകളെ ചർച്ചക്കെടുക്കുന്ന ഇരുപതിൽപരം പ്രബന്ധങ്ങളുടെ സമാഹരണമാണ് ഈ പുസ്തകം. പ്രസ്തുത പഠന മേഖലയുമായി ബന്ധപ്പെട്ട് മലയാളസർവകലാശാല സംഘടിപ്പിച്ച ത്രിദിന ദേശീയ സെമിനാറിൽ അവതരിപ്പിക്കപ്പെട്ട പ്രബന്ധങ്ങളാണ് ഭൂരിഭാഗവും. വിവർത്തനത്തെയും താരതമ്യപഠനത്തെയും പ്രാഥമികമായിത്തന്നെ അന്വേഷിക്കുന്ന ചില വസ്തുതകൾ ആമുഖ പഠനത്തിൽ ഉൾപ്പെടുത്താൻ ഉദ്ദേശിക്കുന്നുണ്ട്. പ്രസ്തുത വിഷയങ്ങൾ മലയാളമാധ്യമത്തിൽ എം.എ, എം.ഫിൽ കോഴ്സുകൾക്ക് പഠിക്കുന്ന വിദ്യാർത്ഥികൾക്ക് ഉപകാരപ്പെടാൻ വേണ്ടിയാണ് ഇങ്ങനെയൊരു ഉദ്യമത്തിന് മുതിരുന്നത്. വിവർത്തനപഠനമേഖലയെ താരതമ്യ സാഹിത്യപഠനമേഖലയുടെ കൂടക്കീഴിലാക്കി അന്വേഷിക്കുന്ന പ്രവണത അതിന്റെ തുടക്കം മുതലേ രൂപപ്പെട്ടിരുന്നു. ആധുനികാനന്തര പഠനങ്ങളുടെയും അന്തർവൈജ്ഞാനിക മേഖലകളുടെയും ഇടപെടൽ വിവർത്തനപഠനത്തിന് സ്വതന്ത്രാസ്തിത്വം തന്നെ രൂപപ്പെടുന്നതിന് കാരണമായിത്തീർന്നിട്ടുണ്ട്. ഗായത്രി സ്പിവാക്ക് ചക്രവർത്തി, വാൾട്ടർ ബഞ്ചമിൻ, ഹോമിഭാഭ തുടങ്ങിയ ചിന്തകരുടെ സങ്കല്പനങ്ങൾ വിവർത്തനത്തെ സംബ



## വിവർത്തനങ്ങളിലെ 'അഭിജ്ഞാനങ്ങൾ'

◆ ഡോ. എം.ആർ.ഷെല്ലി

ഓരോ കൃതിയും നിയതാർത്ഥത്തിൽ ഓരോ വിവർത്തനമാണ്. മുമ്പേ നടന്നുപോയ ഒരേഴുത്തുകാരനെ ഏതെങ്കിലുമൊക്കെ അംശത്തിൽ പ്രദക്ഷിണം ചെയ്യാതെ ഒരു കൃതിയും ഇവിടെ സ്വതന്ത്രമായി പിറന്നു വീഴുന്നില്ല. ഈ യാഥാർത്ഥ്യം അംഗീകരിക്കുകയാണെങ്കിൽ ആദികാവ്യമൊഴികെ സാഹിത്യ ഗ്രന്ഥങ്ങളെല്ലാം തന്നെ വിവർത്തന വേഷം സ്വീകരിച്ച പ്രച്ഛന്നരൂപികളാണെന്നു പറയേണ്ടി വരും. അപ്പോൾ സ്വതന്ത്രകൃതികൾ, വിവർത്തനകൃതികൾ എന്നീ വേർതിരിവിന് എന്തു പ്രസക്തിയെന്ന സന്ദേഹമുയരുന്നു. ഈ സന്ദേഹമാണ് വിവർത്തന ചിന്തകളെ മറ്റൊരു അർത്ഥഭൂമികയിൽ പ്രതിഷ്ഠിക്കാനുള്ള ശ്രമങ്ങൾക്കു ജീവൻ വയ്പിക്കുന്നത്. "അർത്ഥം നിലനിറുത്തിക്കൊണ്ട് മറ്റൊരു ഭാഷയിലേക്കുള്ള മാറ്റം" എന്നുള്ള ഡോ. ജോൺസന്റെ പരിഭാഷാനിർവ്വചനം മുതൽ "സ്രോതഭാഷയിൽ ആവിഷ്കരിക്കപ്പെട്ട ആശയങ്ങളെ ഏറ്റക്കുറച്ചിൽ കൂടാതെ ലക്ഷ്യ ഭാഷയ്ക്കിണങ്ങും വിധം ആവിഷ്കരിക്കുകയെന്ന' ഏറെക്കുറെ അംഗീകരിക്കപ്പെട്ട വിവർത്തന നിർവ്വചനം വരെ ഈ സന്ദേഹത്തിന്റെ ഫലമായി ഉടലെടുത്തവയാണ്. ഏതെങ്കിലും ഒരു അംശത്തെയല്ല, സമഗ്രതയെത്തന്നെ സ്വാംശീകരിക്കലും ഭാഷാന്തരണം ചെയ്യലുമാണു വിവർത്തനം എന്നു വരുന്നതോടുകൂടി ആദ്യത്തെ കാഴ്ചപ്പാടു മാറ്റിവെച്ചുകൊണ്ട് എല്ലാ കൃതികളും വിവർത്തനങ്ങളല്ല എന്നും പറയേണ്ടി വരുന്നു ഈ തിരിച്ചറിയലാണു ഗൗരവതരമായ വിവർത്തന ചിന്തകൾക്കു തുടക്കം



# വിവർത്തന താരതമ്യ പഠനത്തിലെ നൂതന പ്രവണതകൾ

ജനറൽ എഡിറ്റർ / ഡോ. ടി. അനിതകുമാരി  
എഡിറ്റർ / ഡോ. മുഹമ്മദ് റാഫി എൻ. വി

വിവർത്തനത്തിന്റെ ചരിത്ര സൂചനകൾ മുതൽ താരതമ്യ പഠനത്തിന്റെ വർത്തമാനകാല സാഹചര്യം വരെ ചർച്ച ചെയ്യുന്ന പ്രബന്ധ വൈവിധ്യം തീർച്ചയായും അക്കാദമിക്-ഗവേഷണ താല്പര്യങ്ങളെ പരിരക്ഷിക്കുന്നതാണ്. മലയാള സർവകലാശാല കേരളത്തിന്റെ വൈജ്ഞാനിക മണ്ഡലത്തിൽ സജീവമായി ഇടപെടുന്നതിന്റെയും ജ്ഞാനോല്പാദന പ്രക്രിയ നിർവ്വഹിക്കുന്നതിന്റെയും ധീരമായ സൂചനകളാണിവിടെ പ്രകടമാകുന്നത്. തീർച്ചയായും വിവർത്തന പ്രക്രിയയിലൂടെയും താരതമ്യപഠനത്തിലൂടെയും സാംസ്കാരിക വിനിമയത്തിന്റെ വലിയ തുറസ്സുകൾ സാധ്യമാവുന്നു. ഓരോ ജനസമൂഹത്തിന്റെയും സാംസ്കാരിക സവിശേഷതകൾ വിവർത്തന-താരതമ്യ പഠനങ്ങളിലൂടെ വിനിമയം ചെയ്യുന്നതിലൂടെ പ്രാദേശിക സ്വത്വ സംസ്കൃതിയുടെ സൂക്ഷ്മ വായനകൾക്ക് അവസരമൊരുങ്ങുന്നുവെന്നത് സുപ്രധാനമായ സംഗതിയാണ്.

 <p>9 788193 745816</p>		<p>താരതമ്യ വിവർത്തന പഠനത്തിലെ നൂതന പ്രവണതകൾ ജനറൽ എഡിറ്റർ ഡോ. ടി. അനിതകുമാരി എഡിറ്റർ ഡോ. മുഹമ്മദ് റാഫി എൻ.വി</p>
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