35TH KERALA SCIENCE CONGRESS

10-14 February 2023

50 YEARS GOLDEN JUBILEE CELEBRATIONS OF SCIENCE AND TECHNOLOGY IN KERALA

KERALA SCIENCE CONGRESS 35TH

COMPENDIUM

Focal Theme and Memorial Lectures

&

ABSTRACTS

Selected Papers

Focal Theme

Nanoscience and Nanotechnology for Human Welfare

Organized by

Kerala State Council for Science, Technology & Environment

Kerala Forest Research Institute, Peechi, Thrissur.

Mar Baselios Christian College of Engineering Kuttikkanam, Peermade, Idukki.

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सत्यमेव जयते

KSCSTE

KFRI

35th Kerala Science Congress

Compendium of Focal Theme and Memorial Lectures & Abstracts of Selected Papers

Focal Theme
Nanoscience and nanotechnology for human welfare

Editor-in-Chief
Prof. K.P. Sudheer
Executive Vice President, KSCSTE &
President, 35th Kerala Science Congress

Editors
Dr. S. Pradeep Kumar
Dr. Anilkumar C
Dr. C. Arunan
Dr. M. Rajendra Prasad
Dr. K. Vijayakumar
Dr. P. Balakrishnan
Dr. Neethu B.
Dr. Binuja Thomas

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Pinarayi Vijayan
Chief Minister

Government of Kerala

February 6, 2023

Message

Kerala State has been in the forefront in fostering Science and Technology and adopting new trends for the socio-economic development of Kerala. In view of the importance given to the S&T sector by the Government, Kerala uniquely possesses the highest density of multidisciplinary R&D centres in the country. The state government is very liberal to provide all possible help to promote viable research programmes through admissible policies and financial support. Another unique aspect of KSCSTE is that it is the only state S&T council in organizing state level science congress unfailing every year.

In this context, I have great pleasure to write a message to the proceedings of the 35th Kerala Science Congress being held at Peermedu, Kuttikanam, Idukki under the impresario of Kerala State Council for Science, Technology and Environment. The focal theme of this largest scientific event is "Nanoscience and Nanotechnology for Human Welfare", in my opinion this linkage of the new emerging branch of science with possible development in humanity is highly significant and relevant for the coming decade. Nanoscience deals with manipulation of materials at atomic and molecular scales; while nanotechnology is the ability to observe, measure, manipulate, assemble, control, and manufacture matter at the nanometer scale and have applications in day-to-day life of human beings such as electronics, energy, biomedicine, environment, food, textile, etc.

I take this opportunity to congratulate and appreciate the organizers for the selection of the appropriate theme. I hope that this science congress will provide a suitable platform for scientific interactions for scientific communities belonging to different strata and come out with productive and fertile deliberations and recommendations which will ultimately improve the well-being of the common people of the Kerala state. I once again wish to declare that the Government is committed to strengthening the R&D in the State through various programmes, developing skilled human resources in S&T, popularizing new scenarios of science and technologies. Also, I take this opportunity to congratulate the scientists, especially young and student researchers of the State who are participating and showcasing their discoveries and inventions in this 35th KSC.

I wish all the success for this mega scientific event and look forward to the scientific output from this event for the development of the state.

Pinarayi Vijayan

Prof. K.P. Sudheer
Executive Vice President,
KSCSTE

**Kerala State Council for Science,
Technology and Environment**

Foreword

The Kerala Science Congress (KSC) is an annual gathering organized by the Kerala State Council for Science, Technology, and Environment (KSCSTE). It offers a platform for young researchers, academicians, technologists, and others to present, exchange, and share their research findings and technologies. The 35th KSC will take place at Mar Baselios Christian College of Engineering and Technology in Kuttikkanam, Idukki from February 12-14, 2023.

The theme of the 35th Kerala Science Congress is "Nanoscience and Nanotechnology for Human Welfare". This theme aligns with the 14th Five-Year Plan, which emphasizes the importance of science and technology for Kerala's growth. Nanotechnology, an application of nanoscience, is a promising technology of the 21st century with the potential to transform theories into practical applications in a variety of fields such as chemistry, physics, biology, medicine, engineering, and electronics. Advances in this field may result in customized materials and products with improved properties such as nano-electronic components, intelligent medicines, and interfaces between electronics and biology. The discussions and interactions at the KSC on these topics will help the state to plan the use of this emerging field of science.

During the 35th Kerala Science Congress, researchers will present their findings in 12 different fields, including Agriculture & Food Sciences, Biotechnology, Chemical Sciences, Earth & Planetary Sciences, Engineering & Technology, Environmental Sciences, Forestry & Wildlife, Fisheries & Veterinary Sciences, Health Sciences, Life Sciences, Mathematical Sciences, Physical Sciences, and Scientific Social Responsibility. A highlight of the event is a series of memorial lectures established by the KSCSTE to honor famous S&T figures such as Dr. P. K. Iyengar, P. T. Bhaskara Panicker, Dr. P. K. Gopalakrishnan, Dr. P. R. Pisharoty, Dr. G. N. Ramachandran, Dr. E.K. Janakiyammal, and Dr. Thanu Padmanabhan, to pay tribute to their contributions and inspire young people. There will also be a session for interaction between bright PG students in science and prominent scientists and academicians. Another highlight is the Children's Science Congress where participants of the recent National Children's Science Congress will present their findings.

This “Proceedings” contain the abstracts of papers presented during the 35th Kerala Science Congress. I am grateful to all contributors whose work is included in this book. The efforts of the reviewers who meticulously selected the papers for this congress are commendable. I sincerely thank all members of the organizing committee for making this year's Kerala Science Congress a reality.

I hope the 35th Kerala Science Congress is a great success.

Prof. K.P. Sudheer

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FOCAL THEME LECTURES

FOCAL THEME: NANOSCIENCE AND NANOTECHNOLOGY FOR HUMAN WELFARE

Focal Theme Invited Lecture-1

by

Dr. Bhagavatula L. V. Prasad

Director

Centre for Nano and Soft Matter Sciences (CeNS), Bengaluru

Bhagavatula L. V. Prasad is currently working as the Director of Centre for Nano and Soft Matter Sciences, Bengaluru. He also holds the position of Chief Scientist in the Physical/Materials Chemistry Division of National Chemical Laboratory (CSIR-NCL), Pune, India. He had his schooling and his early education in Vijayawada a city located on the banks of river Krishna in Andhra Pradesh. Later he moved to Hyderabad Central University from where he obtained a Master of Science and PhD degrees in Chemistry. After two post-doctoral stints; one at Tokyo Institute of Technology (2 years JSPS fellowship and 1 year Research Associate ship) and second at Kansas State University (KSU; 2.5 years -NASA sponsored project); he joined NCL in 2003. In 2021 he has assumed the office of Director, Centre for Nano and Soft Matter Sciences, Bengaluru. His group is actively working in the general area of material synthesis and in particular nanoparticles and nanoscale materials. He has published close to 130 papers in international peer reviewed journals and has 8 international patents to his credit. He was invited as visiting professor by different universities in many countries, including Japan, USA, UK, France and Germany. 18 students have completed PhD under his supervision and another 6 are pursuing their PhD currently. Prof. Prasad received a number of national and international awards and recognitions which includes Distinguished Alumnus Lecture Award (School of Chemistry, University of Hyderabad), CNR Rao National Prize for Chemical Research, MRSI-ICSC Materials Science Annual Prize, Young Career Award-DST Nanomission (2013), Chemical Research Society of India, Bronze Medal, CSIR-RAMAN Fellowship, Materials Research Society of India medal, Scientist of the year 20029 NCL Research Foundation, Chief Editor – Bulletin of Materials Science (Springer/Indian Academy of Sciences), Elected as Fellow of the Andhra Pradesh Akademy of Sciences, 2017, Fellow of Royal Society of Chemistry (FRSC), and Fellow of the Indian Academy of Sciences for research excellence.

A CHEMIST'S PERSPECTIVE ON NANOMATERIAL SYNTHESIS: HOW TO BRIDGE THE GAP BETWEEN LABORATORY AND MARKET?

Dr. Bhagavatula L. V. Prasad

Abstract

As the applicative domain of nanomaterials is increasing day by day there is a great demand for their large-scale production. Conventional batch processes have several limitations regarding the scale up of nanomaterial synthesis as they involve several steps and/or reagents. To scale-up any synthesis we need to reduce the number of steps/reagents/solvents involved to make the process viable. We have taken up this task and embarked on a journey to develop methods to synthesize nanomaterials of in three different routes. These are, (i) One step synthesis of metal nanoparticles using micro-reactors and microwave methods (ii) "All-in-one" precursors for the preparation of semiconducting metal, metal sulfide and bimetallic sulfide nanocrystals (iii) Rapid sol gel synthesis of nanocrystalline MgO of high surface area. In each of these cases we have carried out systematic studies to understand the batch processes thoroughly and later extended the same knowledge to develop/transform these processes into large scale ones. In this talk we will first briefly introduce the different approaches for the chemical synthesis of nanomaterials that are being practiced. We will then take up each of the above mentioned cases one by one and delineate the challenges involved in achieving large scale synthesis. Our efforts in successfully circumventing these problems to yield reproducible and reliable size and shape selective synthesis of the above mentioned nanomaterials will be described.

Focal Theme Invited Lecture-II

by

Prof. Deepthy Menon
Professor, Nanobioengineering & Drug Delivery Group,
Amrita School of Nanosciences & Molecular Medicine,
AIMS-Kochi, Kerala

Dr. Deepthy Menon is a Professor at the Amrita School of Nanosciences and Molecular Medicine, Amrita Vishwa Vidyapeetham (University). She received her Ph.D in Physics from Indian Institute of Science, Bangalore and completed her post-doctoral trainings from the Technical University of Eindhowen, The Netherlands; National Cancer Institute, Maryland, USA and International School of Photonics, Cochin University, India. Her current research at Amrita is at the interface of nanotechnology and biology for biomedical applications, and is primarily focused on understanding the potential of nanoscale engineering of biomaterials and medical implants for translational applications in the fields of cancer nanomedicine and regenerative engineering. Her research on polymeric nanomaterials for drug delivery, nanotextiles for medical device development and nanomedicines for cancer therapy, has received wide acclaim. She is the inventor of 8 patents and her research team has produced more than 120 research publications. She is the recipient of several recognitions in her research career including the Materials Research Society of India (MRSI) Medal 2022, Young Research Award from International Union of Materials Research Society, Young Scientist Fellowship and BOYSCAST fellowship, both from Department of Science & Technology, Government of India. She serves as the Council Member of Materials Research Society of India, and Task Force Member of DBT, DST and Nanosafety Regulations in India.

NANOENGINEERED MATERIALS: POTENTIAL APPLICATIONS IN MODERN MEDICINE

Prof. Deepthy Menon

Abstract

Nanomaterials are unique materials with overall dimensions in the nanoscale, ie., under 100 nm, which possess radically different properties (optical, electrical, thermal, magnetic, etc.) in comparison to materials at the macroscopic scale. This uniqueness of nanomaterials has paved the way for its diverse applications in fields as distinct as energy, electronics, power and medicine. The use of nanotechnology in the field of medicine has revolutionized the way we detect and treat diseases. It is the remarkable capacity of biological systems to respond differently to nanoscale materials that has led to the emergence of next-generation smart biomaterials for medical needs, ranging from drug delivery, diagnostic imaging and biosensing, to tissue engineering and regenerative medicine. Nanomaterials, on account of its large specific surface area, allow encapsulation or anchoring of therapeutic molecules to their surface, thus improving the bioavailability and targeting capability of drugs, apart from reduction in the toxic side-effects of drugs. Likewise, nanomaterials provide significant improvements in traditional biological imaging of cells and tissues through the use of optical, magnetic, X-ray and radio nanocontrast agents. The enhanced sensitivity and specificity offered by these nanocontrast agents allow visualisation of features that would not otherwise be detectable by conventional imaging modalities. The use of nanoparticles in developing diverse types of sensors is yet another field which has emerged successful. Being an ex vivo application, the possibilities offered in the diagnosis of various biomarkers are numerous, such as the use of gold nanoparticles in Covid diagnosis. Research in tissue repair and regeneration has also benefitted remarkably through the use of nanomaterials and the prospects of this field are unsuspected. Thus, innovative biomaterials engineered at the nanoscale have emerged for precise and smart functions in medicine. As these innovations advance to clinical application, attention must be paid to the environmental and societal implications, particularly with the use of non-degradable nanomaterials. This talk would provide an overview of the characteristics and advantages of nanomaterials as well as their applications in the medical field, and the research progress thus far.

MEMORIAL LECTURES

P. T. Bhaskara Panicker Memorial Lecture

as a prelude to 35th Kerala Science Congress

on 17th January 2023
at KSCSTE-KFRI, Thrissur

by

Prof. C. P. Aravindakshan

Renowned Science communicator and
Former Principal, Government College for Women,
Thiruvananthapuram

Dr. C.P. Aravindakshan was former Principal, Government College for Women, Thiruvananthapuram. Though he retired in the year 1996 as Principal, he still continues his academic activities as a committed science teacher. He is a graduate of Madras University and took his post-graduate degree from Banaras Hindu University. He worked for a long period in heterocyclic chemistry along with Dr. C.P Joshua former HOD of Chemistry, University of Kerala and took his Ph.D. from Kerala University. He was a member of Senate, University Kerala; Chairman, Board of Studies and member of various academic bodies of Govt. of India and as well as Govt. of Kerala. After retirement, he served Ministry of HRD, Govt.of India as Director,Sharmik Vidyapeeth and thereafter he joined corporation of Trivandrum as Director, Computer Training center and served for another five years. He is known more in the field of "Popularization of Science". Currently, he is associated with various child development programmes. Also, he is a resource person and faculty in many Government supported education, development and training programmes. Dr. C.P Aravindakshan has won the prestigious Science Literature Award 2013 (Children's literature category) instituted by the Kerala State Council for Science, Technology and Environment. He was the Chairman of the state Level Academic Committee of National Children's Science Congress for three Years. Dr. C.P Aravindakshan has travelled extensively and visited many Research Centres and Universities at Africa, Europe, U.K, China, Russia, and USA.

Abstract

Nineteenth and twentieth were centuries of science. When looking through the old pages of history often we find bright personalities who served the people with unsullied selflessness, sages, dedicated teachers with a vast knowledge. They have immensely contributed to the progress of society since prehistoric times. Kerala has a series of teachers of such personalities. Knowledge explosions are great source of satisfaction. Science is always a way of seeking truth. It is also a pilgrimage in search of natural pleasures. Many discoveries made during that journey expand the horizon of the mind. If we examine the history, we will understand that there have been periods when man's rationality and scientific thought were sky-high and periods when all these collapsed and lay still. At times lack of scientific background have failed to raise the scientific consciousness of the people and build a scientific society. The greatest legacy of man is the scientific sense he has acquired, which ensures their salvation and growth forever. Science should be seen in relation to daily life, society and development. This is how science has always been existed and in addition the relevance of Darwin and Galileo's life experiences lies in that. Therefore, only if their scientific findings and subsequent developments are presented alongside mentioning the associated scientific background, we could expect the growth of scientific culture. In a sense, scientific culture is more important than science. Our ultimate objective should be to grow it.

Dr. E. K. Janaki Ammal Memorial Lecture

as a Prelude to 35th Kerala Science Congress

on 3rd February 2023,
at KSCSTE-MBGIPS, Kozhikode

by

Dr. A. William Jebadhas
Principal Scientist (Retd.)
ICAR-Sugarcane Breeding Institute
Coimbatore

After a stint in teaching, William Jebadhas did his post-graduation in Botany from the Annamalai University, Tamil Nadu and joined the Sugarcane Breeding Institute, ICAR, Coimbatore in 1972. He had completed Ph.D. in Botany from the University of Madras in 1981 under the guidance of Dr. E.K. Janaki Ammal, for the thesis entitled "Ethnobotanical Studies on some Hill Tribes of South India". His major contributions were in the field of exploration, collection, maintenance and utilization of sugarcane genetic resources, mutation breeding, and development of sugarcane varieties for the subtropics and East coast of India. Published articles on sugarcane genetic resources, biodiversity, ethnobotany, and cultural anthropology of the Nilgiris tribes in reputed national and international journals, and edited books. Dr.Jebadhas served the ICAR in Sugarcane Breeding Institute over 34 years in cytogenetics, and retired as Principal Scientist in 2006.

LIFE AND SCIENTIFIC CONTRIBUTIONS OF PADMASHRI DR. EDAVALATH KAKKAT JANAKI AMMAL

Dr. A. William Jebadhas

Abstract

The most outstanding botanist the country has ever produced, hailing from a small town in Kerala on pre-independence era has breached the social taboos and gender discrimination to become one of the internationally acclaimed cytogeneticist/botanist of her time. After completing her formal education in India, she proceeded to the University of Michigan, earned her M.S. and D.Sc., degrees and returned to home country for persuading her research career. She joined the prestigious Sugarcane Breeding Station, Coimbatore as a Geneticist, leaving her teaching career. Her stay at Coimbatore during 1934 – 1939 was marked by ground breaking research in sugarcane cytogenetics which included production of novel interspecific and intergeneric hybrids of *Saccharum*. The sugarcane x maize hybrids she produced were the widest cross ever made in sugarcane. She left Sugarcane Breeding Station to join John Innes Horticultural Society in the U.K. to work on cytogenetics of cultivated plants. She published the Chromosome Atlas of Cultivated Plants with C.D. Darlington in 1945 which is a monumental contribution to cytogenetics. She returned to India in 1951 at the invitation of the then Prime Minister, Pandit Jawaharlal Nehru and reorganized the Botanical Survey of India. Her further assignments were with Regional Research Laboratory (CSIR), Jammu and B.A.R.C., Trombay followed by Emeritus Scientist in the University of Madras from 1970 where she continued her contributions to ethnobotany till the end of her life in February 1984. She was also concerned with social and environmental issues. She was in the forefront in the Silent Valley movement to preserve its pristine environment as such.

Dr. P. K. Gopalakrishnan Memorial Lecture

as a prelude to 35th Kerala Science Congress

on 7th February 2023
at KSCSTE, Thiruvananthapuram

by

Prof. Jiju P Alex
Member, Kerala State Planning Board
Thiruvananthapuram

Prof (Dr.) Jiju P Alex, faculty at the Kerala Agricultural University was formerly Director of Extension of the university. He had graduated from the Kerala Agricultural University and got his doctoral degree from the Indian Agricultural Research Institute, New Delhi. He started his career as a scientist with the Indian Council of Agricultural Research (Agricultural Research Service) and later moved on to Kerala Agricultural University. He also served the Information Kerala Mission as the head of its human resource development division on deputation. He has vast experience in subjects viz. agriculture and rural development, democratic decentralisation, technology- society interface, innovation management, entrepreneurship development, human resource development and e-governance. He was instrumental in designing the training methodology of the e- governance programmes of local self-government institutions. He has led several research projects and published on the above topics, guided PhD students and participated in many national and international conferences. He is a member of the Board of Management of the Kerala Bank. He has also served as member of the academic/policy level committees of many academic institutions in the country. At the State Planning Board, he deals with decentralisation, housing and art and culture.

PUBLIC SECTOR R & D INSTITUTIONS AND KERALA'S DEVELOPMENT: PRIORITIZING RESEARCH, FOSTERING INNOVATION, AND ENGAGING SOCIETY

Dr. Jiju P Alex

Abstract

As development of the society becomes increasingly knowledge intensive, it is important to formulate policies and programmes based on the best available scientific evidence, objective assessment of the preferences of the stakeholders, feasibility and prospects of further growth. However, in most cases the decision-making processes do not rely much on scientific information. Science and other forms of knowledge are not always used effectively in policy making and planning as policymakers do not generally consult scientists or scientific institutions about their needs. On the other hand, scientists also do not always proactively engage in the policy process.

Involving R & D institutions in policy making requires exclusive programmes on a wide range of issues related to various development sectors. It could be not only on developing new technologies and protocols, but also about assessment of situations, projecting trends, simulating future scenarios, and applying existing information and knowledge for problem solving. Scientists tend to define research problems and develop solutions that may not be fully relevant to the needs of the society. This inadequacy may also get reflected in policy-making. Though communication regarding science-policy– society interface appears to follow a 'linear model', the interactions are complex and mostly non-linear.

This calls for a relook at how R & D institutions influence development. Public sector R & D institutions are primarily intended to respond to the research needs of the society and their products are generally regarded as public goods. One could argue that funding research is not for urgent, short-term purposes because some research takes longer than others to produce results. Still, public institutions are obligated to return their investment to society in the form of beneficial goods and services. The extent to which the development concerns of the society get factored in the priorities of the R & D institutions requires to be examined in detail. Equally important is the process by which these institutions decide their research and development priorities.

It is also to be noted that R & D initiatives in the private sector systematically produce tangible results that are sooner or later commercialised, research out puts of public sector institutions take longer periods to get translated into usable products. Many authors have attributed this to the inadequacy of the public research systems in identifying relevant problems and establishing better interface with the society, among other reasons. In this light, it is crucial to evaluate how the public sector R & D institutions draw up their programmes and prioritise their research. This assumes more importance since the investment in R & D is still lower in India, at around 0.7 percent of the national GDP.

Public research and development are vital to the advancement of technology and thereby support economic prosperity. This is done in different ways. One of them is public research bringing innovations with commercial value to the business sectors, increasing the economic impact of

public spending in R & D. Second, research and development organisations support development organisations' use of technology in the execution of their programmes. Third, by using analytics and reports in the creation of policies and programmes, the state's development interventions might immediately profit from R & D institutions. Fourth, research and development organisations might assist the government with consulting services regarding the use of technologies in development initiatives. There could be many other forms by which R & D institutions engage with development and policy making, based on specific situations.

It is becoming increasingly evident that maximization of the economic impact of academic research will happen only when different types of stakeholders use and build on research done in the public sector and when industrial research complements and guides basic research. In view of this, government, industry, NGOs, academia, entrepreneurs and different organisations and grassroots level institutions of relevance must collaborate to discover solutions for the escalating social requirements and difficulties in order to promote an inclusive, vibrant, and sustainable eco-system for R & D and innovation. The experiences drawn thus should help the R & D institutions to increase their contribution to evidence- based policy making in different development sectors. In order to have a greater impact on society and the academic community, R & D institutions should organise and prioritise their research and technology transfer projects according to the recommendations provided by this collaborative process. For this, we require a robust research eco-system made up of R & D institutions, the assistance of the government, appropriate regulations, strategic frameworks, linkages with the development agencies of the state, engagement from private sector, encouragement of start-ups and entrepreneurs, and a talent pool of researchers. This also underlines the significance of promoting translational research in different sectors.

Research agenda of higher education and R & D institutions could be prioritised based on the requirement of the industry and the knowledge gap experienced by the society at large and development agencies and practitioners, in particular. On the other hand, government should also seek advice of R & D institutions, which would improve research conducted by the latter. Interestingly, these two processes are complementary to each other. In order to strengthen the role of R & D institutions in policymaking, the scientific community must make more concerted efforts to address society's knowledge needs.

The role of public sector R & D institutions in Kerala in building up a knowledge society as envisaged in the 14th Five Year Plan of the state is pivotal. While formulating the research agenda, emphasis must be given to build up synergy in developing indigenous and cost-effective and innovative technological solutions through inter institutional collaboration, problem-oriented research, and dialogue with different types of stakeholders. An important area that deserves to be supported is local economic development, which involves building up an congenial entrepreneurship eco system, supported by R & D and higher education institutions. The government has initiated a slew of innovative measures to foster innovation and enhance the contribution of R & D institutions in Kerala by progressively increasing the investment in this sector. The first ever R & D budget presented in Kerala Legislative Assembly is an indication of the government’s thrust on science and technology.

Dr. G.N. Ramachandran Memorial Lecture

by

Prof. Deepak T Nair
Professor
Regional Centre for Biotechnology, Faridabad, Haryana

Prof. Deepak T Nair is an Indian Structural Biologist and a scientist at Regional Centre for Biotechnology. Prof. Deepak enrolled for his doctoral studies at the National Institute of Immunology, India to secure a PhD in structural immunology in 2001. Later, he moved to the US to complete his post-doctoral work in the laboratory of Prof. Aneel K. Aggarwal at the Mount Sinai Medical Center. He returned to India in 2007 to take up the position of an independent investigator at the National Centre for Biological Sciences (NCBS). He worked in NCBS as Reader-F (2007–2013) and Associate Professor (2013–2014). In July 2014, he joined the Regional Centre for Biotechnology as an Associate professor, and was promoted to the position of Professor in July 2019.

Prof. Deepak was selected for the Ramanujan Fellowship by the Department of Biotechnology for the period 2008–2013. He became a member of the Guha Research Conference in 2013. He received the National Bioscience Award for Career Development (N-BIOS Prize) in 2014.The Council of Scientific and Industrial Research awarded him the Shanti Swarup Bhatnagar Prize, one of the highest Indian science awards for his contributions to biological sciences in 2017. He was inducted as a fellow of the Indian National Science Academy (New Delhi, India) in December, 2022.

STRUCTURE, MECHANISM AND FUNCTION OF POLYMERASES

Prof. Deepak T Nair

Abstract

The blueprint of life is resident in the genome of living organisms. For the survival and propagation of the organism, the genome has to be copied accurately and this critical function is carried out by enzymes known as DNA polymerases. Using macromolecular crystallography along with other allied tools, we study the molecular mechanism utilized by these enzymes to achieve function. An overview of the key findings made in our laboratory will be presented.

Dr. Thanu Padmanabhan Memorial Lecture

by

Prof. L. Sriramkumar
Professor, Department of Physics,
Indian Institute of Technology Madras, Chennai

L. Sriramkumar is a Professor of Physics at the Indian Institute of Technology Madras, Chennai. He had completed his thesis work under the supervision of Prof. Thanu Padmanabhan at the Inter-University Centre for Astronomy and Astrophysics, Pune, in 1997. He had worked as a postdoctoral fellow under the mentorship of Prof. Jacob Bekenstein (at the Racah Institute of Physics, Hebrew University, Jerusalem, Israel) and Prof. Don Page (at the Department of Physics, University of Alberta, Edmonton, Canada) during 1997-99 and 1999-2001, before joining the Harish-Chandra Research Institute, Allahabad, initially as a postdoctoral fellow in 2001, and then as a faculty in 2003. He had moved to the Indian Institute of Technology Madras in 2011. Prof. Sriramkumar has worked on various aspects of gravitation and cosmology, and his recent research has been focused on the physics of the early universe.

PROBING THE PHYSICS OF THE EARLY UNIVERSE

Prof. L. Sriramkumar

Abstract

The physics at play in the early universe is responsible for the generation of the primordial perturbations which leave observable imprints on the cosmic microwave background (CMB) and the large scale structure. Therefore, cosmological observations allow us to probe the physics operating in the primordial universe. The inflationary scenario remains the most promising paradigm to describe the origin of the density perturbations. Apart from the density perturbations, the inflationary epoch also generates primordial gravitational waves (GWs), which offer a unique window to the early universe. While the primordial scalar power spectrum is well constrained on the large scales by the CMB data, the current bounds on the scalar power spectrum over smaller scales are considerably weaker. Recently, there has been an enormous interest in examining inflationary models leading to a sharp rise in the scalar power on small scales resulting in significant formation of primordial black holes and generation of secondary GWs of possibly detectable amplitudes. In the standard picture, the inflationary epoch is to be followed by the phase of reheating during which the energy from the inflation is transferred to radiation. It has been recognized that post-inflationary dynamics can leave tell-tale signatures on the spectrum of GWs that could, in principle, be detected by the current and forthcoming GW observatories. In this talk, I shall outline the manner in which the physics operating during inflation and reheating can be constrained by cosmological observations.

Dr. P. R. Pisharoty Memorial Lecture

by

Dr. A.M. Ramiya
Associate Professor
Indian Institute of Space Science and Technology (IIST), Trivandrum

Dr. A.M. Ramiya works as associate professor in Remote Sensing and Image Processing at the Indian Institute of Space Science and Technology, Department of Space, Thiruvananthapuram. She has received her PhD in Remote Sensing from IIST, Thiruvananthapuram, and M.S. in Remote Sensing and Spatial Analysis, University of Southampton, UK and B.E in Geoinformatics from College of Engineering, Guindy. She has more than 18 years of experience in handing and processing geospatial images from multispectral/ hyperspectral/ LiDAR sensors captured from various platforms such as satellite, airborne, drone/UAV, ground-based and mobile platforms. Her research interests include developing algorithms and methodologies using machine learning techniques for processing very high-resolution remote sensing images for natural and man-made resource management. She has published several research papers related to remote sensing and image processing in top remote sensing journals.

She is the recipient of the prestigious Commonwealth award from Government of India and Government of UK for pursuing Masters Program at the United Kingdom. Recently she has been awarded the Kerala State Young Scientist award from the Government of Kerala for her contribution in Geospatial Technology. She also acts as reviewer of top remote sensing journals including IEEE GRSS, International Journal of Remote Sensing, ISPRS etc. She acts as the Executive Committee Member of ISRS Thiruvananthapuram and IEEE GRSS Kerala Chapter.

GEOSPATIAL INTELLIGENCE: HARNESSING THE POWER OF GEOSPATIAL TECHNOLOGY FOR LOCATION INTELLIGENCE

Dr. A. M. Ramiya

Abstract

Globally more than half the population lives in urban cities, and the trend is expected to increase to 70% by 2050. Precise mapping and monitoring of urban resources is critical for sustainable development. The power of geospatial technology for understanding the dynamics of urbanization is well documented. With better observational capabilities from new generation satellite missions, aircraft, drone, and ground based remote sensing techniques, there is a radical change on how recent advances in geospatial technology can be effectively utilized for better understanding and mapping the world around us. The power of geospatial technology can be better harnessed through advancement in machine learning and artificial intelligence for deriving deep insights and thus making an informed decision by the common citizens and policymakers alike. The access to open datasets, open tool, and software, coupled with the power of cloud computing, has increased the accessibility for better utilization of the geospatial data for effectively mapping the cities. Recent advancements have led to a paradigm shift from 2D to 3D mapping with an emphasis on digital twins for better management of resources.

Combined with ancillary information and the power of visualization, can transform the geospatial data into a location-intelligent tool to derive location analytics for strategic decision-making in our day-to-day activities. However, the increasing volume of data from these techniques, making it big spatial data, provides challenges and opportunities for the geospatial community to exploit its full potential in location intelligence.

Dr. P. K. Iyengar Memorial Lecture

by

Dr. Vivek Datar

Senior Professor (Retd.),

Tata Institute of Fundamental Research (TIFR), Mumbai

Dr. Vivek Datar is presently a Raja Ramanna Fellow at the Institute of Mathematical Sciences, Chennai. He was the Project Director of the India based Neutrino Observatory (INO) between 2016 and 2020 and a Senior Professor at the Tata Institute of Fundamental Research (TIFR), Mumbai from May 2015- May 2020. Before moving to TIFR he was a Distinguished Scientist and Head of the Nuclear Physics Division (NPD), Bhabha Atomic Research Centre (BARC) having served there between 1975 and 2015. He was a Senior Professor of the Homi Bhabha National Institute (HBNI) and Dean-Academic for Physical and Mathematical Sciences, BARC. He has also been an adjunct professor at the School of Natural Sciences, TIFR. He obtained his PhD from the University of Mumbai in 1983 and did post-doctoral work at IPN, Orsay, France and SUNY (Stony Brook), USA (1986-88). He joined NPD, BARC in 1975 after a year at the BARC Training School. His areas of interest include low energy nuclear physics and neutrino physics.

THE ATOMIC NUCLEUS – UNDERSTANDING THE HEART OF MATTER

Prof. Vivek Datar

Abstract

The atomic nucleus carries more than 99.9% of the mass of the atom and consists of neutrons and protons interacting ‘strongly’ with one another in addition to the Coulomb repulsion between the latter. I will discuss the present status of our understanding of the nucleus building on insights from some landmark experiments. While performing experiments to learn about the structure and dynamics of nuclei some of the novel techniques that were used led to applications that could not have been foreseen, in areas as diverse as healthcare to energy production. I will end with possible future directions of research in nuclear physics.

01-AGRICULTURE & FOOD SCIENCE

ORAL PRESENTATION

01-1

ELUCIDATING THE NATURE OF TRANSMISSION OF PRSV -P STRAIN IN PAPAYA

Aashitha Joy[1] and S.K Manoranjitham[2]

[1] Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore – 641003, (Tamil Nadu), India. [2] Dept. of Crop Protection, Agricultural College & Research Institute, Eachangkottai, Thanjavur-614902, Tamil Nadu, India.

Background: The Central American-originated papaya is one of the most extensively marketed and consumed fruit in the world. The Papaya ringspot virus (PRSV) ravaged almost all papaya crops across the globe. Papaya plants are propagated through seeds and the presence of virus in papaya seeds needs to be ascertained for better management of PRSV. A thorough understanding of the function of aphid vectors in the dissemination of the disease is required as it influences PRSV epidemiology.

Materials and methods: Serological detection of PRSV by DAC- ELISA and molecular detection by Reverse transcriptase – PCR using PRSV-specific primers was done in papaya seeds collected from healthy and PRSV-infected ripened and unripened fruits to assess the seed transmissibility and in aphids to assess the insect transmission.

Results: Seeds with and without sarcotesta did not produce any amplicon in RT-PCR assay using PRSV-specific primers. PRSV-infected leaf sample (Positive control) showed an amplicon size of 850bp. Hence, the transmission of PRSV through seeds was negligible. And in the case of insects also the amplicon of 850bp was not produced.

Conclusion: The study aimed to confirm different methods of transmission of PRSV. Since vertical transmission of PRSV by seeds is negligible, more research and studies have to be made giving emphasis on the other modes of transmission of the virus.

Keywords: Papaya, PRSV, seeds, aphids, transmission

01-2

NUTRITIONAL AND QUALITY CHARACTERISTICS OF YOGHURT ENRICHED WITH SPIRULINA POWDER

Akshay P[1*]., Amruth P[1]., Gopika R[2]., George Ninan[3], Suseela Mathew[4]

*[1,2,4]Biochemistry and Nutrition Division, ICAR-Central Institute of Fisheries Technology, Kochi, Kerala -29, [3]Director, ICAR-Central Institute of Fisheries Technology, Kochi, Kerala -29, [1]Faculty of Marine Sciences, Cochin University of Science and Technology, Kochi, Kerala 682022, *akshay.cift@gmail.com*

Background: Spirulina is a cyanobacteria which possess excellent bio resource of nutrients with a protein content of 60-70% along with essential amino acids, fatty acids, carotenoids, phycobiliproteins, minerals and vitamins and thus can potentially play a vital role in the human diet. The popularity of yoghurt is due to its pleasant favour, thick creamy consistency and its

reputation as food associated with promoting good health. Interestingly, a noteworthy trend is the addition of Spirulina for the improvement of the nutritional properties of yogurt and fermented dairy products. In fact, recent studies have shown that these cyanobacteria can promote the growth of lactic acid bacteria.

Method: The current study focuses on enrichment of yoghurt with spirulina with its addition in concentrations of 0.1, 0.3 and 0.5 per cent. The nutritional characteristics are tested against control and commercial yogurt asper AOAC 2015 standards.

Results: An increase in protein and fat content is observed in the inclusion of higher concentration of spirulina in the yogurt. Increase in acidity, rheological properties and reduction in setting time was observed with increase in sprirulina concentration. Yoghurt prepared with 0.3 per cent spirulina had comparable sensory evaluation scores for sensory parameters like colour and appearance, texture, whey separation, flavour and overall acceptability with that of control. Though viability of yoghurt culture declined during storage, viability of yoghurt cultures in yoghurt prepared with spirulina was higher when compared to control during storage at 4°C also shows promising property of spirulina to extend shelf life of yoghurt.

Conclusion: Yoghurt prepared with spirulina showing pronounced nutritional properties than control and commercial yoghurts with promising probiotic effects.

Keywords: Spirulina, yoghurt, nutrition, enrichment

Acknowledgement: World Fish centre and ICAR-Central Institute of Fisheries Technology for facilities and funding.

01-3

COMPARATIVE STUDY OF SAFETY ASPECTS OF GHEE AND OTHER COOKING OILS ON REPEATED FRYING

Aleena K.S and Divya M.P.

Varghese Kurien Institute of Dairy and Food Technology, Kerala Veterinary and Animal Sciences University

Background: The high temperature cooking process creates a series of complex chemical reactions in oil and affects the sensory as well as functional properties of foods and the oil. The reuse and repeated heating of cooking oil results in oil deterioration leading to adverse health effects. The extent of thermal degradation in ghee over other edible oils on repeated use as cooking medium was analysed in this study.

Method: Coconut oil and sunflower oil were selected for comparison with ghee, due to their popularity in different parts of India. Paneer was fried in different cooking oils as well as Ghee and the frying process was repeated. These were analysed to study the interactions occurred during frying processes. Ghee and sunflower oil had least interaction with food upon repeated heating. Smoke point of all the selected oils and ghee was determined to analyse the suitability for high temperature cooking and deep fat frying. The safe extent of repeated usage of ghee and other cooking oils were determined by analysing the fatty acid composition (GC-MS) and Total polar compounds (ATR- FTIR and Testo 270).

Results: The present study found out that coconut oil is having highest heat stability at 180˚C for 6 hours as well as at very high temperature like, 300˚C followed by Ghee. Sunflower oil was

found to be least stable against oxidation. It was found that Sunflower oil and Coconut Oil experienced increased TPM content after each repeated frying, whereas inghee no change in TPM was found even after 4th repeated heating.

Conclusion: It was recommended that up to 4 repeated heating, coconut oil, sunflower oil and ghee are safe for consumption.

Keywords: Coconut oil, Sunflower oil, Ghee, Iodine value, Peroxide value, Smoke point, GC-MS, FTIR, Total polar compounds

01-4

BIOCHEMICAL RESPONSES OF THE TOBACCO CUTWORM, *SPODOPTERA LITURA* ON EXPOSURE TO *COCCULUS LAURIFOLIUS* EXTRACTS

Alina Paul[1,2] and R. Jayaraj[1],

[1]Division of Forest Ecology and Biodiversity Conservation,
KSCSTE - Kerala Forest Research Institute, Peechi, Thrissur, 680653, Kerala.
[2]Cochin University of Science and Technology, Kochi, 682022, Kerala, India.

Background: *Spodoptera litura* (F.) is a polyphagous pest with migratory behaviour which has been known to harm a variety of host plants, including agricultural crops. It was reported that a number of chemical pesticides are efficient yet have detrimental impacts on the ecosystem and environment. Currently, the emphasis is on moving to botanical pesticides to circumvent the effects of chemical pesticides.

Methods: A polarity based bioactivity guided fractionation of *Cocculus laurifolius* bark methanolic extract against *Spodoptera litura* was carried out. The anti-feedant, growth inhibitory activities, biochemical and histopathological effects of active fraction V against third instar larvae of *S. litura* were analyzed. The chemical compositions of the active fraction V was analyzed using GC-MS.

Results: Active fraction V (100 % Methanol) showed anti-feedant activity 90.94 ± 4.09 % at its 2.5 % concentration was taken for further assays. Reduction in body weight of the larvae was noted at 1.0 % and 2.5 % concentration compared to control. Enzymes involved in the nerve impulse transmission and detoxification pathways were also affected by the exposure of active fraction. A significant increase in the activity of glutathione S- transferase (GST) and alterations in carboxylesterase was noted in the exposed larvae compared to control. Significant inhibition of acetylcholinesterase was also noted in exposed organisms. Even at a 0.5% exposure, histological investigations of the intestine (midgut) revealed structural damage, goblet cell disintegration, edema and lysis of the epithelial cells in the exposed larvae compared to control. The chemical molecules or active compounds in the active fraction were identified in gas chromatographic-mass spectrometric analysis.

Conclusions: The anti-insect properties shown by the active fraction V of *C. laurifolius* is mediated through its ability to alter detoxifying enzymes and cause pathological damages. This could be further explored for preparation of newer biopesticide formulations.

Keywords: Biopesticides, Antifeedant activity, Growth inhibition, Biochemical assays, Histopathological analysis, GC-MS, *Spodoptera litura.*

01-5

IMPROVEMENT OF VASE LIFE BY PRECOOLING IN *Dracaena fragrans* cv. 'Massangeana'

Amrutha Lakshmi [1*], Dr. Anupama T. V [1], Dr. Saji Gomez [1], Dr. Parvathi M Sreekumar [2]

[1]Department of Post Harvest Management, College of Agriculture, Vellanikkara, Kerala Agricultural University, Thrissur

[2]Department of Plant Physiology, College of Agriculture, Vellanikkara, Kerala Agricultural University, Thrissur

[*]Author for correspondence; email: amruthalakshmi-2020-12-023@student.kau.in

Background: Cut foliage are important components of the floricultural industry, largely used for decoration in floral compositions. *Dracaena fragrans* cv. 'Massangeana' (corn plant) belonging to the family Asparagaceae is a popular foliage plant which possess high export potential. Despite the production and export of cut foliage from Kerala, post harvest studies of foliage are in nascent stage, which have to be taken up for extending the vase life, and ensuring fair price and income for the farmers engaged in this sector.

Method: This work investigated the effect of various precooling methods on the vase life of *Dracaena fragrans* cv. 'Massangeana'. Mature *Dracaena* leaves were harvested in morning and subjected to precooling treatments for six hours at both refrigerated and cold storage conditions. This was done in both wet storage and dry storage conditions. The vase life studies were conducted at weekly intervals. The data obtained was statistically analysed.

Results: The results of the study indicated that precooling the *Dracaena* leaves for six hours at a temperature of 12±1° C in 200 gauge thick polyethylene sleeves resulted in an increased vase life of the leaves when compared to the other treatments. The rate of ethylene evolution was also correlated with the vase life of the leaves and higher rates were obtained towards the end of vase life of the leaves. The total water absorbed also depended on the storage duration and temperature. The samples in refrigerated conditions showed symptoms of chilling injury within one week of vase life studies.

Conclusion: This work establishes the effect of different precooling methods on the vase life of the cut foliage species *Dracaena fragrans* cv. 'Massangeana' and identifies the best precooling temperature for an extended vase life.

Keywords: Precooling, vase life, *Dracaena fragrans* cv. 'Massangeana', cut foliage, cold storage, dry storage

01-6

MANGROVE DERIVED ENDOPHYTIC ACTINOMYCETES FOR PLANT GROWTH PROMOTION, PROTECTION AND AGROWASTE TRANSFORMATION

ANJALI S MOHAN[1]*, REVATHY M R[1], DHANYA KESAVAN[1], C. K. RADHAKRISHNAN[1] & ROSAMMA PHILIP[1]

[1]Dept. of Marine Biology, Microbiology & Biochemistry, Cochin University of Science and Technology, Cochin-682016, Kerala, India.

***Correspondence:** Anjali S. Mohan – 9562372821;anjusal310@gmail.com

Background: Mangroves are intertidal ecosystems often referred to as obligate halophytic systems offering ideal habitat for a variety of macro/micro fauna and flora. Actinobacterial

endophytes are well known but less explored inhabitants of live plant system and perform critical assignments in growth and health. Reports are limited on the mangrove associated actinobacterial endophytes reflecting their antagonistic and plant growth promoting attributes. Therefore, the major objectives of the current investigation focus on the isolation and characterization of endophytic actinomycetes associated with mangroves and their role in antagonism, plant growth promotion (PGP), and agrowaste management by biotransformation.

Along with plant growth promoting agents, the isolates were also able to produce industrially important microbial enzymes. Among the screened enzymes cellulase enzyme seeks serious attention due to its ability in bio-transformation of agrowaste, starch processing, animal feed production, grain alcohol fermentation, malting and brewing, pulp and paper industry and textile industry. Studies were conducted for the eradication through utilization of the natural resources for the potential production of microbial enzymes, this theme is implemented in cellulase production by *Streptomyces albidofavus* by using *Pontederia crassipes* (water hyacinth) leaf and root as substrates. Present study focused on the plant growth promoting, antagonistic and bio-transforming ability of mangrove derived actinobacterial isolates.

Method: Ten different mangroves from three different locations were selected for the isolation of endophytic actinomycetes. Due to limited literature the surface sterilization, isolation techniques and isolation media were standardized. The mangrove endophytic actinobacteria were also screened for their antagonistic activity against 12 different bacterial pathogens and 5 phytopathogenic fungi. The isolates were also screened for their ability to produce plant growth hormone indole acetic acid (IAA) and growth promotion studies were conducted in both terrestrial and aquatic plants. Other additional growth promotion activities such as siderophore production, ammonia production and hydrogen cyanide production was also estimated. The microbes were also screened for extracellular enzyme production and potential isolates were selected. From the 12 different enzymes cellulase producing isolate was selected and further employed in the agrowaste management and cellulase production from natural substrates.

Result: Sixty three actinomycete isolates were obtained from newly attempted sandwich method from 2 different media. The isolates showed 65% antibacterial and 14% antifungal activity. IAA producing strains were selected and applied in seed soaking and germination studies resulted that 98% germination was noticed in all sets. Prominent radicle and faster hypocotyl development were noticed in 90% of the sets. Out of the total isolates 13% siderophore producers, 75% ammonia producers and 6% were hydrogen cyanide producers. All the isolates were amylase, protease and lipase producers, 34% Tyrosinase, 31% Ligninase, 26% Asparaginase, 22% DNase, 20% glutaminase, 17% cellulase, 8% Chitinase,11% phosphatase and 2% Laccase producers. No sulfatase positive was detected. Cellulase positive strains were finally selected for agrowaste management with special focus on common water hyacinth through eradication through utilization and reducing sugar was estimated and *Streptomyces albidoflavus* EA 54 was selected as a potential candidate for industrial waste management.

Conclusion: From the current study it can be concluded that mangrove derived endophytic actinomycetes are potential agents for antimicrobial compounds, plant growth promoting agents and a cheap source of industrially important enzymes and bio remediators.

Keywords: Endophytic actinomycetes, antimicrobial, plant growth promoters, cellulase, Indole acetic acid

01-7

RESPONSE OF BLACKGRAM (*VIGNA MUNGO* (L.) HEPPER) VARIETIES TO FOLIAR NUTRITION AND GROWTH REGULATOR APPLICATION UNDER PARTIAL SHADE

Pooja A. P.[1*], Ameena M.[2] and Arunjith P.[3]

[1,2,3]Department of Agronomy, College of Agriculture, Vellayani, Thiruvananthapuram, Kerala Agricultural University - 695 522, Email id: [*]appoojaap@gmail.com

Background: Blackgram is generally considered as a shade sensitive crop. Nevertheless, it fits well in intercropping, crop rotation and crop mixture in coconut gardens thus forming an integral part of cropping systems of the tropics. The research aims to study the growth and yield response of blackgram varieties to foliar spray of nutrients and plant growth regulators in partially shaded coconut garden

Method : Five performing blackgram varieties under the partial shade *viz*; Sumanjana, DBGV 5, VBN 5, VBN 6, CO 6 were given foliar sprays of nutrients (19:19:19 NPK, sulphate of potash) and plant growth regulators (naphthalene acetic acid (NAA) and salicylic acid (SA) alone and in combinations in split plot design at 45 and 60 days after sowing (DAS). Observations were recorded

Results: The study revealed that, among the varieties, growth attributes *viz*., plant height, number of branches and number of leaves per plant, and leaf area index at flowering were recorded higher for Sumanjana followed by DBGV 5. Higher seed yield as recorded for the varieties Sumanjana and DBGV 5 during both the seasons. The foliar spray of 19:19:19 (1%) at 45 and 60 DAS + foliar spray of NAA at 40 mg L^{-1} and SA at 100 mg L^{-1} at pre-flowering and 15 days later revealed higher growth attributes and seed yield ha^{-1} during both the seasons.

Conclusions: The variety Sumanjana /DBGV 5 along with foliar spray of 19:19:19 (1%) at 45 and 60 DAS + foliar spray of NAA 40 mg L^{-1} and SA 100 mg L^{-1} at pre-flowering and 15 days later could be recommended for getting higher productivity in blackgram under partially shaded coconut garden.

Keywords: Blackgram, Coconut garden, Growth attributes, Partial shade, Varieties, Yield

01-8

DIAGNOSTIC DNA MARKERS TO ASSESS MARKET ADULTERANTS AND GENDER BASED RESOURCE AUGMENTATION IN *COSCINIUM FENESTRATUM*

Remya Unnikrishnan[1], Swathi Balakrishnan[1], Suma Arun Dev[1], Jayaraj R[2]

[1] Forest Genetics and Biotechnology Division, Kerala Forest Research Institute, Thrissur, 680653, [2] Forest Ecology and Biodiversity Division, Kerala Forest Research Institute, Thrissur, 680653

Background: The extensive consumption of medicinal plants from the wild to meet supply and demand ratio exerts a heavy strain on the natural resources. This subsequently led to adulteration and substitution of the medicinal plants with look-alike species. Hence, it is imperative to bring forth universally acceptable standard tools to authenticate ayurvedic raw drugs before being processed further into formulations. Scientific management, restoration, cultivation and

conservation measures should also be given utmost priority to meet the rapidly increasing demand of the herbal industries as well as to reduce the depletion of wild resources.

Methodology: DNA barcoding has been used for authentication and illicit trade of *Coscinium fenestratum* (Gaertn.) Colebr. using Consortium for Barcode of Life (CBOL) recommended standard barcode regions. Transcriptomics approach was adopted to identify sex specific, Single Nucleotide Polymorphism (SNPs) for gender identification in the vegetative stage/seedlings of *Coscinium fenestratum* to maintain a viable population during the restoration/resource augmentation programmes.

Results: Tree based as well as AI based MLA methods were utilised for the DNA barcode analysis. ML tree indicated adulteration in 66.6 % of market samples of *C. fenestratum*. Out of thirty traded raw drug samples tested, twenty market samples were identified as *B. aristata* and remaining ten samples were authenticated as *C. fenestratum*. To maintain a viable *Coscinium fenestratum* population during the restoration/resource augmentation programmes, we could identify three SNP loci which could distinguish the known sexes, which were further utilized for the sex determination of seedlings in restoration activities.

Conclusion: Our study recommends the inclusion of DNA barcoding as one of the strategic tools in the Ayurvedic Pharmacopeia of India to validate the authenticity of herbal drugs, prior to its usage in herbal formulations. The developed sex specific SNP markers can be further utilised for gender discrimination in seedlings during restoration activities and to identify the sex of surviving immature individuals in the wild so as to maintain a viable population for long term survival of the resources.

Keywords: DNA barcoding, Artificial Intelligence, Transcriptomics, Sex determination.

01-9

A CRITICAL APPRAISAL TO THE SUSTAINABILITY OF TRIBAL RICE FARMING IN WAYANAD DISTRICT OF KERALA

Shahlas Binth T and A. Anil Kumar

Department of Agricultural Extension, College of Agriculture, Vellayani, KAU, Thiruvananthapuram, Kerala, India

Background: Agriculture is the main occupation for most of the tribal communities in Wayanad district of Kerala and cultivation was mainly centered on paddy. As paddy is not remunerative, most of them have shifted to commercial crops such as banana, ginger and other crops. The degradation of the environment, particularly the deforestation brought about by logging concessions, the increasing needs of an expanding population, government programs which support cash-cropping and thus more forest denudation, and climatic changes have translated into less irrigation water for the rice fields. Thus there is a strong need to adapt agricultural practices in order to increase the production of rice in a manner that is socially acceptable, economically viable and environmentally sustainable.

Method: The sustainability index of tribal rice farming is calculated by the mean of the scores of three indicators namely, social, economical and environmental based on an Entangled sustainability model. A maximum of 30 tribal rice farmers from the three identified panchayats of Wayanad were randomly selected in consultation with Krishi Bhavan concerned. Thus, 90 tribal rice farmers were the respondents for the study.

Results: The study revealed that 70 per cent of the overall sustainability was found in the tribal rice farming of Wayanad district. Among the indicators environmental sustainability has the highest index value (79%), followed by social sustainability (73%) and economical sustainability (59%).

Conclusions: The overall effect of tribal rice farming has been that of preserving the environment and at the same time feeding the communities. Thus, traditional rice farming of tribal farmers was found to be a sustainable model for agriculture.

Keywords: Tribal rice farming, Sustainability index, Social sustainability, Economical sustainability, Environmental sustainability.

01-10

PATTERN OF METABOLIC SYNDROMES IN SELECTED ISCHEMIC STROKE PATIENTS

Siji.S[1], Beela G. K [2], P. N Sylaja[3]

Dept of Community Science, College of Agriculture, Vellayani, Thiruvanathapuram[1, 2], Comprehensive Stroke Care Program, Department of Neurology, Sree Chitra Tirunal Institute of Medical Science and Technology, Thiruvanathapuram3

Worldwide, stroke is the commonest cause of mortality after coronary artery disease. Also, it is the commonest cause of chronic adult disability. In the past decade, stroke incidence in Kerala emerged as a major public health problem (Somasundaran and Potty, 2020). Studies shows that different factors contribute to stroke incidence especially metabolic syndromes, like elevated blood pressure, elevated blood glucose, obesity and dyslipidemia (Bernadette *et al*.,2008). Metabolic syndrome has been widely associated with stroke incidence and total mortality risks primarily in the middle-aged population (Vatakencherry et al., 2019). Hence, the present study is an evaluation of pattern of metabolic diseases present in the selected ischemic stroke patients in south Kerala.

The study was conducted among the ischemic stroke patients admitted at Comprehensive Stroke Care Program, Department of Neurology, Sree Chitra Tirunal Institute of Medical Science and Technology (SCTIMST), Thiruvananthapuram. Hundred ischemic patients selected for the study based on the inclusion and exclusion criteria. Age and gender distribution of the total 100 patients, 25 were female and 75 were male, overall 52 per cent of the ischemic stroke patients were under over weight category. In case of stroke diabetic with hypertension (40.9 per cent), hypertension (13.6 per cent), diabetic, hypertension and hyperlipidemia (19 per cent) these were major pattern of metabolic syndromes found.

Keywords: ischemic stroke, diabetic mellitus, obesity, hyperlipidemia

01-11

EFFECT OF TOP-SOIL HARVESTING FOR SMALL SCALE BRICK PRODUCTION ON SOIL QUALITY

Sophia Baby[1] and Betty Bastin[2]

[1] Kerala Forest Research Institute, Peechi, Thrissur, [2] Kerala Agricultural University, Vellanikkara, Thrissur

Background: The utilization of clay for construction of habitations and buildings dates back to the period of ancient civilizations. Brick production requires fine clayey loam soil with plenty of water supply. With the increasing demand for construction material, clay mining had shifted from river banks to fertile agricultural lands. This change in land use had resulted in the deterioration of soil health and decrease in crop production. The entry of large number of small-scale brick production units is causing irreversible damages to the soil, hydrology and ecosystem.

Methodology: A comprehensive survey was conducted at Alathur taluk of Palakkad district to identify locations with desurfaced soils. Soil and water samples were collected from 11 locations including a control location without mining activities. A total of 88 soil samples were collected for the study. Soil samples were analysed for various physico- chemical and biological properties.

Results: The temperature and bulk density were found to be higher in desurfaced soils when compared to control. The water holding capacity, porosity and moisture content were found to be reduced in desurfaced soils. The texture of the soil changed from clay loam to sandy loam. The organic carbon content of desurfaced soils were in the range of 0.08 – 0.46 per cent with a reduction of 61 per cent when compared with control soil. The content of available nitrogen, phosphorus and potassium were also reduced to the extent of 43.70, 74.50 and 43.36 per cent respectively. The available magnesium content was found to be lower in desurfaced soils (55.6 per cent reduction). The content of plant available micronutrients (Fe, Mn, Cu and Zn) and heavy metals (Ni, Cr and Pb) were high in desurfaced soils. The presence of earthworms (13 nos. per m^2) and termite mound were observed only in the control soil. The microbial biomass carbon and dehydrogenase enzyme activity were highly reduced in desurfaced soils.

Conclusion: The study revealed that top soil mining for brick production predominantly affected bulk density, soil temperature and water holding capacity of the soils. The content of organic carbon and available nutrients such as N, P and K were also reduced. The biological properties like dehydrogenase enzyme activity and microbial biomass carbon reduced to a greater extent.

01-12

PROCESS STANDARDIZATION OF PROTEIN HYDROLYSATE INCORPORATED FUNCTIONAL PREMIX FOR INDIAN WOMEN

R.L. Beena*, S.N. Rajakumar

Department of Dairy Technology, VergheseKurien Institute of Dairy and Food Technology, Mannuthy, Thrissur, Kerala – 680651, India

***Corresponding Author:** R.L.Beena, Department of Dairy Technology,College of Dairy Science and Technology, Thiruvananthapuram- 695040, Kerala, India. E-mail: beenarl@kvasu.ac.in

Background: Indian women mostly suffer from osteoporosis, due to low calcium absorption in the body. Composite flour foods have gained much attention today. Casein hydrolysate contains

bioactive peptides that are found to bind divalent minerals, especially calcium. An attempt was made to formulate and standardize a composite flour premix containing casein hydrolysate for Indian women as per the energy requirements laid down by ICMR, 2020.

Method: Casein hydrolysate was prepared by enzyme hydrolysis and checked for its calcium solubilizing and binding properties. Techniques like SDS-PAGE and MALDI-TOF were applied. Composite flour premix was standardized by Response Surface Methodology (RSM) and a storage study was conducted in a suitable package.

Results: The casein hydrolysate was found to bind 0.488 ± 0.01mg of calcium/mg and could solubilize calcium up to 64.36 ± 1.17 per cent. Most of the peptides were of 2.85 K Da size. A 100g of the formulated composite flour premix could meet 18.7 per cent of the daily value of energy, 50 per cent of protein and all the calcium required for an adult woman.

Conclusion: A functional composite flour premix for women was formulated and standardized for better calcium absorption.

Keywords: calcium absorption, composite flour premix, functional, women

01-13

OPTIMISATION OF PREPARATION OF FREEZE DRIED AVOCADO POWDER

Geethu, M. and Saji Gomez

College of Agriculture, Kerala Agricultural University, Vellanikkara, Thrissur

Background: Avocado (*Persea americana* Mill), is a highly nutritive subtropical fruit tree crop belonging to Lauraceae. Due to its unique climacteric pattern, harvesting and post harvest management of fruits require more attention due to the autoxidation and further deterioration of fruit pulp. One of the best preservation methods for thermolabile and sensitive frits is freeze drying working under the principle of lyophilisation.

Method: In this work, fresh avocado pulp added with preservatives and food additives was freeze dried at -70 ^{0}C and 25 milli torque vacuum for 72 hours. The effect of the preparation under different packaging and storage conditions were evaluated based on different physical and nutritive quality parameters for three months.

Results: Refrigerated storage showed significant effect in the preservation and maintaining the storage quality of the fruit powder. Significantly high bulk density, solubility, total protein, total carbohydrate and lower total phenols were observed in samples treated with higher maltodextrin content in Completely Randomised Design of analysis.

Conclusion: The study shows that the freeze drying of avocado fruit pulp added with food additives like maltodextrin and appropriate packaging and storage conditions have significant effect in preserving the highly nutritive and highly sensitive fruit pulp of avocado.

Keywords: Avocado, Freeze Drying, Maltodextrin, Refrigeration,

01-14

INFLUENCE OF SARDINE BODY OIL INCORPORATION ON THE FATTY ACID PROFILE OF3D PRINTED FISH PRODUCT

Rasheeda, M*., Mohan, C. O., Remya, S., Elavarasan, K., Bindu, J

** KUFOS, Panangad, Kerala, ICAR-Central Institute of Fisheries Technology, Willingdon Island, Kochi 682029*

Background of the study: Polyunsaturated fatty acids are the functional ingredients which when incorporated to foods, impart potential health benefits, especially for improving the health of heart. Healthy fish products are created by enriching with essential fatty acids.3D printing technology is used to create the complex structured products, so that the final products are not only altered functionally, but aesthetically too, as per the choices of the consumers.

Method: This method involves addition of 8% sardine body oil to a low-fat fish as the PUFA source in comparison to vegetable oil. The enriched formulation is loaded into the 3D printer in the designed fish shape. The prints are then baked in an oven at 210°C for 15min. Fatty acid profile analyses were performed for the product before and after baking to assess the influence.

Results: The results of fatty acid analyses showed that though the fish mince has a very low fatty acid content, addition of sardine oil resulted in increased level of fatty acids like EPA and DHA, as compared to the control. Baking resulted in some losses of EPA (11.3%) and DHA (28.4%).

Conclusion: Sardine oil incorporation resulted in 3D printed product enriched with essential fatty acids.

Keywords: 3D printing, Sardine oil, fortification, poly unsaturated fatty acids

01-15

PHYTOCHEMICAL CONSTITUTION AND ANTIOXIDANT ACTIVITY OF NUTRACEUTICAL HERBAL DRINK FROM INDIAN GOOSEBERRY (*EMBLICA OFFICINALIS* GAERTN.) FRUITS (*AONLA)* CONTAINING SPICES AND CONDIMENTS

Saji Gomez [1], Anjali C [1], Bintu Kuruvila [1], Maneesha P.K [1], Meagle Joseph [1], Anu Mary Markose [1], Achuthan C. Raghavamenon [2], Manu K. Aryan [2]

[1] Dept. of Post Harvest Technology, College of Agriculture (KAU), Vellanikkara, Thrissur-680656, [2] Amala Cancer Research Centre, Thrissur

Background: Incidence of covid-19 pandemic has raised awareness among people the importance of maintaining higher levels of immunity. Foods or their components having therapeutic properties are referred to as 'nutraceuticals'. A study was undertaken at Kerala Agricultural University during 2020-21 to develop an herbal nutraceutical drink from Indian gooseberry fruits.

Methods: The herbal drink containing 20 % (v/v) Indian gooseberry juice, 5 % ginger juice (v/v), 2 % each of turmeric rhizome powder and black pepper powder (w/v) along with 5 % acid lime juice of 2.45 % citric acid content, followed by homogenization at a pressure of 175 Bar (2500 psi) with a speed of 235 SPM. The herbal drink was filled into 500 ml capacity glass bottles and was pasteurized at 100^{0} C for 10 minutes, followed by storage at 5 ± 2^{0} C.

Results: The product is a good source of health-protective bioactive compounds such as vitamin C, total polyphenols, flavonoids, carotenoids and curcumin. The herbal drink also exhibited strong antioxidant capacity. Immunomodulatory studies revealed higher platelet count in mice fed with herbal drink along with Cyclophosphamide, compared to normal (control) mice.

Conclusions: The findings of the study establish that the herbal drink is a good source of bioactive compounds with strong antioxidant potential**.**

Keywords: Indian gooseberry, bioactive compounds, antioxidant activity, immunomodulatory

01-16

FERTILIZER PRESCRIPTION EQUATIONS THROUGH INTEGRATED PLANT NUTRIENT SYSTEM FOR SUSTAINING CROP YIELDS AND SOIL HEALTH MANAGEMENT IN KERALA

Betty Bastin, K. Smitha John, M. R. Mayadevi, V. Divya Vijayan and K. M. Haneena

AICRP on STCR, Kerala Agricultural University, Vellanikkara, Kerala, India

Back ground: Targeted yield approach provides scientific basis for balanced fertilization with soil available nutrients and considering crop response. The soil test based fertilizer recommendation for a targeted yield through integrated plant nutrient system assures efficient and balanced nutrition, infallible yield and sustainability.

Method: A refined method of fertilizer prescription by considering nutrient requirement per unit of grain production, nutrient contribution from soil and percent contribution of nutrients from fertilizer/ manure developed by Indian Council of Agricultural Research (ICAR) under All India Coordinated Research Projecton Soil Test Crop Response Correlations (AICRP on STCR) for crops based on the concept of target yield by Ramamoorthty (1974) is used for developing fertilizer recommendations.

Results: 28 targeted yield equations for 23 crops including food crops (rice), fruit crops (*Nendran* banana, water melon), vegetables (ash gourd, amaranth, bitter gourd, cucumber, salad cucumber, snake gourd, bhindi, brinjal, chilli, pumpkin, tomato, cowpea and cluster bean) root crops (coleus, sweet potato, cassava), spices (ginger and turmeric) and oil seed crop (groundnut, sesame) have been developed by the centre.

Conclusions: The STCR-IPNS fertilizer recommendation could achieve the targeted yields with reduced quantities of fertilizers. The optimum use of fertilizers and manures reduced the cost of cultivation besides increasing the yield to the targeted level.

Keywords: STCR, Fertilizer Recommendation, Targeted Yield

POSTER PRESENTATION

01-17

ETIOLOGY, SYMPTOMATOLOGY AND MANAGEMENT OF PITTING DISEASE OF BANANA IN KERALA

Alan C. Antony[1*], Vimi Louis[2], Rashmi C.R[3], Namitha P.M.[2] and Athira K.V[2]

*[1]Dept. of Plant Pathology, College of Agriculture, Vellanikkara, 680656, [2]Banana Research Station, Kannara, Kerala Agricultural University, Thrissur, 680656, [3]AICVIP Vellanikkara, Kerala Agricultural University, Thrissur, 680656, *alan-2020-21-007@student.kau.in*

Pitting disease in Kerala was first appeared in Ernakulum district in August, 2019. Within one year of first report from central Kerala, the disease started to appear in almost all districts of Kerala. Occurrence of leaf blast on tissue culture plants and pitting disease on maturing banana bunches has been recorded in variety Nendran during rainy season of 2019 to 2022. The most serious symptom associated with the disease is development of distinct small circular dark brown concave spots on maturing fruits which reduce the visual appeal and the market value. Symptoms of the disease includes development of characteristic spindle or round shaped sunken spots on mid rib, petioles, peduncle, maturing bunches, bunch stalks, cushions and boot, leaves. Taxonomical identification as well as DNA sequence analysis of the internal transcribed spacer region (ITS) of fungus isolated from affected tissues (MW269689, OP897582 and OP901198), confirmed the pathogen to be *Pyricularia angulata* Hashioka. Koch's postulates were proved on young plantlets of cv. Nendran. Management of the disease on tissue culture generated plantlets under shade net house were evaluated using different fungicides, plant oils and bio-control agents. Among the treatments Tebuconazole + Trifloxystrobin (0.14%) found most effective.

01-18

A COMPREHENSIVE STUDY TO EXTRACT TITANIUM DIOXIDE NANOPARTICLE FROM MORINGA OLEIFERA LEAF EXTRACT

Alex Joby, Janish C, Aparna Shine, Nithin Sakariah and **Shravan Subin**

NIFTEM, 97, Niftem Rd, HSIIDC, Industrial Estate, Kundli, Sonipat, Haryana 131028

Background: The physical and chemical processes used to make nanoparticles (NPs) have a number of adverse and toxic effects on the environment. Increased particle reaction and cytotoxicity, as well as unanticipated negative health impacts, may arise from the use of nanoparticles along with detrimental effects to human health and the environment. Green synthesis approaches are very intriguing since they have the ability to reduce NP toxicity.

Method: Moringa oleifera aqueous leaf extract (MOALE) solution was made by dissolving 15 g of M. oleifera powder in 100 ml of deionized water. Then boiling it for 15 minutes at 450°C kills the pathogens. The ALE solution was filtered using Whatman No. 1 filter paper after cooling. Titanium dioxide nanoparticles were created by mixing 100 ml of a 5 mM titanium dioxide solution (pH 3) with 10 ml of a filtered MOALE solution in an Erlenmeyer flask at 500 °C while stirring. They were finally obtained by centrifugation at 8,000 rpm for 25 minutes.

Results: Using a particle size analyzer, the average particle size was found to be 95 nm. Overall weight loss from room temperature to 800 °C was assessed using a thermogravimetric curve that showed a 0.98% loss.

Conclusion: The green synthesis of titanium dioxide nanoparticles was achieved because of the presence of flavonoids, saponins, and tannins in *Moringa oleifera,* as these bioactive compounds were responsible for the synthesis of these nanoparticles. The successful production of nanoparticles was confirmed by the presence of spherical-shaped TiO2 NPs with a size of 95 nm.

Keywords: Green synthesis, *Moringa oleifera*, Cytotoxicity, particle size analyzer, thermogravimetric curve.

01-19

ECOPHYSIOLOGICAL SCREENING AND GENETIC DIVERSITY ANALYSIS OF TOMATO GENOTYPES IN RESPONSE TO SUMMER HEAT.

Amrutha Vijayakumar[1], Beena R.[2*]

[1]*Department of Plant Physiology, College of Agriculture, Vellayani, Thiruvananthapuram, Kerala, India.*,[2]*Department of Plant Physiology, College of Agriculture, Vellayani, Thiruvananthapuram, Kerala, India.*

Corresponding author: beena.r@kau.in

Abstract: The impact of heat stress on agriculture is severe and negatively impacts crop productivity. In tropical and subtropical tomato-growing regions around the world, poor fruiting of tomato plants caused by heat stress is a major factor in low output. Exceeding optimum temperatures can shorten plant life and greatly accelerate fruit flowering and maturation. Temperatures above the reference temperature cause irregular flower development, reduced pollen production, pollen viability, fruit drop, ovule abortion, and ultimately reduced yield, generates an excess of reactive oxygen species (ROS), oxidative stress, and metabolic mechanism instability. High temperatures severely affect flower shedding, with tomato plants losing 80% of their flowers and reducing fruit set. For the characteristics pollen viability, photosynthetic rate, membrane stability and fruit number, high values of genotypic coefficient of variability, phenotypic coefficient of variability, heritability, and genetic progress were discovered. All nine separate traits demonstrated additive gene action in trait expression and should be given the utmost weight in phenotypic selection. Eigen value > 1 and cumulative variance of 75.04% were shown for the four main components.

Acknowledgement: We thank Kerala Agricultural University for the technical and scientific support.

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01-20

ADAPTATION OF RICE VARIETY SREYAS TO SALINE ENVIRONMENT BY MARKER-ASSISTED GENOME REDESIGN

Anju Mariam Joseph [1], Veena Vigneswaran[2], Arya K[1], Thouseem N[1]

1 Department of Plant Breeding and Genetics, CoA, Vellayani, Thiruvananthapuram, Kerala
2 Plant Breeding and Genetics, Rice Research Station, Vyttila, Ernakulam, Kerala

Background: Rice (*Oryza sativa* L.), one of the most important cereal crops, serves as the staple food for over one-third of the world's population. Susceptibility or tolerance of rice plants to high salinity is a coordinated action of multiple stress-responsive genes. Introgressing the QTL for salt

resistance *Saltol* into the high-yielding variety Sreyas will improve its suitability for cultivation in salinity-affected regions.

Method: Hybridization of the variety Sreyas (MO-22) with the identified salt donor FL478, a source of *Saltol* QTL induces salt tolerance. Marker Assisted Backcross Breeding (MABB) can be employed effectively in minimizing the field screening procedure by early screening and identification of tolerant lines carrying the locus. Polymorphism assay of SSR markers was done to select the foreground markers associated with the QTL located on the short arm of chromosome 1 and genome-wide markers for background selection polymorphic between parents.

Results: The parental population was assayed for foreground polymorphism using 30 SSR markers of which 8 were found to be polymorphic. In the case of background markers, of the 200 SSR markers assayed 75 showed polymorphism. 152 F_1 plants were phenotyped *in vitro* and the tolerant plants under 12 dS m^{-1} (NaCl) and genotyped using polymerase chain reaction (PCR) and polyacrylamide gel electrophoresis (PAGE) for heterozygosity regarding all the foreground markers. The plants hence selected were backcrossed with the recurrent parent to develop BC_1F_1 generation. 288 BC_1F_1 plants were phenotyped *in vitro* and the tolerant plants under 12 dS m^{-1} (NaCl) were genotyped for heterozygosity of the markers linked to *Saltol*. The plants selected in foreground screening were genotyped for background homozygosity with recurrent parent and 8 BC_1F_1 plants with maximum homozygosity with the recurrent parent was selected and backcrossed with the recurrent parent to raise BC_2F_1 generation.

Conclusion: The *Saltol* locus has been successfully transferred to the backcross progeny of Sreyas and FL478 which showed considerable salinity tolerance at seedling stage with *Saltol* locus in heterozygous state. 8 BC_1F_1 plants were selected to be forwarded to the next generation to develop the introgressed lines.

Keywords: Saltol, Salinity tolerance, Introgression, Rice, Markers

01-21

EFFECT OF NATIVE STRAINS OF RHIZOBIA IN COMBINATION WITH LIME FOR IMPROVED NODULATION OF FRENCH BEAN (*Phaseolus vulgaris*)

Athul P. P*, Ranjan Kumar Patra, Narayan Panda*** and Sushanta Kumar Pattanayak****

** Department of Soil Science and Agricultural Chemistry, OUAT, Bhubaneswar*
***Department of Soil Science and Agricultural Chemistry, OUAT, Bhubaneswar*
**** Department of Soil Science and Agricultural Chemistry, OUAT, Bhubaneswar,*
athulp.puthanpurayil@gmail.com

Abstract: The legume seed inoculated with *Rhizobium* culture increased the crop yield from 20-80% and the beneficial effect on the subsequent crop yield was also observed significantly. The micro pot experiment to study nodulating ability of the two isolated strains- RBHR- 15 and RBHR-21. The experiment was carried out with sterilized river sand, soil, vermicompost mixture (1:1:1) in 500g capacity pots. The test crop Raikia bean received six treatments, namely; (1) No inoculation and no liming- Control, (2) Seed inoculation with RBHR-15, (3) Seed inoculation with RBHR-21, (4) Soil application of lime @ 0.2 LR alone, (5) Soil application of lime + Seed inoculation with RBHR-15 and (6) Soil application of lime + seed inoculation with RBHR-21. The crop was grown up to 60 days after germination (DAG). Root nodules were observed only in

the inoculation treatments and the numbers ranged from 18 to 33 and 28 to 43 per plant at crop growth stages 40 and 60 DAG respectively. The RBHR-21 strain superseded RBHR-15 significantly in nodulation behaviours such as total nodule number, nodule weight and nodular N content at both the stages of crop growth. The efficiency of the strains improved (33%) considerably when the acid soil was limed @ 0.2 LR.

Keywords: *Rhizobium,* Root nodules, French bean, Liming

01-22

ENHANCED FUNCTIONALITY OF SEMI-REFINED CARRAGEENAN NANOCOMPOSITE AS FOOD PACKAGING MATERIAL BY INCORPORATING SOY PROTEIN

Bhavya EP[1, 2] and **Maya Raman[1]***

[1]Department of Food Science and Technology, Faculty of Ocean Science and Technology, Kerala University of Fisheries and Ocean Studies, Panangad P. O., Kochi. mayaraman@kufos.ac.in, [2]Department of Food Processing Technology St. Teresa's College, Ernakulam*

Background : Carrageenan-based packaging films have demonstrated as readily available and sustainable biopolymers, and with good performance. Seaweed-based biopolymers (alginates and carrageenan) have been paid a great interest in recent years due to their good barrier properties as well as mechanical properties. Nanotechnology is a promising technology in food packaging sector which has proven capabilities that are valuable in food packaging including improved barriers, mechanical, thermal, and biodegradable properties; and applications in active and intelligent food packaging. Incorporation of different types of nanoparticles also provides excellent antimicrobial activities.

Method : Bio-nanocomposite films were prepared by the solution casting method with semi refined carrageenan (SRC-2%, w/w) and nanocellulose (NC-2%, w/w) with glycerol as plasticizer (0.8%w/w). The effect of incorporation of soy protein (0.2- 0.6%, w/w) in the films were investigated. The tensile strength and elongation at break were evaluated. The morphological characteristics of the films were evaluated using Scanning electron microscope and the permeability of the films were also studied. The colour, moisture content and the swelling ratio of the films were studied. The films were also subjected to FTIR analysis.

Result : The semi-refined carrageenan-based films were developed and the effects of nanocellulose and soy protein (SP) concentration on the physico-chemical, structural, mechanical, thermal and barrier properties were evaluated. The films comprising of nanocellulose and soy protein had reduced moisture content (20-30%), which possibly could be due the disruption of the hydrogen bonds between N-H groups of soy proteins and water molecules, assisted by nanocellulose. The nanocellulose and protein concentration was effective in improving the barrier properties of the films to oxygen and water vapor. The nanocomposite films that obstructed permeant molecules through the film. The water vapor permeability was 2677.99 g/m^2.24h in SRC films, which decreased to 2109.45 g/m^2.24h in SRC- (0.6%). The addition of nanocellulose and soy protein significantly ($p<0.05$) reduced the water vapor permeability. In structural characterisation formation of hydrogen bond between nanocellulose and soy protein resulted in better dispersion in films. FTIR spectra showed strong N-H stretch in soy protein incorporated films. The incorporation of soy protein increased the tensile strength and it ranged between 14 MPa to 17 MPa, which may possibly be attributed to the combined action of nanocellulose and soy

protein. Least elongation was observed for increased protein concentration. SRC-NC film had reddish-yellow colour indicated by higher a* and b* values, which could be due to the cellulose, minerals and insoluble aromatic compounds. The swelling ratio of the SRC-NC films with soy protein (0.6%) decreased by 41% compared to the control; nevertheless, the moisture content showed no significant variations at high protein content. The film with low protein content had low moisture content. This possibly emphasize the water holding ability and low swelling property at higher concentrations of the soy proteins.

Conclusion : The present study revealed that the bio nanocomposite film from semi refined carrageenan-soy protein reinforced with cellulose nanoparticles has proven to be a promising option in improving the barrier and mechanical properties of the film, which could also be utilized for active food packaging system. The nanocellulose and soy protein improved the functional properties of the film.

01-23

DEVELOPMENT OF A BRINJAL HYBRID WITH INNATE RESISTANCE TO BRINJAL SHOOT AND FRUIT BORER

Dr Neeraja Puthiamadom[1] and Dr. Jiji Josesph[2]

[1] Rice Research Station, Vyttila, Kerala Agricultural University, 086850065, neerajaputhiamadom@gmail.com, [2]Plant Breeding and Genetics, College of Agriculture, Kerala Agricultural University, jiji.joseph@kau.in

Background : Eggplant is one among the top ten preferred vegetables in the world. A majority of high yielding varieties of brinjal are susceptible to a wide range of pests and diseases, among which fruit and shoot borer (*Leucinodes orbonalis*) causes severe crop loss of about 70 per cent. Host plant resistance is an economically feasible method of managing pest effectively. It reduces the cost incurred in adopting crop protection measures. Continous use of broad spectrum synthetic chemicals lead to contamination of environment, bioaccumulation and biomagnification of toxic residues and disturbance in ecological balance (Dadmal *et al*., 2004). Several studies are in progress for the development of transgenic brinjal types with resistance to biotic and abiotic stress. Though work on Bt brinjal was started in 2000, no GM crop has been released so far for cultivation in India. Developing varieties or hybrids with innate resistance to brinjal shoot and fruit borer is one of the most effective alternative for mitigating the pest. Keeping these facts in view, the present study was taken up with an objective to develop a high yielding F_1 with innate resistance to brinjal shoot and fruit borer.

Methods : Selection of parents and evaluation on field

Thirty one accessions of *Solanum* were evaluated in the field for resistance to brinjal shoot and fruit borer. The morphological, biochemical and biophysical basis of resistance was also elucidated as per standard procedures**.** The male and female parents were selected based on the extend of resistance and susceptibility to brinjal shoot and fruit borer. IC618044, IC618035, IC624241, A. Kusumkar and Vengeri falling under the resistant and moderately resistant category were selected as testers to cross with the highly susceptible lines Haritha, Ponni and A. Neelkanth. The standard procedures for hybridization was followed (Neeraja, 2017). The hybrids were screened in the field along with the hybrid Neelima as the commercial check. The extend of resistance or tolerance as well as the morphological, biochemical and biophysical basis of

resistance was also elucidated as per standard procedures. Organoleptic evaluation was also carried out to identify the superior hybrid on the basis of taste and consumer preference.

Results : The highest per cent of shoot damage was observed in the parents Ponni and A. Neelkanth followed by Haritha and the hybrid A. Neelkanth x IC618035.The number of fruits per plant was the highest in A. Neelkanth and Ponni x A. Kusumkar and the lowest in Ponni x IC624241.The number of damaged fruits per plant was highest in A. Neelkanth, followed by Ponni and Haritha. Lowest number of damaged fruits was observed in IC618035, IC624241, Haritha x IC624241 and Ponni X IC624241. Lowest percent of fruit damage was observed in IC618035, IC624241, Haritha x IC624241 and Ponni x IC624241. Highest yield per plant was observed in Ponni x Vengeri , followed by Vengeri and Haritha x Vengeri . Marketable yield per plant was the highest in Ponni x Vengeri .On the basis of per cent fruit infestation the hybrids Haritha x IC618044, Haritha x IC618035, Ponni x IC618035 and Ponni x Vengeri were graded as resistant. Haritha x IC624241 and Ponni x IC624241 were graded as immune. The hybrids Haritha x Vengeri , Haritha x A. Kusumkar, Ponni x IC618044 and Neelima were graded as moderately resistant. Ponni x A. Kusumkar was graded as tolerant. The hybrid A. Neelkanth x IC618035 A. Neelkanth x IC618044 were graded as highly susceptible.L x T analysis revealed that Vengeri can be considered as a good combiner with respect to per cent shoot damage, yield per plant and marketable yield per plant. While A. Kusumkar is a good combiner with respect to number of fruits per plant, number of damaged fruits and per cent fruit damage. Among the lines Ponni can be considered as a good combiner. Ponni x Vengeri can be considered to be superior as it exhibited high heterosis for yield over the mid parent, better parent as well as the commercial check. Entries with high total sugar and high protein content are preffered in organoleptic point of view. While, the entries with higher amount of phenol, peroxidase and polyphenol oxidase are preferable in terms of resistance. Organoleptic evaluation identified Ponni x Vengeri as a superior hybrid.

Conclusion : The study identified Ponni x Vengeri to be superior in terms of yield, resistance to brinjal shoot and fruit borer, fruit properties as well as organoleptic qualities. This F_1 can be advanced further for release as a commercial hybrid after stability trials. This is likely to be a promising hybrid for brinjal farmers.

Keywords: Brinjal shoot and fruit borer, resistance, Ponni, Vengeri.

01-24

ANTIBACTERIAL AND ANTIOXIDANT EFFECT OF GREEN SYNTHESIZED IRON AND COPPER NANOPARTICLES FROM *Justicia gendarussa*

Gauthame A, Dinu V Raju, Vinaya Chandran, Dr. Linu Mathew

School of Biosciences, Mahatma Gandhi University, Kottayam, Priyadarshini Hills,686560

Background: Biogenesis is a bottom-up method that utilizes plant extract as a reducing, capping, and stabilizing agent, which reduces the metal ion into metal nanoparticles. *Justicia gendarussa* (is a weed with insecticidal activity. This study aims to synthesize copper and iron nanoparticles in the green method using and test their antimicrobial and antioxidant activities

Method: In the present study, copper and iron nanoparticles are synthesized using the leaves of this plant. These nanoparticles are characterized by UV-Vis spectroscopy, SEM, TEM, FT-IR, and XRD. Then these characterized nanoparticles were tested for their antioxidant analysis using the

DPPH method. The antibacterial effect against *Klebsiella pneumoniae, Staphylococcus aureus* and *Salmonella typhi* was estimated by the well diffusion method.

Results: The nanoparticles are found to be of good antioxidant and antibacterial effect.

Conclusions: From the study, we concluded that Cu nanoparticles have better antibacterial and antioxidant activity than iron nanoparticles.

Keywords: Nanoparticles, Biogenesis, DPPH scavenging, Antibacterial effect

01-25

CHITOSOMES: AN ADVANCED NANOCARRIER FOR NUTRACEUTICAL CONVEYANCE

Jean Mary Joy[a,b], Pavan Kumar Dara[a], Amruth Prakash[a,b], Tejpal C. S.[a], Suseela Mathew[a], Rangasamy Anandan[a*].

*[a] Biochemistry and Nutrition Division, ICAR-Central Institute of Fishery Technology, Cochin 682029, India [b] Faculty of Marine Sciences, Cochin University of Science and Technology, Cochin 682016, India,*kranandan@rediffmail.com*

Background: Encapsulation is considered as one of the most promising techniques for the facile delivery of bioactive molecules to the targeted site without altering their nutraceutical properties. Nano-encapsulated delivery systems are well known to modulate taste, consistency, texture, extended shelf-life of potential bioactive nutrients. It has ability to enhance the bioavailability of nutraceutical ingredients in functional food formulations and supplement diets. Even though, Liposome based encapsulation of active ingredients is found to demonstrate structural instability on subjecting to higher temperatures and gastrointestinal stress. Blending of liposomes with polymerbased coating is found to have improved stability on encapsulated vesicle

Method: In the current study, chitosan is employed as a coating agent to stabilize the liposomal structures. Liposome are formulated by thin film hydration method coupled with ultrasonication. The method is found effective to prepare chitosome for the tailored release of nutraceutical ingredients to the targeted sites. The physico, biochemical, morphological and functional properties of chitosomes were characterized by Particle size and Zeta potential analysis, Fourier transform infrared (FTIR), Scanning electron microscope (SEM) and Atomic force microscopy (AFM).

Result: Encapsulation efficiency (EE) has revealed that the entrapment of bioactive peptides in nano-chitosome is possessing better thermal, physico-chemical, mechanical and rheological properties as compared to uncoated liposomes.

Conclusion: Employing liposomes as shelling material for encapsulation permits the release of both hydrophilic and hydrophobic ingredients. Chitosan coatings to the liposomal vesicle is an effective approach to eliminate the problem of stability at extreme environmental conditions.

Keywords: Nanoliposome, Chitosan, encapsulation, transport vesicle, drug delivery.

01-26

RELEASE PATTERN OF NITROGEN FROM BIOCHAR BLENDED UREA FERTILIZER IN SANDY SOIL

Kavya S. R. [1], Dr. Rani B. [2*] and Nihala Jabin P. P. [3]

*Department of Soil Science and Agricultural Chemistry, College of Agriculture, Vellayani - 695 522, Kerala Agricultural University, Thiruvananthapuram, Kerala *rani.b@kau.in*

Background: A study was conducted to assess the efficiency of biochar as a nutrient carrier to delay the release of nutrients into the soil, reduce nutrient leaching, and improve nutrient utilization efficiency by the soil application of biochar blended fertilizers. The objectives of the study were to characterize paddy husk biochar and biochar-blended urea fertilizers in different ratios (1:0.5, 1:1, 1:2), and elucidation of ammoniacal and nitrate nitrogen release pattern in sandy soils.

Methods: Biochar produced by slow pyrolysis was blended with urea fertilizer by the adsorbent process. The produced biochar and biochar blended fertilizers were also subjected to SEM and FTIR analysis for the structural interpretations. To elucidate the release rate of mineralizable nitrogen, a one year laboratory incubation study was carried out at the Department of Soil Science and Agricultural Chemistry, College of Agriculture, Vellayani, Thiruvananthapuram. In order to evaluate the effect of bentonite clay on sustained release of nutrients it was also blended with biochar and urea fertilizer.

Results: The highest total nitrogen content was recorded in Biochar: Urea in 1:2 ratio (33.04%) followed by Biochar-Bentonite: Urea in 1:2 (31.13%). The porous structure of biochar and basic aromatic functional groups were altered due blending of urea fertilizers. The blending of fertilizers with biochar enhanced the duration of nutrient release than from the fertilizer alone. Mineralizable nitrogen release was about 6-7 months from biochar mixed fertilizers while it was up to one month from urea fertilizer alone. The release of nitrate nitrogen was approximately 30-50% more than that of ammoniacal nitrogen and the content of both were less for biochar – bentonite blended urea fertilizers.

Conclusion: This work revealed the potential of biochar and biochar- bentonite to serve as a carrier for sustained release of nutrients and the different ratios can meet a wide varieties of crop requirements.

Key words: Biochar, Biochar blended fertilizer, SEM and FTIR, Ammoniacal and nitrate nitrogen, release rate, sandy soil

01-27

ESSENTIAL OIL NANOEMULSION BASED NANOCOMPOSITE FOR PACKAGING OF PERISHABLE FOODS

Mary Theresa[1], Adila Shahana[1], Sreekanth K[1], Midhun Dominic CD[2], Radhakrishnan E K[1]

[1] *School of Biosciences, Mahatma Gandhi University, Kottayam, Kerala,* [2] *Department of Chemistry, Sacred Heart College, Ernakulam, Kerala Email ID- radhakrishnanek@mgu.ac.in, Ph- 9847901149*

Biopolymer-based films have significant applications in active food packaging and have increased demand to ensure the quality of foods in an eco-friendly manner. Among the various biopolymers,

chitosan based films have a substantial role as an emerging packaging material due to its film-forming and antimicrobial properties. Various materials have also been used to increase the mechanical and antimicrobial properties of chitosan based films to extend their applications in food packaging. In the present study, chitosan incorporated with nanocellulose, zinc oxide nanoparticles (ZnONP) and cinnamon essential oil nanoemulsion (CEONE) was prepared by solvent casting technique. The prepared CEONE was analysed by DLS, FTIR and TEM to confirm the size and stability. The developed films were further characterised for mechanical properties which showed improvement in its properties. The film was also found to be active against *Escherichia coli* and *Staphylococcus aureus* when compared to the control films. The synthesised film was also found to be highly efficient in reducing the microbial load of beef samples compared to the control polyethylene pouches, signifying its potentiality in extending the shelf life of meat products.

01-28

MORPHOTOXICITY OF FUNGICIDE MANCOZEB ON CUCUMBER (*Cucumis sativus* L.)

Mintu Hanna Reji [1], Dicto Jose [2], Rashmi C. R. [3], Pradeepkumar T. [1]

1. Department of Vegetable Science, College of Agriculture, Vellanikkara, Kerala Agricultural University, Thrissur. 2. Banana Research Station, Kannara, Thrissur. 3. AICRP (VC), Dept. Vegetable Science, College of Agriculture, Vellanikkara, Kerala Agricultural University, Thrissur.

Background: Mancozeb is an ethylene-bis-dithiocarbamate salt commonly used as a dithiocarbamate fungicide to protect crops from a wide range of fungal diseases. In the present study the toxic effect of mancozeb on cucumber is investigated. Phytotoxicity is the ability of chemicals to cause temporary or permanent damage to plants. The extend of phytotoxicity depends on the concentration of chemicals, environmental condition during application and sensitivity of plant species.

Method: Mancozeb 75% WP, Carbendazim 12% + Mancozeb 63% WP and Cymoxanil 8% + Mancozeb 64% WP were sprayed and drenched on ten day old seedlings along with a control. Fungicide concentration were based on Central Insecticide Board recommendation for vegetables. Observations were taken on day six after application.

Results: Results of the study revealed that Mancozeb application have adverse impact on the growth and development of cucumber seedlings. It has significant effect on root length, shoot length, collar girth, no: of primary rootlets, no: of true leaves. Drenching of cucumber seedlings with Mancozeb causes severe phytotoxic effect compared to spraying.

Conclusion: Mancozeb alone or in combination is highly phytotoxic to cucumber seedlings.

Keywords: Mancozeb, cucumber, phytotoxicity, fungicide

01-29

OPTIMIZATION OF PYROLYSIS CONDITIONS FOR THE PRODUCTION OF HIGH-QUALITY BIOCHAR FROM SELECTED AGRICULTURE RESIDUES

Naseefa, P. K.* & C.C. Harilal

Division of Environmental Science, Department of Botany, University of Calicut, Kerala.
Email: naseefanasi@gmail.com; ccharilal22@gmail.com*

Background: Crop residue burning is a major environmental issue in India. Every year, approximately 92 metric tons of crop waste is burned, causing excessive particulate matter emissions and air pollution. One of the sustainable approaches for its management is its conversion to biochar, a fine-grained, carbon-rich, porous product produced by the thermal degradation of biomass in the absence of oxygen. Optimized production of biochar and its characterization for desired traits is significant in sustainable carbon sequestration efforts in every agro ecosystem.

Method: The present study is an attempt to analyze the properties of biochar from sugarcane bagasse and cassava residue, synthesized under diverse experimental conditions. Pyrolysis temperatures were maintained at 200, 250, 300, 350, and 400°C and retention time for 30, 60, and 90 min. The physico-chemical characteristics of biochar assessed include loss on ignition, moisture content, bulk density, water holding capacity, pH, EC, TDS, salinity, resistivity, CEC and carbon content. In addition to this,an elemental analysisof the synthesized materials (carbon, hydrogen, and nitrogen) was also carried out. Surface characteristics of the biochar were assessed by SEM, FTIR, and XRD studies.

Results: Increased temperatures (200-400°C) contributed to an increase in pH of biochar from 5.84 to 10.03. Biochar from cassava residue exhibited a higher yield (19.3%) than bagasse (10.62%) at 400^0C. This can be attributed to the differences in the composition of feedstocks, with regard to their moisture, lignin, cellulose, and hemicellulose contents. The increase in temperature and residence time resulted in an increase in the LoI, EC,water holding capacity, and CEC and a decrease in the yield and bulk density of both the synthesized materials. The TOC of both biochars at 350^0C was found to be higher than at 400^0C.Biochar from sugarcane bagasse showed a higher carbon content (64.24%) than cassava (54.47%).The FTIR spectra of both biocharsindicate the presence of carboxyl, hydroxyl, phenol, and carbonyl functional groups and also showed the presence of aromatic compounds. The XRD patterns showed that both the biochars are amorphous in nature, which has an impact on their sorptive property.

Conclusions: The basic composition of the source materials is influential in the thermal conversion to form biochar. The presence of aromatic compounds, oxygen-containing functional groups, amorphous structure and high surface area are indicative of their capabilities in effective soil carbon sequestration. The bagasse biochar synthesized at 400°C had a higher carbon content, conductivity, CEC and surface area, attributing them with more stability in the soil. Therefore, the use of bagasse biochar is recommended as a soil amendment for long term carbon sequestration.

Keywords: Feedstocks, Pyrolysis temperature, Biochar, Physicochemical characteristics

01-30

SOIL CARBON SEQUESTRATION USING RICE HUSK AND COCONUT FROND BIOCHAR IN A GINGER FIELD

Nihala Jabin P. P., Rani B. and Kavya S. R.

Department of Soil Science and Agricultural Chemistry, College of Agriculture, Vellayani, Thiruvananthapuram - 695 522, Kerala, India, rani.b@kau.in

Background: Biochar is a stable, carbon rich, black solid product formed after the process of pyrolysis of biowaste. It is known for its ability to sequester carbon in soil in addition to other agricultural applications. Biochar addition to soil is suggested as an efficient mechanism to establish a long-standing sink for carbon dioxide present in the atmosphere.

Method: A field experiment was conducted to compare the effect of biochar and FYM application using ginger as the test crop in laterite soil on soil carbon sequestration. The treatments included Paddy husk biochar (PHB) and coconut frond biochar (CFB) each @ 10, 20 and 30 t ha^{-1} + NPK as per POP, KAU POP (30 t FYM + 75: 50: 50 kg NPK ha^{-1}) and control.

Results: Significantly highest value for ginger yield was recorded in the treatment receiving PHB @ 30 t ha^{-1} which was on par with CFB @ 30 t ha^{-1}. Carbon sequestration in PHB @ 30 t ha^{-1} was significantly highest with value of 1.82, 1.77 and 1.69 t ha^{-1} respectively at 60 and 120 DAP and at harvest except with CFB @ 30 t ha^{-1} at 60 DAP, with PHB @ 20 t ha^{-1} and CFB @ 30 t ha^{-1} at 120 DAP and with PHB @ 20 t ha^{-1} at harvest where it was on par.

Conclusions: PHB and CFB produced by the method of slow pyrolysis could be an important technique for soil carbon sequestration.

Key words: Biochar, carbon sequestration, ginger, yield study

01-31

DESIGN OF NANO SOLAR CELL ASSISTED BIRD SCARER SYSTEM FOR POKKALI PADDY FARMS

Rathinavel S[1], Kavitha R[2], Siva M[3], Sanjeevi P[4]

Tamilnadu Agricultural University, Coimbatore, Tamilnadu, India

Background: Pokkali ecosystem in central Kerala have observed with decline in pokkali paddy cultivation. The decline is mainly due several reasons and one important among them was birds attack (especially endangered 'moorhen'). Hence an attempt was made to design a bird scarer system suiting the environment.

Method: A solar bird scarer system suiting the saline water stagnant field and standalone power was designed. The components include scarer unit, nano solar module, battery, control unit frame and float. The system was designed with mathematical calculations, commercially available components, and SolidWorks software.

Results: The nano solar assisted bird scarer unit was designed as a standalone system with scarer unit (50 W), nano solar module (20 W), control unit (relay, microcontroller and remote) and battery (5 Ah). The system can stay active for 12 h a day with a run time of 2 min every 10 min. Suitable frame and the float (0.006 m^3) were suggested to be made with marine aluminium coated with nano materials. The system can withstand saline water stagnation, fouling and corrosion.

Conclusion: The designed system can be experimented and a successful outcome of with other measures can increase the area of pokkali paddy cultivation, indirectly protects the environment from salinity hike and salt water intrusion and also protects the traditional organic paddy variety.

Keywords: Pokkali; Bird scarer; Solar cell; Nanotechnology.

01-32

EFFECT OF SEED INVIGORATION WITH INORGANIC NANOPARTICLES ON YIELD IN CHILLI (*capsicum annum*)

Riya Mary Mathew, Dijee Bastian, Rose Mary Francies, Anita Cherian. K, K. Raja,

Department of Seed Science and Technology, College of Horticulture, Vellanikkara, Kerala Agricultural University

Background: Seed invigoration with nanoparticles is a relatively novel technology successful in many crops. The size of nanoparticles being 100 nm (or less than 100nm) in one or more dimensions, have unique properties and they have the potential to improve plant metabolism. The positive effects of nanoparticles include enhanced germination per cent, length of root and shoot and vegetative biomass of seedlings in many crop plants (Agarwal & Rathore, 2014).

Materials: Chilli seeds of variety Anugraha were dry dressed with nano grade ZnO and TiO_2. The seeds along with the treatments were taken in a screw capped glass bottles and was shaken gently 5 times for 3 min at an interval of 3hrs. Untreated seeds served as control. The experiment was conducted in a Randomized block design and the treatments included, control ; nano ZnO-500 mg kg^{-1}, nano ZnO-900 mg kg^{-1} , nano ZnO-1300 mg kg^{-1} , nano TiO_2-500 mg kg^{-1}, nano TiO_2-900 mg kg^{-1} nano TiO_2-1300 mg kg^{-1}.

Result: Seed invigoration with nano particles of ZnO and TiO_2 was found to be beneficial in improving yield and yield attributes. Seed treatment with nano ZnO @ 1300 mg kg^{-1} of seed and nano TiO_2 @ 900 mg kg^{-1} exhibited increased plant height, fruits per plant, fruit length, fruit yield, number of seeds per fruit and seed yield.

Conclusion: The nanoparticle treatments at higher concentration performed better than at lower concentrations. Nanoparticles of ZnO @ 1300 mg kg^{-1} of seed and nano TiO_2 @ 900 mg kg^{-1}recorded superior results throughout the experiment.

Keywords: Seed invigoration, nanoparticle, seed quality

01-33

EFFECT OF NANO-NITROGEN SUPPLEMENTED WITH POTASSIUM ON THE GROWTH AND YIELD ATTRIBUTES OF RICE (*ORYZA SATIVA* L.)

Sajan S. Thomas[1], Shalini Pillai. P[2], Susha V. S [3], B. Aparna.[4]

[1]Department of Agronomy, College of Agriculture, Vellayani, Thiruvananthapuram, 695 522, Kerala Agricultural University (KAU) Email: sajan-2020-11-055@student.kau.in [2] Department of Agronomy, COA, Vellayani, [3]Department of Agronomy, COA, Vellayani, [4] Organic Agriculture COA, Vellayani

Background: Excessive use of chemical fertilizers has been proved to cause severe environmental pollution. Thus modern agriculture needs to confront the issue of ensuring safe and healthy food

for the burgeoning population at justifiable costs with minimal impact on the environment. Nano-fertilizer technology is an innovative area that focuses on facilitating balanced crop nutrition in accordance with the crop needs. Nanofertilizers are being looked upon as the contrivance to enhance nutrient use efficiency in crops.

Method: A study was conducted to economise nitrogen in rice (*Oryza sativa* L.) production through nano-nitrogen supplemented with potassium was undertaken at College of Agriculture, Vellayani, Thiruvananthapuram with a short duration rice variety KAU Manu Rathna. Graded levels of basal recommended dose of nitrogen (RDN) was applied followed by top dressing with potassium laid out in randomized block design with nine treatments replicated thrice and the effect on growth and yield attributes were assessed.

Results: Growth attributes of rice, *viz*., plant height, number of tillers m^{-2}, leaf area per hill, leaf area index, leaf area duration, flag leaf area per hill and total dry matter production were observed to vary significantly with the application of graded levels of basal RDN supplemented with top dressing of nano-nitrogen and potassium sulphate at different growth stages of rice**.** And it also had a significant effect on the yield attributes of rice *viz*, grain yield, straw yield and harvest index, except grains per panicle, sterility percentage and thousand grain weight.

Conclusions: From the study it could be concluded that reducing the basal recommended dose of nitrogen by 50 per cent followed by top dressing with foliar application of nano-nitrogen as nano-urea (4 ml L^{-1}) at active tillering stage, supplemented with foliar application of potassium as potassium sulphate (15 g L^{-1}) at panicle initiation stage resulted in better growth, yield and economics in short duration rice, raised under aerobic condition.

Key words: Flag leaf area, Nano-nitrogen, Potassium, Rice, Yield attributes.

01-34

INSECT PEST INCIDENCE IN THE RICE FIELDS OF NORTH KERALA AND THE FARMER PERCEPTION OF CHEMICAL PESTICIDE ALTERNATIVES

Sreejina Sreedharan Kallyadan and Mannankadiyan Nasser

Insect Ecology & Ethology Lab, Department of Zoology, University of Calicut, Thenhippalam, Malappuram-673635

Background: The most common approach for managing rice insect pests is chemical pesticides. However, it leads to issues with pesticide resistance, insect resurgence, high dose per unit crop, operational risks, residual environmental contamination, and impacts on non-target vegetation and non-target organisms. So, they need to be replaced by an alternative chemical pest control strategy. For example., the management of insect pests through the formulation of nanomaterial-based insecticides. For that, we must know the farmer's perception of alternatives to chemical pesticides. So, we assessed the insect pest community structure and diversity, farmers' knowledge of conventional chemical pesticide alternatives, including nano pesticides, and biological control in the three agroecological zones of North Kerala.

Method: The sampling of pests was conducted along the sides of the paddy fields by hand picking and sweep netting, dividing the paddy fields into transects (25m x 2m). Relative abundance of the species was calculated by the formula, Relative Abundance (%) = (Number of individuals of one species / Sum of the abundance of all species) X 100. The diversity of the three agro-ecological zones, viz., high hill, foothill, and midland laterite, was quantified using Simpson's diversity index

(D), Shannon-Wiener index (H'), Margalef Index (α), and Pielou's Evenness Index (E1). Farmer surveys were conducted in all three agro-ecological zones. Likert scale techniques have been used to collect data on the farmer knowledge of chemical pesticide alternatives.

Results: The highest number of pests was collected from the Foothill region, followed by the Midland and High Hill regions. *Cnaphalocrocis medinalis* and *Paraponyx stagnalis* are more abundant than other pests. The dry season showed high insect pest diversity in the High hills and Foothills. In contrast, the Midland laterite region showed no significant difference in pest diversity in the dry and wet seasons. In all zones, values for species richness and evenness were also high. Farmers identified six sources of rice pest management information. Most farmers in the High Hill area learned about the chemical pesticide alternatives from other farmers and through personal experience. Farmers in the Foothill region consulted agricultural agencies, and farmers in the Midland laterite area learned about pesticide alternatives through pesticide suppliers. Information sources on chemical pesticide alternatives differed significantly across agroecological zones. Farmers who received information from multiple sources had significantly different opinions about chemical pesticide alternatives (biological control, botanicals or bio-pesticides, cultural practices, and mechanical control). Interestingly, no farmers in the study area knew of nano pesticides as chemical pesticide alternatives.

Conclusions: In North Kerala rice fields, there is a high incidence of rice insect pests. Effective and advanced eco-friendly pest management training programs are required since farmers in North Kerala are least knowledgeable about biological control and unaware of nano pesticides.

Key words: Nano pesticides, Knowledge diffusion, Biological control, Rice pest diversity

01-35

GROWTH AND YIELD OF COWPEA [*Vigna unguiculata* (L.)] INFLUENCED BY FOLIAR NUTRITION UNDER DIFFERENT MANAGEMENT SYSTEMS

P. Sugina* and T. K Bridgit

Department of Agronomy, College of Agriculture, Padannakkad, 671314, Kerala Agriculture University, Kerala, India

Background: Organic farming has recently emerged as an important practice even though there are lot of disputes regarding the production potential of organic farming. Application of nutrients as foliar spray increases the absorption of nutrients which in turn reflect on growth, yield, and quality of the produce. The direct and indirect effect of liquid organic formulations and micronutrient combinations along with normal recommendations of organic and integrated nutrient management on growth and yield were studied in detail in the research

Methods: The field experiment was carried out in randomized block design with 12 treatments, combinations of management system and six foliar nutrition. Management system includes KAU adhoc organic POP recommendations (2017) (S_1) and KAU POP recommendations (2016 (S_2). Six foliar nutrition, *viz*. '*sampoorna*- KAU multi nutrient mix' (F_1), micro nutrient solution (F_2), *jeevamrutham* (F_3), humic acid (F_4), fulvic acid (F_5) and a control without foliar spray (F_0), were tested in the study.

Result: Results of the study revealed that yield and yield attributes enhanced by KAU POP recommendations (2016) compared to KAU adhoc organic POP recommendations. KAU POP along with humic acid spray increased the pod weight per plant and was on par with S_1F_3, S_1F_3,

S_2F_1, S_2F_2, S_2F_3 and S_2F_5. Pod yield was found highest in humic acid spray and was on par with fulvic acid. Seed yield was enhanced by the fulvic acid, which was on par with humic acid and micro nutrient solution.

Conclusion: Integrated management practices has a significant role in increasing yield of cowpea compared to organic farming. Foliar nutrition of fulvic acid, humic acid and micro nutrient solution are beneficial for getting higher yield and maximum economic returns. Fulvic acid with KAU organic POP and KAU POP enhanced the BCR and was on par with all treatment combinations of KAU POP.

Key words: Cowpea, Fulvic acid, Jeevamrutham, Micronutrients, Organic, *Sampoorna*

01-36

DEVELOPMENT OF BIOSYNTHESIZED SILVER NANO PARTICLES INCORPORATED ANTIBACTERIAL PACKAGING FILMS FOR TRADITIONAL KERALA FOODS

Sumi Maria Babu and Dr Leon Ittiachen

Department of Biotechnology, Sahrdaya College of Engineering and Technology, Kodakara, Kerala, 680684

Background: Nowadays, traditional foods of Kerala, including banana and jack fruit chips are seeing an increased global demand. But due to their seasonal nature, these matured fruits are not fully utilized compared to their production rate in Kerala. Despite their higher market value globally, the shelf life of chips is limited to three to four months. Hence, bulk collection of matured fruits for chips production is not happening in the existing set up. Through the present research, we intend to develop a nano silver based packaging material to improve the shelf life of these chips and thereby benefit both the small scale industry and the farmer This innovative packaging material will have both antimicrobial and antioxidant potential and thus can be used in other industries to a wider extent in the future.

Methods: In the present paper, antibacterial activity of biosynthesized silver nanoparticles coated on low density poly ethylene films was evaluated against Gram negative *Escherichia coli* as the representative organism. Silver nanoparticles were biosynthesized using plantain peel extract as the reducing agent and characterized by means of UV-Visible spectroscopy, Scanning Electron Microscopy and Energy Dispersive X-ray analyses. Antibacterial activity of these biosynthesized silver nanoparticles coated onto low density poly ethylene films was also evaluated.

Results: Optimally biosynthesized silver nanoparticles were polydispersed and spherical in shape with size in the range of 50-300nm as confirmed by characterization studies. The nanoparticles were coated onto low density poly ethylene film by melt mixing method and the antibacterial studies revealed that the coated films declined the growth profile of bacteria starting from the log phase.

Conclusion: The silver nanoparticle coated low density poly ethylene film was prepared successfully and it can be suggested as an active packaging material for food packaging to enhance the shelf life of traditional food products after further characterization and migration studies.

Keywords: Food packaging, Plantain peels, Increased Shelf life, Low Density Poly Ethylene

01-37

ASSESSMENT OF FLAVONOID BIOSYNTHESIS FROM *IN VITRO* CULTURES OF *GENDARUSSA VULGARIS*

Vinaya Chandran[1], Gauthame A[1], Dinu V Raju[1], Linu Mathew[1]

[1]School of Biosciences, Mahatma Gandhi University, Kottayam, Kerala

Background: The present study was conducted to evaluate the presence of flavonoids in the *in vitro* cultures of *Gendarussa vulgaris.*

Methods: Leaf and Stem explants were cultured with different combinations and concentrations of plant growth regulators to study the effect on callus induction. Cell suspension culture was established from friable callus initiated. The total flavonoid content, PAL and catalase activity of the cultures were determined and the flavonoids were identified by using LCMS/MS and HPLC.

Results: Leaf was the best explant for the initiation of a friable callus and the best callus response was observed from the leaf explants on MS media supplemented with 1.0 mg/L 2,4-D. After 45 days of cell suspension culture the initial inoculum size of 5g was increased to six-fold in fresh weight. Two bioactive flavonoids apigenin and apigetrin were identified in *in vitro* cultures of *G. vulgaris.*

Conclusion: I*n vitro* culturing of *Gendarussa vulgaris* is a useful alternative method for the production of flavonoids.

Key words: *Gendarussa vulgaris,* LCMS/MS, HPLC, *in vitro* cultures, PAL activity

01-38

MAGNESIUM NANOPARTICLES FOR IMPROVEMENT OF RT-qPCR EFFICIENCY

Vinayak Mohandas, Swapna Alex, Soni K. B., Sindura K.P. and Shily C.

Department of Plant Biotechnology, Kerala Agricultural University, College of Agriculture, Vellayani, Thiruvananthapuram

Background: Quantifying low copy number target DNA in high DNA background is often a major problem in RT-qPCR. PCR specificity and efficiency are reported to be improved by the inclusion of nanoparticles. In this context, the objective of the present study was to evaluate the efficacy of silver, magnesium and zinc nanoparticles for the improvement of efficiency of RT-qPCR.

Method: The total RNA was isolated from black pepper (spike samples of Panniyur-1) and rice (leaf samples of Uma) . Real-time PCR (RT-qPCR) was performed to study the efficiency and to analyze the fold increase in amplification of *Actin1* and *OsYUCCA1* genes in rice and *Actin* and *TAA1* genes in pepper using silver, magnesium oxide and zinc oxide nanoparticles.

Results: In RT-qPCR, inclusion of MgONPs also showed maximum fold increase in amplification in all genes whereas Ag NPs showed 0.14 to 5.61 fold increase in amplification in RT-qPCR. The inclusion of a combination of Ag and MgO nanoparticles showed a slight improvement in RT-qPCR efficiency. However, ZnONPs showed no Cq values.

Conclusion: Among the different nanoparticles analysed for increasing the efficiency of RT-PCR addition of MgONPs at a concentration of 175mgL^{-1}exhibited a maximum fold increase in RT-qPCR amplification.

Keywords: RT- qPCR, Nanoparticle, Magnesium oxide, low copy number, efficiency

01-39

AGRO-FRUIT WASTE VALORIZATION FROM SWEET LIME PEEL (*CITRUS LIMETTA*) INTO NANOEMULSION OF ESSENTIAL OILS AS A BIOPESTICIDE

N. U. Visakh* and Berin Pathrose

*Department of Agricultural Entomology, College of Agriculture (Kerala Agricultural University), Vellanikkara, Thrissur, Kerala, India *visakhnu17palazhi@gmail.com*

Background: Citrus peel is a major fruit waste generated during the processing of citrus fruits. Control strategies in stored-product facilities mainly rely on synthetic pesticides. The development of new environmentally friendly alternatives, such as essential oils (EOs), is a key issue.

Method: The aim of this research was to develop a stable nano-emulsion containing a high amount of sweet lime (*Citrus limetta*) EO and to evaluate its insecticidal activity against *Tribolium castaneumm* (Coloptera: Tenebrionidae). We extracted and chemically characterized essential oil from *Citrus limetta* peel waste and evaluated its insecticidal and phytotoxic activities.

Results: The experimental nano-emulsion showed a droplet size within the range of 308 nm with PDI of 0.53. The EO nano-emulsion presented good fumigant toxicity toward adult insects of *Tribolium castaneum*, which lasted until 24 h of exposure at the highest dosages. Furthermore, the developed nano-formulation showed acute fumigant toxicity against *T. castaneum* insects. In fumigation trials, adults of *T. castaneum* were observed with more mortality than nanoemulsion-formulated essential oils of *C. limetta*. Moreover, there was no phytotoxicity observed in germinated wheat seeds in both nanoemulsion EO and EO of *C. limetta*. The EO-nano-emulsion was effective in controlling the target pests.

Conclusions: Hence, the nano-formulation of essential oil extracted from sweet lime peel waste can be valorized and utilized as a botanical insecticide against *T. castaneum*.

Keywords: Citrus peel waste, Nanoemulsion, Essential oils, Fumigant toxicity, Phytotoxicity

01-40

MALE BUDS OF 'KUNNAN' BANANA- A POTENTIAL SOURCE OF DIETARY FIBER IN COOKIES

Anjali C[1], Dr. Pushpalatha P. B.[2], Dr. Manju P. R.[3], Dr. Saji Gomez[4], Anu Mary Markose[5]

[1, 4, 5] - Department of Post Harvest Technology, College of Agriculture, Vellanikkara, Kerala Agricultural University, [2, 3] - Banana Research Station, Kannara, Kerala Agricultural University

Background: Dietary fibers are plant derived complex carbohydrates having several health benefits. The male buds of bananas have high content of dietary fiber and associated nutrients. Kunnan is a widely cultivated banana variety in Kerala. The male buds of the Kunnan variety,

which are usually discarded as waste after the harvest of fruits could be used as a potential ingredient for preparation of dietary fiber rich cookies.

Method: The cookies were prepared by incorporating powdered male buds of the banana variety Kunnan at different concentrations (10%, 20%, 30%, 40% and 50%) to the banana flour. They were analyzed for biochemical parameters such as protein, total minerals, calcium, potassium, dietary fiber, fat, carbohydrate, starch, total sugars and energy value as well as sensory attributes (9-point hedonic scale).

Result: The protein, total minerals, calcium, potassium, dietary fiber and fat content of cookies increased with the level of incorporation of male bud powder of Kunnan and the carbohydrate, starch, total sugars and energy value decreased with the level of incorporation. The cookies incorporated with 10 % male bud powder of Kunnan were adjudged as the best with respect to different sensory attributes analyzed, resulting in better overall acceptability. Hence, it was selected as the best treatment.

Conclusion: The present study revealed the better nutritional and dietary fiber content of powdered male buds of Kunnan and thus their potential as a functional ingredient in baked products.

Keywords: Dietary fiber, Banana, Kunnan, Cookies

01-41

SILVER NANOPARTICLES GREEN SYNTHESIZED WITH LEAF EXTRACTS OF DISEASE-RESISTANT AMARANTHUS GENOTYPES PROTECT RED AMARANTHUS FROM LEAF BLIGHT DISEASE SEVERITY

S. Divya[1], Susha S. Thara[1] and K. N. Anith[2]

[1] Department of Plant Pathology, [2]Department of Agricultural Microbiology, College of Agriculture, Kerala Agricultural University, Vellayani, Thiruvananthapuram, Kerala, India.
**Correspondence: divya.s@kau.in*

Background: Amaranthus, the most popular leafy vegetable of Kerala, is regarded as a superfood with significant nutraceutical benefits. The most devastating disease that severely reduces productivity is the leaf blight of Amaranthus caused by *Rhizoctonia solani*. In the present study, the potential of the silver nanoparticles green synthesized with leaf extracts of disease resistant amaranthus genotypes for their ability to suppress foliar blight disease in a susceptible amaranthus variety was evaluated.

Method: The work involved the isolation of the pathogen, green synthesis of silver nanoparticles using aqueous leaf extracts of green Amaranthus, *Amaranthus viridis* and red Amaranthus, characterisation of nanoparticles using UV-visible spectrophotometry and X-ray diffraction (XRD) analysis, *in vitro* studies for confirming the anti-fungal activity of green synthesized silver nanoparticles and *in vivo* experiments to confirm the efficacy of these nanoparticles in suppression of foliar blight in Amaranthus.

Results: Nanoparticle formation was confirmed by UV-visible spectrophotometry and XRD. Green synthesized nanoparticles using leaf extract of green Amaranthus, a resistant genotype at 750 ppm, showed the highest Percentage Inhibition (81 %) of mycelial growth of the pathogen among all the treatments and the test concentration was set at 750 ppm for further *in vivo*

experiments. All plants sprayed with the green synthesized nanoparticles prepared using the leaf extract of green Amaranthus remained uninfected and the Percentage Disease Incidence (PDI) was zero, whereas plants sprayed with the green synthesized nanoparticles prepared using leaf extract of red Amaranthus showed of 77.78 % disease incidence. PDI was comparatively lower (22.22%) in plants sprayed with nanoparticles produced with extracts from *Amaranthus viridis*. Disease severity was zero and 4.94 in plants treated with nanoparticles from green Amaranthus and *Amaranthus viridis,* respectively, compared to red Amaranthus (28.40). In short, silver nanoparticles green synthesized with extracts from the disease-resistant genotypes of Amaranthus exhibited high disease control potential against the foliar blight pathogen.

Conclusion: The green synthesized nanoparticles using extracts of disease-resistant genotypes have remarkable effectiveness in managing the foliar blight in Amaranthus.

Keywords: green synthesized nanoparticles, foliar blight, Amaranthus, *Rhizoctonia solani*.

01-42

DIAGNOSIS OF JACKFRUIT BRONZING - A NEW DISEASE OF JACKFRUIT IN KERALA

Vimi Louis[1], Vidya, C V[1], Athira K V[1] and Namitha P.M[1]

[1]Banana Research Station, Kannara, Kerala Agricultural University, Thrissur, 680656

Background: Jackfruit (*Artocarpus heterophyllus Lam.*) is most widely grown fruit species and also less exploited largest edible fruit crop in Kerala. An unreported disease locally named "Jackfruit bronzing" mainly affecting the fruits were found out during the Jack fruit disease survey 2021 -22 as part of All India Co-ordinated Research Project (Fruits) in variety Vietnam Super Early. The diseased Jackfruit samples were collected from Palakkad and Malappuram districts and *in vitro* studies were conducted at Banana Research Station, Kannara, Kerala Agricultural University.

Methods: Inside of the infected Jackfruit, reddish to brownish discoloration were seen on bulbs and rags. The external appearance of the fruits was symptomless. But the internal discoloration leads to reduction in fruit quality and compromised consumer's preferences. Jackfruit with bronzing symptoms were collected from Jackfruit plantations and the isolation of pathogenic bacteria was carried out using standard technique in Nutrient agar medium. Pathogenicity was proved by artificial inoculation of pathogenic bacteria into healthy detached Jackfruit. The bacterial isolates showing typical symptoms were studied for cultural and morphological characters. The molecular identification of pathogen was carried out by DNA extraction and PCR analysis using 16s rRNA Primers.

Result: Rusty, reddish brownish specks/ discoloration was observed in 30-40% fruits of in variety Vietnam Super Early, collected from Palakkad (Chitta) and Malappuarm (Vandoor) districts in Kerala in month of November 2022. In the affected fruits, even though no symptom observed externally, well distributed reddish brown specks were seen internally on bulbs and rags. The artificially inoculated Jackfruit produced typical symptoms of bronzing in a period of 10 days. The pathogenic bacteria produced yellowish coloured colonies in Nutrient agar and were gram negative, non-motile, non-spore forming, non-capsulated, slightly pleomorphic short rods. The bacteria were able to grown in *Pantoea* genus-specifc agar medium (PGSA). Amplicon of approximately 1.1 kb size was obtained by PCR amplification of isolated DNA of the bacteria.By

insilico analysis the bacteria were identified as *Pantoea stewartii* and the isolates are Gene bank deposited. (Accession number: OP954498 & OP954536)

01-43

PHYTOCHEMICAL AND TLC PROFILE OF EDIBLE LICHEN *PARMOTREMA TINCTORUM* (NYL.) HALE (PARMELIACEAE) FROM WAYANAD DISTRICT, KERALA

Dr.Anupama T. V [1], Dr.Sheela K B [1],

[1]Department of Post Harvest Management, College of Agriculture, Vellanikkara, Kerala Agricultural University, Thrissur, [*]Author for correspondence; email:anupama.tv@kau.in

Background: *Parmotrema tinctorum* is an edible lichen used as a spice for flavouring food. In Kerala, it's occurrence is reported in the evergreen/sub-tropical forests at an altitude of 750-2300m. Despite large collection from the forests of Kerala for use as spice, the reports on it's phytochemical and biological activities are few.

Method: The lichen *Parmotrema tinctorum* was collected during December 2015 from different areas of Wayanad district, Kerala. The lichen thalli were cleaned, washed, dried under shade and powdered. The lichen extracts were prepared by cold maceration method using organic solvents *viz*. methanol and acetone. The filtrate was screened for phytochemical constituents. TLC was done using Merck silica gel 60 F_{254} TLC plates, by spotting lichen extracts. The plate was developed using solvent systems, hexane –ethyl acetate, chloroform-methanol, benzene-ethyl acetate. The R*f* values of the spots were calculated, and the probable group of compounds was found out.

Results: Methanol extract of *Parmotrema tinctorum* contained maximum phytochemicals *viz*. carbohydrates, phenols, flavonoids, tannins, terpenoids, fixed oils and coumarins. Acetone extract was found positive for carbohydrates, phenols, tannins, terpenoids, fixed oils and quinones (Table 1). Methanol being highly polar dissolves most of the secondary metabolites of *Parmotrema tinctorum*. In TLC, all the three solvent systems S1, S2 and S3 were found to separate compounds from methanol extract of *Parmotrema tinctorum*, resulting in five spots in S1, four spots in S2 and four spots in S3. The R*f* values of spots were S1-0.27, 0.33, 0.54, 0.72, 0.43; S2- 0.31, 0.37, 0.52, 0.85; and S3- 0.16, 0.25, 0.60 and 1.04. When acetone extract was subjected to TLC in the three solvent systems, all the solvent systems produced spots, five in S1, four in S2 and five in S3. Lichen extracts showed the presence of number of phytochemicals mainly phenols and terpenoids.

Conclusion: The extracts of lichen *Parmotrema tinctorum* indicated the presence of phytochemicals *viz*.phenols, terpenoids, tannins, in phytochemical screening and in thin layer chromatography indicating the potential for biological activities of this lichen. It can be explored for developing natural antioxidants.

Keywords: Edible lichen, *Parmotrema tinctorum*, Phytochemicals, R*f* value, Thin layer chromatography

01-44

CARBON AND NITROGEN MINERALIZATION DYNAMICS OF FARM RESIDUES IN SOIL GROWN UNDER INTEGRATED AND ORGANIC NUTRIENT MANAGEMENT

Mayadevi, M. R[a*]., Sushama, P. K[a] and Sandeep, S[b]

[a]Department of Soil Science, College of Agriculture, Kerala Agricultural University, Thrissur - 680 656, Kerala, India. [b]Department of Soil Science, Kerala Forest Research Institute, Peechi, Thrissur – 680653, Kerala, India

Background: Proper management of banana residue poses a challenge to the farmers and at the same time offers great scope for recycling and use in subsequent crop. *In-situ* decomposition of banana wastes after the harvest of bunches will cut down the waste management costs drastically and improve soil health at the planting sites. The quality and quantity of crop residues are highly dependent on the mode of nutrition. Studies on carbon (C) and N mineralization of *in-situ* incorporation of farm residues in soil are helpful in predicting CO_2 emission potential to the atmosphere and soil fertility of the soil.

Method: Field experiment to assess the C and N mineralization of farm residues grown under organic and integrated nutrition was conducted. The contents of C and N were analysed using an elemental analyser. The kinetics of residue decomposition were worked out by fitting C and N contents in first order exponential model. From model fits, half-life and cumulative mineralization were worked out

Results: The rate of C mineralization in residues grown under integrated nutrient management revealed a two-phase system with an increasing slop up to 45days of incorporation into the soil and a consistent slope thereafter. Residues grown under organic nutrition showed a slow and consistent mineralization with a positive slope up to 90 days, higher rate of cumulative C mineralization and longer half-life.

Conclusions: This work proposed the strong relationships between organic and integrated modes of nutrient management and nutrient mineralization in soil. A novel, sustainable and wholistic soil–plant –crop waste–continuum was established.

Key words: Carbon and Nitrogen mineralization, Banana residues, single pool exponential model, soil health

01-45

UTILISATION OF KERALA'S TRADITIONAL YARD LONG BEAN GERMPLASM FOR DROUGHT TOLERANCE

Rahana S.N.[1], Beena Thomas[2], Arya K. [3], Roy Stephen [4], Soni K.B.[5] and Jayakrishnakumar V.[6]

[1]ICAR-IIOPR, Research Centre, Palode, Trivandrum, Kerala
[2,3,4,5,6] College of Agriculture, Vellayani, Trivandrum, Kerala

Background: Yard long bean is an important vegetable that serve to address malnutrition and food insecurity due to its low management requirements and high nutritional content. Being a leguminous crop, it enriches soil and is an integral part of sustainable agriculture. However, it is an underutilised crop in India. Moisture stress is a major abiotic constraint that limits its extension to

non-traditional areas of cultivation. Yard long bean has been in cultivation in Kerala since ancient times, resulting in a rich and diverse local germplasm. Collection, conservation and utilisation of this native diversity is crucial for broadening the cultivar genetic base and exploiting this genetic wealth in developing climate resilient cultivars and future possibilities.

Method: Research was conducted in this context to identify new sources of moisture stress tolerance among the available germplasm and to use the tolerant lines in breeding programmes to develop drought tolerant cultivars. Hundred locally available genotypes were evaluated for drought tolerance both in field and polyhouse under imposed water stress condition.

Results: Seven drought tolerant genotypes selected through germplasm screening were genetically analysed for combining ability and heterosis using a L x T mating design. Twenty one hybrids generated through this were evaluated for twelve morphological and physiological parameters for drought tolerance. All the hybrids manifest a significant amount of dominance variance for commercial exploitation. The identified genotypes and the transgressive segregants from the identified crosses can be used for the development of drought tolerant high yielding cultivars in the future.

Conclusion: The study is a primary initiative in the development of climate resilient varieties in yard long bean. The utilisation of these genetic resources encourages its cultivation into drought prone and waste land regions, ensuring minimal consequences of climate change, malnutrition and helps in improving farmers income and food security of the nation.

Keywords : Yard long bean, Germplasm, Moisture stress, Heterosis, Climate resilient cultivars

01-46

DIOSCOREA VARIETIES USED BY THE TRIBAL COMMUNITIES OF KERALA, INDIA

Roshni. S, Anu Therasa Antony, Anish N.P, Manoj P. and Archana S

DBT-Rajiv Gandhi Centre for Biotechnology, Thycaud, Thiruvananthapuram-695 014, Kerala

Background: The tribal communities are the most important carriers of cultural diversity through generation. From the field study we observed that during lean period they were mainly depends on variety of tuber varieties, especially dioscorea variety. The diversity in vernacular names in different communities necessitates a detailed analysis of morphological characteristics of wild tuber plants for the proper identification of the species, thus decided to carry out an extensive morphological study on dioscorea species.

Materials and methods: The study was conducted with an extensive field survey among 9 tribal communities and elderly grouped farmers of Wayanad and Idukki and Thiruvananthapuram districts. Based on availability of tribal inhabitants, 12 blocks were randomly selected from the 3 targeted districts and interviewed 105 tribal knowledge holders from 56 tribal settlements. The interviews using structured questionnaire, oral questions, and discussions were carried out in Malayalam language. From the field study we observed that during lean period they were mainly depends on variety of tuber varieties, especially dioscorea variety; thus decided to carry out an extensive morphological and genetic study on dioscorea species.

Results: A total of 38 dioscorea varieties belong to 9 species were documented from 3 targeted districts. It includes both domesticated and wild varieties. The study revealed that diet of tribal

people was largely depending upon the locally available tuber varieties. Most domesticated varieties of dioscorea are *D. alata, D.bulbifera,* and *D.esculenta*. By realizing the importance of dioscorea varieties in the diet of tribes, a detailed study on morphological and genetic study of locally available 9 dioscorea species were carried out and documented the specific features. Various morphological parameters as per standard taxonomic procedure were recorded. Taxonomic identification of the species was done with authentic literature like Flora of Presidency of Madras. Morphological characteristics showed major variability in the phenotypic characters of 9 dioscorea species and demanded detailed genetic study of each species.

Conclusion: The wild tubers grow deeply into soil and require tremendous effort to harvest. During harvesting, they used to leave a small piece tuber in soil can regenerate the aerial part, thus preserving the genetic diversity. The use of other varieties is hindered due to the presence of high fibre content and bitter taste. The morphological variability and difference in local names of dioscorea varieties demands a detailed genetic analysis to confirm its diversity.

01-47

SMART FARMING: IOT BASED REMOTE SENSING AND CATTLE LOCALIZATION

Shareena E M, Roshni Alex, Chika K Gangadharan

Department of Electronics, MES College Marampally,Aluva

Background: The main objective of this work is to assist the farmers by protecting the farm from wild animal attacks, authorizing access to a farm, fire safety to a farm area, monitoring the moisture content of the soil and designing smart wearable for cattle management. Usually, wild animals are the main intruders of farmland. Also, there is a chance of unauthorized access by human beings in remote areas. In some cases, there is a chance of threat by fire also. It is also advantageous if the farmers is having a facility to sense the moisture content of the soil in that area. Also, a cattle management system is helpful for the farmers in the hilly areas as there is a chance of missing the animals and it is very difficult to monitor them at the end of the day. A complete solution for the above-mentioned issues can be solved using the latest technology. By introducing this technology the productivity of farming can be increased and also a fully automated cattle management system can be developed.

Methods: The system consists of IR sensor, ultrasonic sensor, temperature and humidity sensor, flame sensor, rain sensor, RFID reader and these modules are interfaced with the host controller. IR proximity sensor is used to detect animal and human intrusion into the agricultural fields. An ultrasonic sensor is used to detect the intrusion of birds into the agricultural fields. Temperature and humidity sensor is used to monitor the ambient condition of agricultural fields. The Flame sensor is used to detect dry crop fires in the fields. A Rain sensor is used to detect rain. RFID reader is used for authorized entry to the field by using RFID tag. It is helpful to avoid unauthorized entries to the field. If the system detected any intrusion of animals or birds, the system activated the pest repeller, rotten sprayer unit, electrical fencing around the field and high intensity light to protect the field from intruder animals or birds. The host controller collects all the data came from the sensor, which sends to a gateway controller. Node MCU is used as gateway controller in this system. Node MCU sends the data that came from the host controller to a server. When the intrusion is detected, authorized personnel get an alert through the application. And also, the application can be used to control the repeller, fence and all other systems remotely using the application.

The block diagram of the wearable gadget is shown in figure 2. Location is monitored using GPS and this is sent to the microcontroller. The microcontroller processes the signals and transmitted them as radio frequency using NRF24L01 module up to one kilometer without internet. So this module is installed within several 1 km areas so that it can be connected to a server placed in the farm.

We can also develop the technology based on Internet of Things (IOT) to monitor the health condition of the cattle using several sensors, this data is sent to the raspberry pi module and it is processed and can be uploaded to the cloud which can be useful for the cattle management system.

Results: The host controller is STM32F103C8T6 and the gateway controller is NodeMCU. The TX pin of STM32F103C8T6 is connected to RX pin of NodeMCU. PA0 pin of STM32 connected to DHT11 signal pin. Trigger and echo pin of the ultrasonic sensor is connected to STM32 PA1 and PA2 pins respectively. Signal pin of IR proximity sensor, rain sensor, and the flame sensor is connected to PA3, PA4, and PA5 of STM32 respectively. Analog pin PA6 is connected to the moisture sensor. The RX pin of STM32 is connected to TX pin of EM-18 RFID reader. D0, D1, D2, and D3 pin of NodeMCU is connected to Relay 1, Relay 2, Relay 3, and Relay 4 respectively. D4 pin of NodeMCU is connected to DC water pump. The power supply circuit is only a regulator section which consists of a 7805 regulator IC with filter capacitors. The 12V DC power is given as input and 5V DC is taken as output to power sensors and modules. The power supply circuit is only a regulator section which consists of a 7805 regulator IC with filter capacitors. The 12V DC power is given as input and 5V DC is taken as output to power sensors and modules.

Conclusions: In the world, the economy of many countries depends upon agriculture. In a country like India main part of GDP comes from agriculture. So problems related to agriculture will be reflected in our economy. Animal interference and fire in agricultural lands are the main reasons for crop loss thereby decreasing the yield. So there should be advanced technology in agricultural fields to support farmers. We could use the internet of things to build smart farming. The farm field near to forest faces animal attacks like an elephant and pigs. Birds also contribute to this crop loss. So this work aims to develop smart farming and cattle management systems.

It is now possible to resolve this problem by intelligently applying the benefits of current technologies. In this work, we have developed a system that consists of several sensors to detect environmental changes, and the presence of animals, birds, etc. Also, there is a part to check the crop condition like soil moisture level, temperature, humidity presence of fire, rain, etc. According to this corresponding actuators like electric fences, bird repellers, rotten egg spray, high-intensity light are activated based on that sensor data. Farmers are alerted using the Android application about the intrusion, and fire in the farm field. Authorized entry and unauthorized entry will be informed to the farmers by a message to the Android application. Also, the work fulfills the intention of locating missing cattle. The work can be extended by including task such as animal identification, genetic mapping, data related to yield, etc.

Keywords: Smart Farming, Cattle Localization, Internet of Things

01-48

DEVELOPMENT OF BIOLOGICALLY INTENSIFIED DISEASE MANAGEMENT STRATEGY FOR LEAF ROT OF COCONUT

Susha S. Thara, Deepthi S Nair, Divya S and Aashitha Joy

College of Agriculture, Vellayani, Thiruvananthapuram

Background: Coconut farming plays a vital role in the agricultural economy of Kerala state. One of the major reasons for the low productivity of coconut in Kerala is due to a devastating disease, root (wilt) disease and leaf rot disease. Biological control using antagonistic microorganisms has long been a subject of research resulting in a wide range of products. In this regard, the study aims to tackle the problems of leaf rot disease using the natural inhibitors of the disease from the phylloplane of the healthy leaflets of the infected palm and to develop an eco-friendly management strategy for leaf rot disease.

Method: The pathogens were isolated from the coconut leaf rot samples collected from heavily infected palms in different agro-ecological zones of Kerala. The virulent isolate identified among the major pathogens were used for further studies. In order to identify the effective antagonists from the phylloplane of coconut, healthy leaflets were collected from the leaf rot infected field or palm. The isolated microflora were tested for their antagonistic potential against major pathogens of leaf rot disease under *in vitro* condition by dual culture technique. The efficacy of seven fungicides were evaluated against the major pathogens by poisoned food technique at three different concentrations viz., 250, 500 and 1000 ppm. The compatibility of selected fungicides and bioagents were tested based on their *in vitro* sensitivity by poison food technique.

Results : The virulent pathogens started exhibiting leaf symptoms after three days of inoculation. The most virulent pathogen isolated from diseased specimen was *Colletotrichum gloeosporioides* and *Fusarium solani*. The five bioagents viz., *Piriformospora indica*, *Trichoderma harzianum*, *Bacillus subtilis*, *Pssuedomonas fluorescens* and *A. niger* were evaluated against *Colletotrichum gloeosporioides* and *Fusarium solani* by dual culture technique under *in vitro* conditions and the highest percentage of inhibition was recorded with *T. harzianum* and *P. indica* (80%). Among seven fungicides and five bioagents tested against the pathogen, the fungicides carbendazim + mancozeb, Tebuconazole + Trifloxystrobin and Copper oxychloride and Hexaconazole exhibit 100 % inhibition at 250, 500 and 1000 ppm and bioagents *T. harzianum* and *P. indica* found to be effective against the pathogen. The compatibility of *P. indica* and *T. harzianum* were tested with above four fungicides by poisoned food technique. The percentage of inhibition of *T. harzianum* with copper oxychloride was 41.4, 34.4 and 20 % and with *P. indica* was 100.0, 100.0 and 45.5 % at 0.1%, 0.05% and 0.025% concentrations respectively.

Conclusion

The present study highlighted the importance of integrating copper oxychloride with bioagent *T. harzianum* for effective management of Leaf rot disease of coconut. Under severe infection also integrated use will give a sudden relief of the disease by the action of the chemical fungicide and the biocontrol agent will give a long lasting management.

Key words: Coconut, Leaf rot disease, biocontrol, disease management

01-49

BIONOMICS AND ECO-FRIENDLY MANAGEMENT OF JASMINE BUDWORM, *Hendecasis duplifascialis*

Swathy I. M[1], Malini Nilamudeen[1]*, Sheena A[2]*

[1]Department of Agricultural Entomology, College of Agriculture, Vellayani, [2]Department of Horticulture, College of Agriculture, Vellayani, Correspondence: malini.n@kau.in

Background: *Jasminum sambac*, belongs to native tropical and subtropical regions of the world. Commercial cultivation of jasmine is a lucrative profession and Kerala climate is well suited for its cultivation. However varying climatic conditions of Kerala demands development of new ecofriendly management.

Method: The work involves the study of bionomic of jasmine bud worm and evaluation of different chemical and biopesticides against jasmine budworm.

Results: The egg, larval and pupal period was 3.35 $\pm$ 0.11, 11.15 $\pm$ 0.08, 5.25 $\pm$ 0.10 days, respectively. Chlorantraniliprole 8.8% w/w+Thiamethoxam 17.5 % w/w SC @150g a.i ha^{-1} had no incidence of pest. Among the biopesticides, oil based formulation of *Metarizhium anisopliae* NBAIR Ma and *Beauveria bassiana* NBAIR Bb 5 both, @ 10 mL L^{-1} caused 73 and 67 per cent reduction in the population.

Conclusion: For initial pest incidence fortnight spray of *Metarizhium* or *Beauveria* is recommended. Single spray of Chlorantraniliprole 8.8% w/w+Thiamethoxam17.5 %w/w SC@150ga.i ha^{-1} can be recommended for severe incidence.

Keyword: jasmine, budworm, *Metarrizhium anisopliae, Beauveria bassiana,* Chlorantraniliprole, Thiamethoxam

01-50

DEVELOPMENT OF A TECHNIQUE TO DETECT THE PRESENCE OF COW MILK IN GOAT MILK

Vandhana. P. S and Dr. Divya M. P

Kerala Veterinary and Animal Sciences University, Pookode, Kerala 673576

Background: Adulteration of Goat milk in terms of mixing with Cow milk has emerged to be a serious issue in the recent years. The higher price and nutritional value coupled with limited availability of the former serves as the driving factor for the mixing of relatively cheaper, easily available cow milk to goat milk. The current available analytical techniques for the detection of presence of cow milk in goat milk are highly sophisticated, laborious, complex and time consuming which cannot be adopted at the basic level by private goat milk producers. So the development of a simple rapid laboratory technique for the same which can be applied at the farm and society level is a great need in the present days.

Methods: The study was conducted using pure goat milk, pure cow milk and cow milk mixed with goat milk at different proportions of 25 percent, 50 percent and 75 percent. The physico chemical and compositional properties of samples were analyzed as a preliminary trial. Ethanol stability of the samples towards 70 percent ethanol was studied together with microscopic view of milk coagulum by Scanning Electron Microscopy (SEM) and fatty acid profile of milk samples

using Gas Chromatography- Mass Spectrometry (GC-MS). The coloured reaction of the samples with Bromocresol purple and Seliwanoffs reagent were performed and difference in the intensity of colour developed was measured quantitatively by Hunter lab colorimeter.

Results: In terms of physico chemical and compositional parameters, a significant variation between the samples was observed in terms of fat and chloride content. Goat milk has lower ethanol stability compared to bovine milk and it improved by addition of cow milk. A blue colour which varies proportionately in intensity from light blue for pure goat milk to dark purple by increased addition of cow milk was developed by addition of Bromocresol purple and was verified using colorimeter. The addition of Seliwanoffs reagent to the above said samples led to the development of coagulum with significant differences in appearance such as a completely dispersed coagulum in case of goat milk and a clearly settled coagulum on top portion for cow milk. The rate of settlement of coagulum to the top increases with increase in content of cow milk in goat milk.

Conclusions: The above stated differences may be considered as the basis for detection of presence of cow milk in goat milk. A rapid platform test for the detection of the same was developed.

Keywords: Adulteration, Goat milk, Coagulum, Bromocresol purple, Seliwanoffs reagent

02 –BIOTECHNOLOGY

ORAL PRESENTATION

02-1

SYNTHESIS AND OPTIMISATION OF A NOVEL PROTOCOL FOR THE PREPARATION OF BACTERIAL MEMBRANE-BASED VESICLES AS POTENTIAL VACCINE CANDIDATES FOR INFECTIOUS DISEASES

Aiswarya P., Sarita G. Bhat, Sreeja Narayanan*

Department of Biotechnology, Cochin University of Science and Technology, Kochi, Kerala
**Corresponding author: narayanan.sreeja@cusat.ac.in*

Background: *Staphylococcus aureus* is a Gram-positive food-borne pathogen that can colonize several parts of the body asymptomatically and can be a reason for gastroenteritis, pneumonia, and so on. The envelope of the bacteria contains a thick peptidoglycan layer, teichoic acids, and some proteins, all of which are suggested as potential vaccine candidates. In the present study, we have optimised a biologically and chemically feasible protocol for obtaining *Staphylococcus aureus* membrane vesicles for use as a vaccine candidate which are characterised by their non-live state, but contain all the immunogenic components intact.

Method: The method utilizes an antiseptic molecule with potential to form pores on the surface of the bacteria to create empty bacterial cell envelopes. Prior to the protocol optimization, the minimum inhibitory concentration (MIC) and minimum growth concentration (MGC) were determined and a concentration ideal for the preparation of the membrane envelopes was optimised. The physico-chemical characterisation of the membrane vesicles was performed using the gel electrophoresis, FTIR, SEM, and Zeta sizer.

Results: Our results indicated that we could successfully obtain a non-live empty cell envelope of size in the nano- dimension (typically 700-800nm), using the antiseptic-based protocol we have designed. Further we also confirmed that the genetic material from the treated bacterial cells were completely expelled while the cell wall immunogens were preserved intact as determined using the gel electrophoresis and FTIR spectroscopy. Also, we found that the vesicles were colloidally stable as was understood from the zeta potential characterisation.

Conclusion: In conclusion, we present a laboratory feasible protocol for obtaining immunogenic vesicles with potential as vaccine candidates for infectious diseases. Our work has implications in oral vaccination strategies for gut-related infections.

Keywords: Membrane-vesicles, bacteria, vaccine, infections, *Staphylococcus aureus*

02-2

CUCURBITACIN B ISOLATED FROM *Corallocarpus epigaeus,* A POTENT DRUG CANDIDATE AGAINST MALIGNANT MELANOMA

Sreekumar U Aiswarya[1, 2], Gowda Vikas[3], Haiprasad Nair Haritha[1], Ravi S Lankalapalli[3]*, Ruby John Anto[2*] & Smitha V B[1*]

[1]Department of Biotechnology, University of Calicut, Malappuram, Division of Cancer Research, Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram, [2]Organic Chemistry Division, CSIR-NIIST, Pappanamcode, Thiruvananthapuram

Background: *Corallocarpus epigaeus* (Cucurbitaceae) is a plant widely used in traditional medicine for various illness and ailments, though not been evaluated for anti-cancer potential. We have isolated and characterised an anti-cancer compound from the plant and investigated its mechanism of action.

Methods: The dried rhizome powder was subjected to polarity-graded extraction. The crude extracts and fractions were analyzed for anticancer potential by cell viability assays. The anti-cancer principle was characterized as Cucurbitacin B (Cu-B), by TLC, column chromatography, NMR (^{13}C and ^{1}H) and Mass spectrometry. The mode of cell death exhibited by Cu-B was analysed by Western blot. Pharmacological safety was evaluated using acute and sub-chronic toxicity models in Swiss albino mice. The anti-melanoma activity of Cu-B was evaluated using melanoma xenograft model in NOD-SCID mice.

Results: The anticancer compound in the bioactive fraction isolated from the ethyl acetate extract of *C. epigaeus* was identified as Cu-B, which showed maximal cytotoxicity against melanoma cells. Anti-melanoma activity of Cu-B involves potentiation of apoptotic cell death and suppression of proliferation by inhibiting MAPK signaling. Pharmacological safety and anti-melanoma activity of Cu-B was confirmed using animal models.

Conclusions: This is the first study reporting the isolation and identification of cucurbitacin B from *C. epigaeus* and demonstrating its anti-melanoma potential, *in vitro* and *in vivo*. Our study put forward Cu-B as a candidate drug against malignant melanoma, the most aggressive and treatment-resistant skin cancer, and accounts for 75% of all skin cancer-related deaths.

Keywords: *Corallocarpus epigaeus*, Cucurbitacin B, melanoma, apoptosis, NMR spectroscopy, mass spectrometry

02-3

HORMONE RECEPTOR HETEROGENEITY IN BREAST CANCER CELLS: UNDERSTANDING THE NON-GENETIC REGULATION OF RECEPTOR DYNAMICS IN HORMONE RESISTANCE.

Aswathy S[1], T R Santhosh Kumar[1]

[1]Cancer Research Program, Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram-695014, Kerala, India

Background: Despite the incredible research and developments, cancer remains a deadly disease, showing resistance against almost all conventional therapies. Pre-clinical and clinical studies have led to the development of many innovative diagnostic and treatment methods contributing to

cancer prevention, diagnosis, and treatment progress. However, the evolution of resistance remains to be the fundamental barrier to long-term disease control and cure. The reason is attributed to the accessibility of many alternative evolutionary resistance pathways to cancer cells. It has been observed that hormone-independent resistance happens, even in the presence of estrogen receptors. A shift of tumor cells from estrogen receptor-positive to negative contribute to a high tumor relapse rate with an even higher risk of metastasis, indicating a poor prognosis, which could be more aggressive than triple-negative breast cancer.

Methodology: We have developed drug-resistant cells in hormone receptor-positive cell lines and studied the dynamics of resistance at distinct stages. Stable cell lines overexpressing receptors of Er-α and Her2 were developed in TNBC cell lines to understand the direct role of receptor status in determining the drug response and cell growth. The cells were exposed to anti-estrogen 4-OH tamoxifen, and the drug responses were analyzed using live-cell imaging and western blotting. The mechanism of proteasomal regulation of receptor expression is also being studied. For this, we have used transcriptomic data sets of Breast cancer patients from TCGA and analysed the differential expression of ubiquitin proteasomal degradation-related genes based on the receptor expression status. These were validated in-vitro via qPCR, and promoter-binding studies were done with CHIP-qPCR (Chromatin Immuno precipitation).

Results: The ER alpha expression decreases while resistance is generated. EMT markers are upregulated. Properties of stemness were increased. Also, a balanced ratio between pro and anti-apoptotic proteins seems to exist, which gets reversed during resistance generation. Research is progressing to understand the link between receptor modulation and Bax/Bcl-XL balance alteration. Potential candidates who account for the downregulation of the receptor's expression via the ubiquitin-mediated pathway, thereby promoting resistance generation, are also being studied.

Conclusion: The expression of receptor proteins seems to be regulated dynamically during physiological conditions and under diverse stress conditions. The generation of a stable hormone resistance mechanism involves complex modulation of pro and anti-apoptotic proteins.

Keywords: Apoptosis, Hormone resistance, Chromatin Immunoprecipitation (CHIP).

02-4

COMPARATIVE GENOMIC ANALYSIS OF THE NON-DAIRY PROBIOTIC *BACILLUS SAFENSIS* SDG14 WITH SELECTED DAIRY AND NON-DAIRY PROBIOTICS WITH EMPHASIS ON ENZYMES IN LELOIR PATHWAY

Bindiya. E. S, Swathikrishna. R. K, Sarita. G. Bhat

Department of Biotechnology, Cochin University of Science and Technology, Cochin-22

Background: We have isolated probiotic bacteria *Bacillus safensis* SDG14 from *Sardinella longiceps* gut. The genomic characterizations along with the wet lab experiments proved the probiotic nature of the organism. The whole genome analysis of SDG14 proposed it as a spore forming, bile salt resistant, bacteriocin producing, essential amino acids and vitamin producing, stress responsive probiotic which can competitively exclude pathogens. The present study focuses on the in silico comparison of Leloir pathway enzymes of *Bacillus safensis* SDG14 with other widely established commercial probiotic bacteria like *Lactobacillus plantarum* WCFS1, *L.*

rhamnosus GG, *Bacillus pumilus* SAFR-032, *Bifidobacterium longum* DJO10A, *Bacillus pumilus* PDSLzg1, *Bacillus* sp. WP8 to establish the advantages of SDG14.

Method: Genome mining for carbohydrate metabolic genes was accomplished by RAST server. The galactose metabolic pathways of selected organisms were compared with that of *Bacillus safensis* SDG14 in KEGG (Kyoto Encyclopedia of Genes and Genomes). Multiple Sequence Alignment (MSA) of the enzyme sequences was done using the Clustal Omega program.

Results: *Bacillus safensis* SDG14 shows more genomic similarity towards *Bacillus pumilus* SAFR-032. Among the 37 genes involved in Galactose metabolism, 15 (40.5%) genes were found in SDG14. All the organisms, irrespective of dairy and non-dairy contain almost equal number of ECs for galactose metabolism except for *Bifidobacterium longum* DJO10A which showed only 10 (27%) ECs for galactose metabolism. *Bifidobacterium longum* DJO10A shows the least similarity in the MSA.

Conclusion: We conclude that the probiotic isolate *Bacillus safensis* SDG14 is a potential non-dairy probiotic capable of galactose metabolism similar to that exhibited by the commercial diary and non-dairy probiotics.

Keywords: Probiotic, Bacillus, Non-dairy, Galactose metabolism

02-5

NEURONAL STEM/PROGENITOR CELLS DERIVED FROM DENTATE GYRUS REGION OF MOUSE ADULT BRAIN EXHIBITS ENHANCED NEUROGENESIS AND DIFFERENTIATION PROFILE COMPARED TO THOSE OF SUB VENTRICULAR ZONE

Ayswaria Deepti [1], Bins KC[1], Baby Chakrapani PS[1@]

[1]Centre for Neuroscience, Department of Biotechnology, Cochin University of Science and Technology, Kalamassery, Cochin – 682022, Kerala, India @ chakrapani@cusat.ac.in

Background: Neural Stem/progenitor Cells (NSC) of the adult brain can be refined as neurospheres and can differentiated to the cells of the Central nervous system (CNS). Hence, they are considered as a promising source for cell regeneration treatments. Unlike embryonic stem cells, there's still little clarity on the signaling system as well as the lineage commitment of these multipotent NSC. These are a few pivotal deterrents for the utilization of these cells in regenerative purposes. Here we try to characterize the cells derived from the two niches of the brain, SVZ and DG to better understand the cellular characteristics and lineage commitment of the cells.

Method: SVZ and DG region were dissected from the Balb/c mice (age 8 – 12 weeks) brain and cells were isolated by trypsinization. The stem cells were cultured in Neurobasal A media supplemented with Glutamax, B27, EGF and FGF. The cells were subjected to MTT assay, neurosphere assay, mRNA sequencing and analysis, Real-time PCR and immunocytochemistry analysis to check various characteristics of the cells like proliferation, differentiation and lineage commitment.

Results: We found that SVZ cells proliferated faster compared to DG and showed higher number of stem cell populations. Also, the markers of stem cells SOX2 were expressed higher in SVZ cells compared to DG. mRNA sequence analysis of both the stem/progenitor cell population indicates

differentiation of DG cells due to the higher expression of genes involved in neuroactive ligand receptors and axonal guidance. Also, Gene ontology analysis shows higher number of genes involved in cell differentiation in DG cells. Hence, we checked the expression of Tuj1, the marker gene for neurons after the unbiased differentiation of the cells for 12 days. We found that Tuj1 gene expression was higher in DG cells which was in line to the immune cytochemical assay of the cells against the marker protein Tuj1.

Conclusions: The NSCs of SVZ are rapidly proliferating than that of DG and the comparatively smaller size of neurospheres of DG can be considered as a sign of differentiation which is supported by the bioinformatic analysis suggesting to axon guidance. Also, DG cells showed higher number of Tuj1 expressing cells indicative of more neuronal differentiation compared to SVZ. These findings will be helpful while selecting cells for stem cell therapy in regenerative medicine.

Keywords: Neural stem cells, Sub ventricular zone, Dentate gyrus

02-6

DEVELOPMENT OF SCAR MARKER FOR THE IDENTIFICATION OF PANNIYUR-6 FROM OTHER *Piper nigrum* VARIETIES

Ebin P Eldho and Jaya Vinny Eapen

Mar Athanasius College, Kothamangalam, Ernakulam

Background: SCAR (Sequence Characterized Amplified Region) maker is a powerful molecular tool used for DNA fingerprinting. This method can be used for trait identification of plants. Black pepper *(piper nigrum)* is a major crop cultivated in south-India. More than 75 cultivar of black pepper is available in the market. However, to distinguish these variety morphologically is difficult, identification of the variety is essential when it comes to the yield and the essential components produced by them. Panniyur is one of the most widely cultivated variety of black pepper. They are dominant in terms of yield and other aspects. Panniyur is currently available in the market but other varieties are also there. Of them Panniyur-6 has several advantages over other variety. In order to overcome this Panniyur-6 can be distinguished using molecular markers. In this work ISSR (Inter Simple Sequence Repeats) is selected due to their several advantage over other markers.

Methods: The tender leaves of Panniyur-6 and other varieties were subjected to DNA extraction using a DNA extraction kit. The obtained DNA sample were undergone PCR amplification using ISSR primers. For the research a sum of seven ISSR primers were selected (ISSR 1-7). A distinct band of approximately 700 bp and band of 900bp were procured using ISSR-6 and ISSR-1. A 50µl reaction was carried out and the selected band was excised from the agarose gel. The band was later eluted out of the gel for cloning and transformation. A TA-cloning Kit which had pMD20-T vector was chosen for cloning. In addition, DHF-α (E. coli) was selected for transformation. The transformed colonies obtained from screening undergoes sequencing. From the result a primer was designed which can be developed as SCAR maker that can be used for the easy identification of Panniyur-6 from other varieties.

Results: Taking the genomic DNA as template the ISSR-PCR reaction gave several bands. Of them PCR amplified product using ISSR-1&6 gave distinct band in Panniyur-6 with a bp of 900 & 700 respectively. With ISSR-6 about 7 visible band was visible which had a size >1000 to 700bp

length. The band with 700 bp was selected due to its desirable size for cloning and transformation. The transformed colonies were isolated and sequenced. The primer designed was confirmed by SCAR-PCR amplification of the panniyur-6.

Conclusion: The main objective of this work was to develop a highly specific SCAR marker which can be used as an interface tool of DNA fingerprinting. Identification of a specific pepper variety from a group through its morphological character is impossible. Use of SCAR marker for identification is a highly specific, rapid, reproducible method.

Keywords: Panniyur, PCR, ISSR marker, TA cloning, SCAR

02-7

GENETIC IMPROVEMENT AND EVALUATION OF PHYSIOLOGICAL TRAITS OF THE *SUB1* INTROGRESSED ELITE RICE VARIETY AISWARYA BY USING MARKER ASSISTED BACKCROSS BREEDING

Meenu M. Nair and Shylaraj K. S.

Rice Research Station, Vyttila, Kochi, Kerala, India

Background: The potential paddy-growing regions of Kerala (Kuttanad, Pokkali, Kole, and Kaipad) are located below mean sea level and have serious water logging issues. In these places during the monsoon, crops cannot be grown due to flooding. The only solution to increase productivity in flooded areas of Kerala at reasonable production costs is to make commonly cultivated high-yielding mega rice varieties more tolerant to submergence stress. Marker-assisted backcrossing (MABC) is considered the most accurate and fastest method to transfer desirable QTLs into the genetic background of elite rice cultivars.

Method: The method adapted for introgression of *Sub1* QTL into rice variety Aiswarya was Marker-assisted backcrossing. Donor parent Swarna *Sub1* and recurrent parent Aiswarya were screened using SSR markers to identify polymorphic markers that can be used for the analysis of *Sub1* introgressed lines. In vitro, phenotypic screening and enzymatic activities of the *Sub1* introgressed lines were monitored under submergence stress for fourteen days.

Results: The selected *Sub1* introgressed BC_2F_2 lines, together with the parental variety, were subjected to 14 days of submergence stress. The IRRI Standard Evaluation System was used to evaluate the survival percentage, elongation percentage, and SES score after 14 days of de-submergence. The tolerance score of the introgressed lines was comparable to that of the tolerant donor parent, Swarna *Sub1*. The activities of major enzymes involved in alcoholic fermentation (PDC and ADH) were assessed in Aiswarya BC_2F_2 lines produced under submergence stress. Aiswarya *Sub1* introgressed lines showed enhanced ADH and PDC activity, similar to the donor parent Swarna *Sub1*.

Conclusions: Finally, the best *Sub1* introgressed BC_2F_2 lines were chosen for field evaluation and pyramiding of the *Sub1* gene for dual stress tolerance.

Keywords: QTL, *Sub1* gene, Marker Assisted Backcrossing, SSR markers

02-8

BIOTIC ELICITATION OF *IN VITRO* PHENYL PROPANOID SYNTHESIS IN *Artanema sesamoides* Benth

Monisha G.[1], Elizabeth Jose[2], Soni K. B.[3], Ancy Joseph[4], Swapna Alex[5] and Deepa S. Nair[6]

[1 2 3 5] Department of Plant Biotechnology, Kerala Agricultural University, College of Agriculture, Vellayani, Thiruvananthapuram. [4] Aromatic and Medicinal Plants Research Station, Odakkali, Perumbavoor, Ernakulam. [6]Department of Plantation Crops & Spices, College of Agriculture, Vellayani, Thiruvananthapuram.

Background: *Artanema sesamoides* Benth is a medicinal plant known to contain phenyl propanoid glycosides (PPGs), a pharmaceutically valued group of compounds with high antioxidant and anti-inflammatory properties. Our preliminary studies indicated a higher content PPGs in callus cultures compared to field grown plants. This study explores the possibility of enhancing the *in vitro* production of PPGs using elicitors.

Method: Ten day old liquid cultures initiated using callus in MS medium with 0.5 mgL^{-1} NAA and 0.5 mgL^{-1} BA were treated with elicitors viz., salicylic acid, methyl jasmonate, abscisic acid, yeast extract and PPGs were analyzed using HPLC followed by RT-qPCR to study the expression profiles of *PAL* (phenylalanine ammonia-lyase) and *UGT* (UDP glucose glucosyl transferase) genes.

Results: YE significantly increased the content of all the major PPGs, with a maximum content of 4.160 mg/g dry weight. YE (1.5 gL^{-1}) enhanced the maximum content of acteoside (36.951%) and isoacteoside (22.220%). Elicitation with SA (100µM) enhanced the content of acteoside (5.85%), isoacteoside (15.5%). Martynoside (19.9%) and plantainoside (10.68%). The two key genes, *PAL* and *UGT* were upregulated by all the elicitors. SA (40µM) upregulated *PAL* gene by 26 fold followed by yeast extract (18 fold with 1.5 gL^{-1}), MJ (16 fold with 25µM) and ABA (11 fold with 50µM). The expression of *UGT* was highest (42fold) with SA (100µM), followed by yeast extract (20 fold with 1 gL^{-1}) and MJ (10 fold with 25µM).

Conclusion: Yeast extract significantly enhanced the *in vitro* production of six major PPGs (artanemoside, isoacteoside, leucosceptoside, martynoside and plantainoside) in *A. sesamoides*. The study shows a possible use of yeast extract in the *in vitro* production of PPGs.

Keywords: *Artanema sesamoides*, Phenyl Propanoid Glycosides, Acteoside, Elicitors, *PAL, UGT*

02-9

OPTIMIZATION OF PIGMENT PRODUCTION BY AN EXTREMELY HALOPHILIC ARCHAEON *HALOARCULA RUBRIPROMONTORII* MS5.5 USING RESPONSE SURFACE METHODOLOGY AND ESTIMATION OF ITS ANTIOXIDANT ACTIVITY

K. P. Neethu[1,2]*, K. S. Sobhana[1], Keerthi R. Babu[1,2], S. Jasmine[1], L. Ranjith[1], H. Jose Kingsley[1], Eldho Varghese[1], K. K. Joshi[1] and A. Gopalakrishnan[1]

[1]ICAR-Central Marine Fisheries Research Institute, Ernakulam North P. O., Kochi – 682 018, Kerala, India, [2]Cochin University of Science and Technology, Cochin University P.O., Kochi - 682 022, Kerala, India, neethunambiar26@gmail.com

Background: Haloarchaea are naturally found in solar salterns and hypersaline lakes. They produce variety of pigments which are red, orange or pink in colour and have wide range of

biotechnological applications. Here, we discuss about an orange-red pigmented halophilic archaeon, *Haloarcula rubripromontorii* MS5.5, isolated from a solar saltern in Tamil Nadu, South India. The pigments produced are mainly bacterioruberin, β-carotene and bacteriorhodopsin. The use of carotenoid pigments in aquaculture feed is well documented. Bacterioruberin acts as cellular membrane reinforcement and bacteriorhodopsin is recognised commercially for use in artifcial retina, holograms, photoelectric devices and optical computing. The purpose of this study was to optimise the conditions of pH, salinity and temperature for cell growth and pigment production employing Response Surface Methodology (RSM) and also to estimate antioxidant activity of the pigment.

Method: For the screening of pigment producing haloarchaea, brine and sediment samples were collected from a saltpan and the isolates were cultured in archaeal specific medium. An orange-red pigment producing haloarchaeal strain MS5.5 isolated was identified by phenotypic and biochemical characteristics as well as using molecular tools. After 7 days of incubation, the pigment was extracted using methanol and then analysed by UV Spectrophotometry, FTIR, and LC-MS. The optimum condition for cell growth and pigment production were e**x**amined by RSM using Bo**x**-Behnken design . Antio**x**idant activity of the pigment was also tested using DPPH and ABTS assay.

Results: The Orange-red pigmented halophilic archaeon MS5.5 isolated from solar saltern water was identified as *Haloarcula rubripromontorii* based on phenotypic, biochemical and molecular characteristics. The 16SrRNA gene sequence of the strain was submitted in NCBI GenBank with Accession no. **OP854675.** The UV spectrophotometry analysis showed highest peak at 220 nm. Through LC-MS analysis, the mass of the compound present was identified. The optimum conditions for pigment production and cell growth were identified by Box-Behnken design.

Conclusion: The haloarchaon *H. rubripromontorii* MS5.5 exhibited good potential for pigment production, which can find industrial, pharmaceutical and bioelectronic applications.

Keywords: Archeal pigment, *Haloarcula rubripromontorii*, LC-MS, RSM,UV Spectrophotometry

02-10

MOLECULAR CHARECTERISATION OF VITELLOGENIN GENE FROM INDIAN BACKWATER OYSTER *MAGALLANA BILINEATA* (MBVTG)

Nidhiya Kottayi[a*], Pradeep M A [a], Nivya A [a], Nisha E A [a], Azhar Shahansha T S [a]

[a] Central Marine Fisheries Research Institute, Ernakulam North P.O, Kochi 682018, India

Background: Vitellogenins (Vtg) are the precursors of the major egg-yolk proteins of oviparous organisms. In vertebrates, Vtg are produced under estrogen control in the liver of the mature female, secreted into the bloodstream and taken up by oocytes via receptor-mediated endocytosis. Vtgs have been shown to be present in almost all species of oviparous animals ranging from nematodes to vertebrates (Chen et al., 1997). Vtg proteins have been isolated from many molluscs including oysters but the expression of vitellogenin in Indian backwater oyster, *Magallana bilineata* (Mb Vtg) during the reproduction and growth is still not clear.

Method: In this study, Based on the results of transcriptome sequencing of the Indian backwater oyster *Magallana bilineata*‘s gonads, we obtained a cDNA encoding vitellogenin (Vg) gene. Sequence homology comparison was carried out by the program BLAST. Molecular mass and

isoelectric point and signal peptide sequence were predicted using bioinformatic tools. The glycosylation sites and the phosphorylation sites were also predicted. Phylogenetic analysis was and conserved domain prediction was also done.

Results: Mb-vtg consisting an open reading frame of 7548 bp. The deduced protein is composed of 2515 amino acids, with an estimated molecular mass of 284 kDa and isoelectric point of 9.17. Analysis with SignalP software revealed that the deduced peptide contains a putative signal peptide of 16 amino acids. Alignment with other known molluscan Vtg amino acid sequences showed that the Mb Vtg exhibited highest identity with Crassostrea gigas Vtg (86.13% identity), followed by *Crassostrea angulata* Vtg, (86.07% identity) and *Saccostrea glomerata* Vtg (63.63% identy). Domain architecture indicated the presence of vitellogenin/ LPD_N (N-terminal lipoprotein domain), VWFD (Von Willerand Factor Type D domain) and DUF (domain of unknown function).

Conclusion: In order to gain a better understanding of the vitellogenesis during oogenesis in *M.bilineata*, ORF of Mb vtg was identified and characterized, Most of the important structural and functional motifs and amino acids residues were found conserved in Mb vtg also, as reported in earlier studies. The phylogenetic analysis showed the evolutionary relationship of the proteins with their homologs across the taxa, and showed similar pattern as they are related in the taxonomic potions.

Keywords: Molluscs, *Magallana bilineata*, Egg yolk protein, Vitellogenein

02-11

MOLECULAR PHYLOGENETIC ANALYSIS OF SQUIDS OF THE FAMILY LOLIGINIDAE USING MITOCHONDRIAL MARKERS, COI

Nisha K*, Sandhya Sukumaran, Wilson Sebastian, A Gopalakrishnan

Marine Biotechnology Fish Nutrition and Health Division, Central Marine Fisheries Research Institute, Post Box No. 1603, Ernakulam North P.O., Kochi-682 018.
Email: nishakrishnanmiya@gmail.com

Background: Due to a paucity of morphological and molecular evidence, the phylogeny of the family Loliginidae is still not fully resolved. In the present study, the taxonomic status of squid species in the family *Loliginidae* was elucidated by performing genetic analysis using mitochondrial marker.

Methods: DNA isolated from the fin base tissue using a modified phenol-chloroform method. Maximum likelihood and Bayesian phylogenetic analysis were carried out in MEGA 6 and BEAST respectively by using mitochondrial COI gene sequence data. Intra and Interspecific genetic distance (k2p) were calculated using MEGA 6 software.

Results: Maximum likelihood and Bayesian phylogenetic analyses using the COI gene sequence revealed the presence of two major clades, primarily the superorders Decapodiformes and Octapodiformes. Order Sepiidae has formed a sister group to other Orders, Spirulidae, Sepiidae, Ideosepidae, and Teuthidae within the Decapodiformes. Both phylogenetic approaches confirmed the monophyly of the Loliginidae family, with *Sepioteuthis australis* occupying the basal position. Two main clades could be observed for the remaining taxa. The first clade composed by *Doryteuthis* and *Lolliguncula*, and the second by *Alloteuthis*, *Afrololigo*, *Heterololigo*, *Loligo*, *Uroteuthis*, and *Loliolus*. In relation to the three loligo species (*Loligo vulgaris*, *Loligo reynaudi*,

and *Loligo forbesi*), *L. forbesi* was identified as the sister species to the *L. vulgaris-L. reynaudi* species pair. The maximum genetic distance among Loliginids was found between the genera *Uroteuthis* and *Sepioteuthis* (0.2103), and the lowest genetic distance between *Uroteuthis* and *Loliolus* (0.1617). Our reconstructed phylogeny strongly supports *Uroteuthis* as a paraphyletic taxon as all organisms belonging to the genus Loliolus explicitly grouped with one of the Uroteuthis clades.

Conclusion: Although the family Loliginidae contains more than 50 species, only 29 species were used in this study, the lack of molecular and morphological data for many of these species continues to be a limitation. Further studies with a large number of samples representing actual Loliginidae diversity and more molecular markers are needed to delineate evolutionary relationships among them.

Keywords: Loliginidae, Phylogeny, Loliolini, Monophyly, Mitochondrial COI

02-12

MEDICINAL PLANT MEDIATED SYNTHESIS OF NANOPARTICLES AND THEIR CHARACTERIZATION

Sangeeth Chandran and A. V. Raghu*

KSCSTE- Kerala Forest Research Institute, Peechi 680653
(Correspondence mail: dravraghu@gmail.com)

Introduction: Plant-mediated green synthesis of nanomaterials is novel and provides a cost-effective and environment friendly alternative to chemical and physical synthesis. In addition, the use of plants can be easily scaled up for large-scale synthesis without the use of toxic chemicals or the need for high pressures, energy and temperatures. In the current study, we approach a novel method for the synthesis of three different metal nanoparticles (CuO-NPs, Ag-NPs and ZnO-NPs) by using an aqueous extract of fresh leaf of *Holostemma ada-kodien*.

Methodology: Freshly prepared leaf extract of *H. ada-kodien* and precursor solutions of respective nanoparticles were mixed in different ratios for the biosynthesis of nanoparticles. The synthesized nanoparticles were characterized in terms of morphology, crystalline nature and structure with UV-vis spectroscopy, XRD, TEM and FT-IR analysis tools.

Results: The synthesized nanoparticles were well crystalline in nature. The silver nanoparticles have a spherical shape with an average particle size of 23.528 nm. The copper oxide nanoparticles were estimated to be about 11.40 nm in size and primarily asymmetrical in shape. The size of the zinc oxide nanoparticles was approximately 19.17 nm, and they were found to be spherical in shape.

Conclusions: The nanoparticles produced from the leaf extract of *H. ada-kodien* are found to be stable and reproducible. The nanoparticles were characterized using XRD, TEM, FT-IR and UV-Vis absorption techniques. Green synthesis of nanoparticles from this plant is the first report in this plant and results of this study may be used for various therapeutical/medical applications.

Keywords: Nanotechnology, Pharmacology, Green synthesis, Precursor

02-13

NANOZYME BASED SIGNAL ENHANCED LATERAL FLOW ASSAY FOR RAPID AND SENSITIVE DETECTION OF COVID-19

Sarathkumar E, and Jayasree R S*

Sree Chitra Tirunal Institute for Medical Sciences and Technology, Thiruvananthapuram, jayasree@sctimst.ac.in

Background: Lateral flow assay (LFA) is a versatile and cost-effective diagnosis technique used for the detection of a wide range of analytes. Recently, nanozyme signal amplified LFA techniques got attention to increase their sensitivity and enable the quantitative detection of analytes towards the development of a highly efficient and affordable diagnosis kit. Generally, 3,3′,5,5′-Tetramethylbenzidine (TMB) is used as a peroxidase enzyme and peroxidase mimicking nanozyme substrate. However, the coloured product of TMB is sensitive to light and the intensity of colour decreases over time, limiting its application in LFA.

Method: Herein, we have utilized gold nanoparticles as a peroxidase mimicking nanozyme and different techniques to enhance the catalytic activity of these gold nanoparticles using different substrates for high contrast in LFA format. In this study, we have adopted specific covid-19 spike protein aptamers as a capturing probe and a catalytic gold nanoparticle as a labelling agent for the development of this covid-19 diagnosis kit.

Result: Using the enhancement techniques adopted, we observed that **t**he brown colour products of nanozyme are persistent, light-insensitive, and resistant to the loss of coloured signal, that would have increased the assay sensitivity. Using this enhancement strategy adopted, LFA has enabled the detection limit up to 7.5 ng/ml for Covid-19 spike proteins and that signal is observable with the naked eye and the technique is more user-friendly. Further, the inclusion of smartphone-based image analysis techniques will enable the quantitative measurement of analytes in samples.

Conclusion: In summary, the developed LFA kit utilizes the principle of gold nanoparticle nanozymatic activity with the support of a high catalytic substrate for a sensitive and quantitative detection of covid-19. This covid-19 LFA kit can increase sensitivity to a level comparable to a standard laboratory technique like ELISA while lowering cost at the same time.

Keywords: Lateral flow assay; Nanozyme; Covid spike protein; Signal Enhancement

02-14

MODELING LPS INFLAMMATION TO STUDY GUT DYSBIOSIS AND ITS EFFECT ON GUT MICRBIOME IN ZEBRAFISH (*DANIO RERIO*) MODEL

Sumi J Menachery , Dr Sarita G Bhat,

Department of Biotechnology,Cochin University of Science and Technology, South Kalamassery, Kochi-682022

Background: The emergence of microbiome research open a new horizon in the field of diagnostics and treatment of disease has been increased immensely in past few years due to the advancement of technology and significant decrease in the cost of analysis. Understanding the role of microbiota can enable the engineering of new diagnostic techniques and interventional

strategies. Inflammation, which is induced by the immune response, is recognized as the driving factor in many diseases, including infections and inflammatory diseases, metabolic disorders and neurodegenerative diseases. As the inflammation leads to gut dysbiosis which may contributes to the development of various diseases. Zebrafish is emerged as a vibrant model in gut micrbiome studies as its microbiome is known.

Methods: Zebrafish was anesthetized using MS-222 and injected intaperioneally/ intrarectally with LPS from *E. coli* 0111:B4 at different concentrations. The fishes were euthanized and gut samples was collected after 48hrs. Histopathology staining of gut samples was done with Haematoxycillin and Eosin. Expression of inflammatory markers TNF α, IL-6, IL-1β was studied using RT-PCR. Metagenomic DNA isolated using QIAamp Stool Mini Kit and 16s RNA sequencing was done.

Results: Gut inflammation was occurred in both intraperitoneal and intrarectal administration of LPS in histopathology staining. In expression study the fold change is decreasing with increase in the dosage of LPS. Metagenomic DNA band was obtained near 21.23kbp in agarose gel electrophoresis. Polymerase chain reaction (PCR) amplification of 16S rRNA gene using genomic DNA and a band obtained at 1500bp.

Conclusion: LPS inflammation model in zebrafish was successfully developed which can be useful for gut microbiome studies. Intarectal administration of LPS showed prolonged inflammatory response than intraperitoneal administration.

Keywords: zebrafish, microbiome, inflammation, LPS, itraperitoneal, intrarectal, inflammation

02-15

BIOTIN-CONJUGATED AZA-BODIPY INDUCED CELL DEATH IN BREAST CANCER PHOTODYNAMIC THERAPY

Rajshree R Nair[1], *, Dhiraj Dutta[2], Pranjal Gogoi [2]and S Asha Nair[1]*

[1]Rajiv Gandhi Centre for Biotechnology, Cancer Research Programme, Trivandrum-695014, [2]CSIR-North East Institute of Science and Technology (CSIR-NEIST), Chemistry Department, Jorhat - 785 006, India,E-mail: sashanair@rgcb.res.in

Background: A growing field of cancer research, photodynamic treatment (PDT) uses photosensitizers (PS) as pro-drugs. When exposed to light of a specific wavelength, these pro-drugs cause reactive oxygen species (ROS) to be produced, which ultimately results in cell death. In the realm of PDT, creating effective sensitizers for therapeutic purposes continues to be a critical predicament . In this endeavor, we created new, effective PSs based on Aza BODIPY bio conjugate (DPR2b) with biotin moiety for PDT and multimodal analysis of cancer in collaboration with Dr. Pranjal Gogoi of CSIR NEIST Jorhat.

Method: Different assays, comprising nuclear condensation, TMRM, Annexin V apotototic, and CM-H2DCFDA tests, were employed to determine the photocytotoxicity of Aza BODIPY bio compound (DPR2b) with biotin moiety in breast cancer cell lines**.** Using WebGestalt, we used a proteomic approach to investigate the molecular mechanisms of DPR2b in PDT. To find significantly (p-value 0.05) enriched pathways connected to altered proteins, a WEB-based GEne SeT AnaLysis Toolkit (WebGestalt) has been used.

Result: Our preliminary investigation into the IC50 value of DPR2b in the breast cancer cell lines MDA MB 231 (6μM) and MCF7 (7μM) supports the sensitizers' potential for use as PDT. These PSs displayed typical chromatin condensation and diminished mitochondrial potential, which are characteristics of cellular death. By using Annexin V-FITC/PI flow cytometric analysis, we further verified early and late apoptosis elicited by these PSs.

Our proteome analysis revealed molecular pathways such as response to unfolded protein, Ribosome Biogenesis, cell redox homeostasis, regulation of programmed cell death, and actin cytoskeletal organization were induced. Venn diagrams and STRING network analysis were used to examine additional interactions. It is widely recognized that oxidative stress-mediated cell death pathways elicit their activity by PDT.

Conclusion: This study suggests that DPR2b Aza BODIPY may be potential photosensitizer for PDT applications in cancer , and further molecule validation could project the PS to be applicable in breast cancer treatment .

Keywords: Photodynamic therapy, WebGesTalt, Aza BODIPY, Breast Cancer.

02-16

SELECTION OF DOMINANT REFERENCE GENE AND EXPRESSION OF AGAMOUS GENE VIA qRT-PCR IN *BORASSUS FLABELLIFER* L.

Soorya S.[1, 2], T. S. Swapna[1] and K. K. Sabu[2]

[1]Department of Botany, University of Kerala Kariavattom, Thiruvananthapuram 695581
[2]Biotechnology and Bioinformatics Division, Jawaharlal Nehru Tropical Botanic Garden and Research Institute, Palode, Thiruvananthapuram 695562

Introduction: Palmyra palm is an economically important multipurpose tree with dioecious nature. A novel strategy known as qRT-PCR technique must be used to understand how gene expressions are connected to the floral organ formation. To quantify the target gene level, a suitable reference gene is essential for the normalization of qRT-PCR. Therefore, the current study's goals were to characterize the expression of the C-class function AGAMOUS floral organ identity gene and to identify stable reference genes constantly expressed in the male and female palmyra palm.

Methods: For this work, ten potential reference genes were chosen, their expression stability in vegetative and reproductive tissues of cDNA was evaluated, and their stability was verified by several methods (RefFinder, NormFinder, BestKeeper, and Delta CT method). To identify AGAMOUS gene we sequenced partial cDNA at Eurofins Genomics, Bangalore, India and the sequence. From that sequence RT PCR primers were designed and validate the stability of most stable reference gene.

Results: Through the software analysis we found that NAD52 was the reference gene that was expressed in both male and female palms the most consistently. Finally, RT-qPCR experiments of the target gene (AGAMOUS) with the most stable reference gene confirmed the reliability of selected reference genes in different stages of flower development. In addition, the AGAMOUS gene shows up regulation in the cDNA samples of stamen and carpel. The standardization of reference genes and floral organ identity gene expression study are reported for the first time in palmyra palm and this information will useful for the future gene expression studies.

Conclusions: The present study identifies the NAD5-2 is the most stable reference gene in both male and female flowers. Results of gene expression analysis show that AGAMOUS could possibly play an essential role in regulating the reproductive organ identity of stamens and carpels.

Key words: Gene expression, reference gene, AGAMOUS, qRT-PCR

02-17

PRO-INFLAMMATORY '*SCHOOLING*' OF HUMAN MACROPHAGES BY BACTERIAL GHOST CELLS AS A PROMISING APPROACH TOWARDS TUMOR IMMUNOTHERAPY

Sreeja Narayanan*[1], Andrea Joseph[1], Praveen Kumar Vemula[2], Sarita G Bhat[1]

[1] Department of Biotechnology, Cochin University of Science and Technology (CUSAT), Kochi, [2] DBT-InStem, GKVK Campus, Bellary Road, Bengaluru
**Corresponding author: narayanan.sreeja@cusat.ac.in*

Background: In recent years, immunotherapy has evolved as a promising strategy for cancer treatments. Of the many immune cells that infiltrate the tumor microenvironment (TME), the macrophages are a major component. They are categorized into two phenotypes viz, M1-type (anti-tumor effectors) and M2-type (pro-tumor effectors). The macrophages are substantially regulated by the TME to perform as pro-tumor entities (i.e., M2-type) after they have infiltrated into the tumor. Hence, a major challenge is to educate the infiltrating naïve macrophages to behave as the M1 anti-tumor type in order to manifest an effective immunotherapy. In the present study, we have developed a strategy based on bacterial ghost cells to tame the naïve macrophages to differentiate into the M1 anti-tumor phenotype.

Methods: We have attempted to achieve two objectives: 1) Preparation, purification and characterization of bacterial ghost cells (GCs) by scanning electron microscopy, fourier transform infra-red spectroscopy, gel electrophoreses and stability analysis, and 2) Subjecting THP-1 human monocyte-derived macrophages to M1-differentiation by the GCs and the evaluation of the immunological biomarkers (TNFα, Il-1β, Il-6, Il-8, IL-10, IL-12, IFNγ, CD86, and CD206) by RT-PCR and ELISA.

Results: We had obtained strictly monodispersed, hollow, and round GCs of size between 700-800 nm, with extended colloidal stability and shelf-life as well as intact surface immunogenicity as observed in our spectroscopy experiments. The GCs have exhibited the potential to educate the human monocyte-derived naïve macrophages to perform as M1 anti-tumor macrophages in a time-dependent manner as evident from our extensive genomic and proteomic experiments.

Conclusion: Our results significantly support the potential of the bacterial ghost cells in educating the naïve macrophages to polarise towards the M1-type population. Our optimised protocol for preparing and purifying GCs is an industry-scalable and cost-effective approach owing to the ease in the preparatory processes. This strategy of using GCs for modulating macrophages could offer a unique opportunity for utilising them as a "Trojan horse" for in situ macrophage activation and cellular immunotherapies.

Keywords: Bacterial ghosts, immunotherapy, macrophages, pro-inflammatory, anti-cancer.

POSTER PRESENTATION

02-18

DEVELOPMENT AND CHARACTERIZATION OF AN IMMUNOGENIC NANO-CONSTRUCT BASED ON POLYLACTIC-CO-GLYCOLIC ACID FOR ACTIVATION OF NATURAL KILLER CELLS

Adheena P.B, Sarita G Bhat, Sreeja Narayanan*

Department of Biotechnology, Cochin University of Science and Technology (CUSAT), Kochi
**Corresponding author: narayanan.sreeja@cusat.ac.in*

Background: Immunotherapy harnesses the human immune system to fight cancer. Nanotechnology, on the basis of their excellent physiochemical properties, such as efficient tissue-specific delivery function, and controllable surface chemistry, holds significant potential in improving the efficacy of cancer immunotherapy. The current study focuses on the development of a immunomodulatory Polylactic-co-glycolic acid (PLGA)-based nanoconstruct.

Method: In the present study, we have developed a PLGA-based nanoconstruct with immunosensitizer inclusions via the emulsion protocol with optimization of the various process parameters. The physico-chemical characterization of the nanoconstruct was performed using the FE-SEM, TEM, Zetasizer, NMR and biochemical assays. Assessment of their cytotoxicity was done using cell viability assays and gene-expression evalution was performed via RT-PCR.

Results: The polymeric immunostimulatory nanoconstruct was below 100nm in size and were well-characterized. The nanoconstruct did not exhibit any cytotoxicity towards natural killer cells and was capable of activating the cells in a time and concentration -dependent manner as was evident from the marker analysis.

Conclusion: Our results validate that immunomodulatory nanoparticles could be used as ex vivo activators for natural killer cells prior ot their infusion into patients for manifesting a cell-mediated immunotherapy. Our future perspective includes the evaluation of our nanoconstruct in small animal models.

Keywords: Polylactic-co-glycolic acid (PLGA), nanoconstruct, immunotherapy, natural killer cells, RT-PCR.

02-19

POPULATION GENETIC STRUCTURE OF INDIAN SCAD, *DECAPTERUS RUSSELLI* ALONG INDIAN COAST INFERRED FROM MITOCHONDRIAL CYTOCHROME B

Anjaly Jose, Sandhya Sukumaran, Neenu Raj

Marine Biotechnology, Fish Nutrition and Health Division.Central Marine Fisheries Research Institute. Ernakulam North PO 682018

Background: The Indian scad, *Decapterus russelli*, is one of the most exploited fishery resources in India and Southeast Asia. It contributed India's major pelagic resource, ranking next to Indian oil sardine. Apart from a study that reported separate stocks from India's east and west coasts using truss morphometric analysis, the molecular basis of its geographic structuring remains unknown. Thus, studying the geographical structure of its population at the genetic level is critical for making effective management recommendations.

Materials and methods: The total DNA was extracted from the muscle tissue using the standard phenol chloroform method. PCR amplifications were carried out in Biorad T100 thermocycler. The products were then sequenced completely in both directions by performing sanger sequencing. The genetic structure and historical demography of the population were analyzed using DnaSPv5.0 and Arlequin v3.1.

Results: 38 haplotypes were observed with an overall haplotype and nucleotide diversity of 0.6723 and 0.00167 respectively. Genetic differentiation among the population from different location was tested using Φ_{ST} pairwise comparison and none of them were significant. The mantel test revealed no evidence of isolation by distance. The values of Tajima's D and Fu's Fs suggested a selective sweep or recent population expansion of the targeted population.

Conclusion: No obvious population structure was detected either related to the coast or related to the geographical distance among the tested populations. Historical demographic analysis revealed a selective sweep or recent expansion of the populations under investigation.

Keywords: Population genetics, Indian ocean, Pelagic fish, Carangidae, mitochondrial DNA,

02-20

SINGLE-CELL OPTICAL DIFFRACTION TOMOGRAPHY TO STUDY RED BLOOD CELLS INFECTED WITH *PLASMODIUM* SPP.

Jessica J.Y. Ong[a], Jeonghun Oh[bc], XiangYong Ang[d], Renugah Naidu[e], Trang T.T. Chu[e], Jae Hyoung Im[f], Christeen Davis[hi]*, Won Sun Park[j], Wanjoo Chun[k], Hojong Jun[l], Bruce Russell[a], Jin-Hee Han[ag], Rajesh Chandramohanadas[deh]

*[a]Department of Microbiology and Immunology, University of Otago, Dunedin 9054, New Zealand, [b] Department of Physics, Korea Advanced Institute of Science and Technology (KAIST), Daejeon 34141, Republic of Korea, [c]KAIST Institute for Health Science and Technology, KAIST, Daejeon 34141, Republic of Korea, [d]Department of Microbiology and Immunology, National University of Singapore, Singapore, [e]Pillar of Engineering Product Development, Singapore University of Technology and Design, Singapore, Singapore, [f]Department of Infectious Disease, Inha University School of Medicine, Incheon 22212, Republic of Korea,[g] Department of Medical Environmental Biology and Tropical Medicine, School of Medicine, Kangwon National University, Chuncheon 24341, Republic of Korea, [h] DBT Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram, Kerala, India, [I] Manipal Academy of Higher Education, Manipal, Karnataka 576104, India, [j] Department of Physiology, School of Medicine, Kangwon National University, Chuncheon 24341, Republic of Korea, [k]Department of Pharmacology, School of Medicine, Kangwon National University, Chuncheon 24341, Republic of Korea, [l]Department of Tropical Medicine, Inha University College of Medicine, Incheon 22212, Republic of Korea*Presenting author*

Background: *Plasmodium* parasites are the causative agents of malaria, which infects vertebrate erythrocytes during asexual development and transmission. During the erythrocyte infection, plasmodial parasites remodel the morphological and biophysical characteristics of the host red blood cells. Characterising these changes within the host cells is essential in understanding the alterations induced by the parasites, underlying biology, and eventually possible scenarios for therapeutic interventions.

Methods: Here, we applied single-cell optical diffraction tomography (ODT) and 3D-Refractive Index (3D-RI) mapping to study the changes within the erythrocytes during the maturation of *Plasmodium* within. Immature red cells (known as reticulocytes) and mature erythrocytes were used as host cells for *Plasmodium*-infection studies.

Results: RI mapping highlights the changes within the erythrocytes due to differential refractive indices of intracellular contents. ODT data highlighted several unique differences, such as cell size, cellular volume, hemoglobin (Hb) content between the immature and mature erythrocytes. *Plasmodium* infection also lead to additional changes in the characteristics of the host erythrocytes. For example, the amount of Hb within the cells is reduced along with parasite growth and maturation due to Hb catabolism. This is correlated with the elevation of hemozoin (Hz) crystals within the cells. These two parameters highlighted the activity of the parasites within the erythrocyte. Further, we discovered that the distribution patterns of Hz are related to the *Plasmodium* species infected, with *P. falciparum* and *P. vivax* showing unique properties. This study highlighted the potential of ODT in characterising the changes in erythroid cells during infections and hemoglobinopathies.

Keywords: Optical diffraction tomography (ODT), Erythrocytes, *Plasmodium* parasites

02-21

ANTIOXIDANT AND ANTIBACTERIAL EFFECTS OF METAL NANOPARTICLES GREEN SYNTHESISED USING *VERNONIA ANTHELMINTICA* L. LEAF EXTRACTS

Dinu V Raju, Ann Tresa Varghese, Vinaya Chandran, Gauthame A, Linu Mathew

School of Biosciences Mahatma Gandhi University, Kottayam, Kerala.
Email: linumathew@mgu.ac.in, Mob: 9447505690

Background: Nanoparticle synthesis is an emerging technology with immense applications in all industrial fields. Plants are the easiest, eco-friendly, and less laborious route for green synthesis. Biogenesis is a bottom-up method that utilizes plant extract as reducing, capping and stabilizing agent, which reduces the metal ions into metal nanoparticles. *Vernonia anthelmintica* is a traditional medicinal plant most commonly seen in high altitudes areas all over India. It contains rich sources of phytochemicals responsible for antioxidant and antibacterial effects.

Method: Copper, Zinc, and Iron nanoparticles are green synthesized using *Vernonia anthelmintica* L leaf extract and was characterized by UV- visible spectroscopy. Further, the particle size and shape characterization were done using X-ray diffraction, SEM, and TEM. The characterized copper, zinc, and iron nanoparticles were tested for their antioxidant analysis using the DPPH method. The antibacterial effect against *Escherichia coli, Staphylococcus aureus, Salmonella typhi* was estimated by well diffusion.

Results: Green synthesized copper nanoparticles showed strong antioxidant activity compared to vitamin C. Antimicrobial activity was tested against *E. coli, S. aureus* and *S. typhi*. The highest measurements for zone of inhibition resulted from zinc nanoparticles followed by copper and iron nanoparticles. *E. coli* was highly inhibited by the nanoparticles.

Conclusion: From this study we green synthesized nanoparticles from *V. anthelmintica.* And they showed strong antibacterial and antioxidant activity due to the presence of bio active molecules on their surface.

Key words: Nanoparticles, Biogenesis, DPPH scavenging, Antibacterial effect.

02-22

MOLECULAR CHARACTERIZATION AND STRUCTURAL ANALYSIS OF AQUAPORIN (AQP) GENE IN THREE *Oryza sativa L* SPECIES; JYOTHI, POKKALI AND KARANELLU NATIVE TO KERALA.

Hasna Shajahan, Harish M, Anoja Kurian, Deepthi D C and Sethulekshmy Nair.

SCMS Institute of Bioscience and Biotechnology Research and Development, Kochi, Kerala, affiliated to Mahatma Gandhi University, Kottayam.

Abstract: Plants have a nano filtering mechanism characterised by the aquaporin gene present, which allows selective filtering of solutes in and out of cell membrane. Aquaporins being the cellular water channels, plays a crucial role in the abiotic stress tolerance capacity of plants. Their ability to facilitate gaseous exchange and role in growth and development of plants are also noted. These proteins are involved in an undisputed biochemical mechanism for water transport and equilibration in all living cells. The objective of the study was to characterize and predict the structure of aquaporin gene of *Oryza sativa L.* Jyothi, Pokkali and Karanellu and to compare it with each other.

In the present investigation, detection, cloning, sequencing, characterization and structure prediction of full coding Aquaporin gene of all the three crops were done. Leaf tissues from twelve day old plants were used to isolate RNA. The full coding region of aquaporin gene of Jyothi, Pokkali and Karanellu was PCR amplified with respective designed primers, cloned and sequenced. The physiochemical properties were noted and the secondary structure was derived from teritiary structure model of proteins using PDBSUM tool.

The physiochemical properties between the three varied much in the instability index, hydrophobicity and molecular weight .When the sequences were aligned the gene has shown a total of eight SNPs and seven amino acid variations. These differences has superintended while deriving the secondary structure of protein from the teritiary structure of the obtained sequence of protein of Jyothi, Pokkali and karanellu.

Keywords: Oryza sativa, Aquaporin gene, Amplification, Sequencing, PDBSUM, Aminoacid variations.

02-23

PHYTOCHEMICAL ANALYSIS AND COMPARATIVE STUDY ON THE ANTIMICROBIAL PROPERTIES OF STEM BARK AND LEAVES CRUDE EXTRACTS OF *MALLOTUS PHILIPPENSIS* (LAM.) MUEL.-ARG. [EUPHORBIACEAE] FROM MALABAR REGION OF KERALA

Jisha Raj P [1], Prof (Dr) K Sreejith *

[1]Dept. of Chemistry, SB College, Changanassery-686101, Kerala, India
**Dept. of Biotechnology and Microbiology, P.O. Palayad – 670661, Kerala, India*

Background: The current study focuses at understanding the phytochemical constituents and the antimicrobial activity of the medicinal plant *Mallotus philippensis* belonging to the family Euphorbiaceae collected from Malabar region of Kerala.

Materials and Methods: The crude plant extracts (hexane, chloroform, ethyl acetate, methanol and ethanol) were obtained by hot extraction method (Soxhlet Extraction method) and they were vacuum dried by rotary evaporator. The antimicrobial susceptibility of different plant extracts were carried out by Agar well diffusion as well as disc diffusion method. Also, the antifungal activity was studied by Poisoned food method and well diffusion methods.

Results and Discussions: Based on the data obtained, it was concluded that, *M. philippensis* stem bark and leaf extracts from the Malabar region of Kerala were found to contain all major phytochemicals and confirms the antimicrobial activity of extracts.

Conclusions: The study proves that the extracts were reckoned to be quite effective against the most pathogenic bacterial strains like *Staphylococcus aureus* which mainly causes infections in wounds and *E.coli,* which is the main causative agent of waterborne and food borne diseases and fungal strain *Penicillium notatum* which mainly causes infections in immune compromised patients.

Keywords: Preliminary screening, *Mallotus philippensis*, antibacterial and antifungal properties.

02-24

SIMULATION OF MECHNICAL PROPERTIES OF POLYCAPROLACTONE GRAPHENE QUANATUM DOT NANOCOMPOSITES FOR BIOMEDICAL APPLICATIONS

Kartik S Menon and **Praseetha P Nair**

Department of Chemical Engineering, Government Engineering College Thrissur, Kerala-680009, India

Background: Polycaprolactone (PCL) scaffold is used in many biological applications like tissue engineering, drug delivery systems, etc. mainly attributed to its biocompatibility. Many studies have focused on synthesis of composite scaffold using PCL and other fillers like graphene oxide (GO), reduced graphene dioxide (rGO), to name a few, have shown efficient applications in the same field. The success of rGO as a filler has prompted us to study the graphene quantum dots (GQD) incorporated PCL scaffold.

Method: Compucell3D, a computational tool, based on Cellular Potts Model (CPM) is used to simulate the electrospinned PCL scaffold. This software is used for absorption related studies especially in the case of cancer cells.

Results: Calculation of Young's Modulus has shown that upon the addition of GQD into the PCL matrix, the value increases to a peak after which it decreases over time. Subsequently, absorption of GQD by the PCL fibers were observed.

Conclusion: A reduction in the amount of GQDs introduced in the system is observed along with an initial increase and then decrease in the Young's Modulus of the system.

Keywords: Polycaprolactone, Graphene Quantum Dots, Compucell3D.

02-25

POTENTIAL OF SILVER NANOPARTICLES TO PREVENT CATHETER ASSOCIATED URINARY TRACT INFECTIONS

Krishnasree R S, Soumya S S, Ragaseema V M

Govt Arts College, Thiruvananthapuram (affiliated to University of Kerala)

Catheter associated urinary tract infection (CAUTI), is a common hospital acquired infection which is coupled with biofilms. It raises mortality rate and healthcare cost. Biofilm matrix reduces the penetration of antibiotic and leads to development of antibiotic resistant strains. Antimicrobial surfaces that resist biofilm formation is a feasible remedy for this problem. In our study we used poly (ethylene) glycol-protected silver nanoparticles for developing antimicrobial surface. PEG protected silver nanoparticles were synthesized and characterized by UV-Vis spectroscopy and high resolution transmission electron microscopy. The antimicrobial activity of these silver nanoparticles was tested against clinically isolated strains of *Klebsiella spp* and *Pseudomonas aeruginosa* which are the major causative microorganisms of CAUTI. From the study we could identify the minimum inhibitory concentration and minimum bactericidal concentrations of silver nanoparticles against the test organisms. Silver nanoparticle incorporated polycaprolactone film was developed by solvent casting method and its antibacterial effect was also examined. These films showed significant reduction in bacterial attachment. The results demonstrate the potential of PEG- protected silver nanoparticle incorporated polycaprolactone for clinical application to reduce the adversities of CAUTI.

Keywords: Silver nanoparticles, catheter associated urinary tract infections, antimicrobial activity

02-26

GREEN SYNTHESIS OF ZINC OXIDE NANOPARTICLES USING CENTELLA ASIATICA LEAF EXTRACTS

S Abishek and Rahimol Ramesh

AL-Ameen College Edathala (affiliated to MG University Kottayam)

Background: Nanoparticles are the particle having 1-100mm in sizes which are surrounded by an interfacial layer. Nanoparticles widely used as an alternative to antibiotics. Nanotechnology is highly effective for treating bacterial infections. Nanoparticles are used for coating for implantable devices and other medicinal devices for preventing infection and promote wound healing

Methods: The extract of Centella asiatica plant's leaf was prepared by using maceration method and different molar solutions of zinc oxide, was prepared using this extract and the absorbance was measured by spectrophotometry The presence of coated nanoparticles on zinc oxide was determined by this process. Then the antimicrobial activity of nanoparticles was studied by using two bacterial strains such as Gram-negative bacteria E. coli and Gram-positive bacteria Streptococcus.

Results: The detection of nanoparticles in Centella asiatica was done by spectrophotometric analysis in the graph obtained after spectrophotometry a slight peak was observed a concentration of 25 mm zinc oxide solution which indicates a slight coating of nanoparticle on to zinc oxide a

defined peak was observed at a concentration of 50 mm of zinc oxide which can be considered as an effective coating of nanoparticle**.**

Conclusions: The presence of nanoparticles in Centella asiatica is identified by making different molar solutions of zinc oxide and it was subjected to Spectrophotometry, which shows antimicrobial activity against the gram-positive bacteria Streptococcus and gram-negative bacteria Escherichia coli.

Keywords: Maceration, spectrophotometry, antimicrobial, molar solutions, gram positive bacteria, gram negative bacteria

02-27

A NEW SUBSTITUTION ON NS1 PROTEIN OF INFLUENZA A (H1N1) VIRUS CIRCULATING IN INDIA: A BIOINFORMATICS APPROACH

Usman Ghani[1], Keerthy Reghunandanan[2] , Sara Jones[1*]

[1] Pathogen Biology, Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram-695014, Kerala, India*

Background: The current influenza A virus epidemic raises a serious concern about the nature and virulence of the virus. The virulence of influenza A virus (H1N1) is multigenic trait. One determinant of virus is multifunctional NS1 protein which functions as multiple ways to antagonist cellular innate immune response. Recent NS1 gene sequence analysis has reported multiple mutations in RNA binding domain and effector domain of NS1 gene.

Methods: The present study was based on NS1 gene sequence analysis. 11 RNA samples was isolated from seasonal influenza infected patients and NS1 gene was Amplified by PCR specific sets of primers and sequenced. Bioinformatics tools were used for sequence analysis and mutational studies. A Bayesian approach was used to construct phylogenetic tree and to explore evolutionary history with time scale.

Results: All the NS1 sequence were aligned using Clustal omega and mutations were visualized using jalview. We have identified conserved substitutions (9 sequences out of 11) at position 55 where glutamic residues is substituted by lysine residues, L90I conserved substitution (10 sequences out of 11). which was first reported in 2011 and become consistent in 2014 and S205N substitutions. These mutations were already reported in India. We have also identified D2E substitutions which is first time reported in India. This substitution is found in RNA binding domain of NS1 protein which we hypothesize that this substitution on NS1 protein can alter its binding with viral dsRNA.

Conclusion: In our study we found conserved substitutions in both RNA binding domain and effector domain. We also reported first D2E substitutions in India. Residue position 2 and 55 are involved in binding viral dsRNA, residue position 90 is involved in PI3K binding region and residue position 205 is involved in viral virulence. Hence, we Hypothesize that these substitutions can modify cellular binding of NS1 protein.

Keywords:

Influenza virus, NS1 protein, mutation, substitution, H1N1, virulence

02-28

STIMULI-RESPONSIVE DRUG RELEASE OF MELANIN NANOPARTICLES OBTAINED FROM *Pseudomonas stutzeri* AND ITS PRODUCTION

Dayana Mathew, Sarita G Bhat*

Department of Biotechnology, Cochin University of Science and Technology,Cochin, India)
**saritagbhat@cusat.ac.in*

Marine ecosystem is a repository of tremendous bacterial diversity. Several bacteria's synthesis biomolecules beneficial for the betterment of human life. Melanin's are one such natural biopolymer abundantly distributed throughout the environment, especially in marine ecosystems. Melanins have diverse functions in different life forms. In eukaryotes, it is mainly involved in structural coloration, photoprotection, photosensitization, free-radical scavenging, metal ion chelation, antioxidant activity and neuroprotection. In microbes, especially in bacteria, it mainly assists to adapt to different adverse environmental conditions, like thermal, chemical and biochemical stresses. Melanins enhance the cell wall strength of bacteria and also provide metal chelation ability[8,6]. Some bacterial melanins reportedly have anti-inflammatory activity[4], while others show antimicrobial[5], anti tumor[2], antivenin[3] and liver-protecting activity[7]. Melanins can act as ultraviolet absorber, cation exchangers, drug carriers, amorphous semiconductors, X-ray and γ-ray absorbers[1].

Here in this study, the potentiality of Nano melanin in treating melanomas was evaluated by using it as a potential drug carrier. Nano-sized (~5-7 nm) melanin particles extracted and purified from marine bacterial strain *Pseudomonas stutzeri* BTCZ109 was surface modified using Polyethylene glycol and impregnated with 5-Fluorouracil, a commonly used anticancer drug. The maximum drug loading capacity was found to be 32.42%. The melanin obtained in its natural form as well as in surface-modified forms were evaluated using different characterization methods, including UV-spectrum, FT-IR, XRD and Particle size analysis. The efficiency of Melanin nanoparticles to release the drug in response to both physiological and acidic pH was also evaluated. From the results, it was observed that drug release from nano melanin particles was controlled and prolonged and showed strong pH dependency, which highlights its potential ability to perform as a natural, biocompatible and biodegradable drug delivery vehicle which can be targeted to specific tumor locations including skin, colon and intestine. The *in-vitro* evaluation of its effect on different cancer cell lines, particularly skin cancer cell lines was also a part of the study.

These nanoparticles were then scaled up industrially using large-scale fermenters after statistical optimization.

02-29

PHYLOGENETIC ANALYSIS OF NATIVE *DIOSCOREA* SPECIES OF KERALA

Dr. Manoj P., Dr. Anish N.P., Deepthi Mohan, Mariya Mary Gigi

Rajiv Gandhi Centre for Biotechnology, Trivandrum

Background: Different species of Dioscorea were collected and documented from tribal areas of Kerala and phylogenetic study was done using 6- FAM labelled ISSR markers. The consistent use of molecular marker such as ISSR for the genetic diversity study in any crop requires the selection

of primers that will give reliable and distinct band needed to study divergence that occur within the crop.

Method: Tender leaf samples are collected and local name, species were documented. Genomic DNA was isolated and stored at -20^{0}C, PCR was done using fluorescent labelled primers and fragment analysis was done. Scoring of fragments were done for the dominant marker as presence or absence. Phylogenetic data was obtained using PopGene software.

Result: In our study no. of polymorphic loci detected per primer combination varies according to the primer. Among the 8 used primers 3 of them are showing polymorphic bands on the *Dioscorea* population. The number of polymorphic loci obtained was 7. The percentage of polymorphic loci varies between 50-100%. *Dioscorea tomentosa* which is considered to be a toxic species was obtained as a different cluster from all other species. Based on Nei's identinty and distance matrix species *Dioscorea tomentosa* and *Dioscorea rotundata* were showing highest distance from all other clusters.

Conclusion: Among the 8 species under study *D. oppositifolia* and *D. wallichi* comes under same cluster and *D. esculenta* and *D. pentaphylla* under same cluster.

Key words: ISSR markers, *Dioscorea*, Phylogenetic, Polymorphic

02-30

POLYSACCHARIDE-COATED SELENIUM NANOPARTICLE FOR COLON CANCER MANAGEMENT

Reshma P L, Sreelekha T T

Laboratory of Biopharmaceuticals and Nanomedicine, Division of Cancer Research, Regional Cancer Centre, Thiruvananthapuram

Colon cancer is the third most common cause of cancer worldwide. Metal nanoparticles are widely used for the theranostic management of cancer and it increases tumour accumulation by enhanced permeation retention effect (EPR effect). The present study aims to develop PST001-coated selenium nanoparticles to treat colon cancer. Polysaccharide coated selenium nanoparticle (PST-SNP) was prepared by reduction of sodium selenite with ascorbic acid. The cytotoxicity of the nanoparticles in colon cancer cell lines was evaluated by MTT assay. The quantitative analysis of cell death in colon cancer cells was determined by Annexin V/ FITC and caspase-3 assays and it was found to cause increased apoptosis. The toxicity profiling in Balb/c mice was performed and the dose of the nanoparticle with the least toxicity and increased efficacy was determined. Tumour reduction studies were conducted in an EAC model of solid tumours in Balb/c mice. Biodistribution of the PST-SNP nanoparticle was evaluated in athymic nude mice by *in-vivo* imaging 2hr, 4hr and 24 hr after treatment with nanoparticle. It was found that the nanoparticles stayed in the system at 2hr and 4hr periods and increased accumulation was found in the tumour. The nanoparticles leave the system after 24 hours but still increased accumulation is seen in tumours and the liver even after 24 hours. The present study validates the better ability of the PST-SNP nanoparticle to mitigate colon cancer.

02-31

SYNTHESIS, CHARACTERIZATION AND BIOEFFICACY STUDIES OF ZINC OXIDE NANOPARTICLES USING LEAF EXTRACT OF *PSIDIUM GUAJAVA*

Sreelekshmy V S, Prameela T, Shirly K Thomas, Dhanyalekshmi C S and Roshin Elizabeth George

Biovent Innovations Private Limited, A Startup under KUBIIC, Department of Biotechnology, University of Kerala, Kariavattom Campus, Trivandrum, Kerala, India.

Background:. Synthesis of metal oxide nanoparticles through plant extracts is an eco-friendly, cost effective and promising alternative to conventional chemical methods. Unique properties and potential applications of Zinc oxide Nanoparticles (ZnO NPs) have drawn great attention.

Method: The freshly prepared aqueous leaf extract of *P.guajava* was treated with 0.01M, 0.02M and 1 M Zinc acetate solution at room temperature for 2 hours for the synthesis of ZnO NPs. ZnO NPs was confirmed and characterized by UV visible spectroscopy and FTIR analysis. Nanoparticle was then analysed for antibacterial, antifungal and antioxidant activity.

Result: The UV visible spectroscopy of ZnO NPs showed maximum peak of absorbance at 316nm. FTIR analysis marked the presence of the functional group C=O or related biomolecules such as amino acids, flavonoids, alkaloids and amines responsible for capping agents and for reducing Zinc acetate into ZnO NPs. ZnO NPs showed antibacterial activity against both Gram positive and Gram-negative bacteria. IC_{50} value of ZnO NPs obtained was 111.7µg/ ml.

Conclusion: The study confirmed the capability of *P.guajava* for the synthesis of ZnO NPs. This is a rapid and cost-effective method for generation of ZnO NPs and has various medicinal uses like biomolecular detection, biosensors and catalysis.

Keyword: Nanotechnology, *Psidium guajava*, ZnO NPs, UV visible spectroscopy, FTIR analysis, Antibacterial activity, Antifungal activity, Antioxidant capacity.

03-CHEMICAL SCIENCES

ORAL PRESENTATION

03-1

NOVEL COPOLYMER BASED VOLTAMMETRIC SENSOR FOR THE SELECTIVE DETERMINATION OF IMPORTANT DISEASE BIOMARKERS

Amoolya Chandran and Dr. K. Girish Kumar*

**Department of Applied Chemistry, CUSAT, giri@cusat.ac.in*

Back ground: Hormones, purine bases and its derivatives play an important role in the physiological functioning of different living systems. These compounds are indicators of certain prominent pathological conditions. This is indispensable to formulate analytical tools for its determination. Hereby we are the proposing a novel copolymer based voltammetric sensor which can be adopted as a mainstay testing tool for the quantification of Epinephrine, Uric acid, Xanthine and Hypoxanthine.

Method: Novel copolymer based voltammetric sensor has been fabricated via cyclic voltammetry and concentration study was conducted using SWV measurements. Mechanistic aspects were derived using LSV and results were validated via conventional HPLC method.

Results: Different experimental parameters were optimised. Individual and simultaneous determination of Epinephrine, Uric acid, Xanthine and Hypoxanthine have been carried out and the applicability of the sensor was checked in real and artificial samples and the results were validated via standard HPLC method.

Conclusion: A novel copolymer based voltametric sensor having high selectivity and sensitivity towards the determination of Epinephrine, Uric acid, Xanthine and Hypoxanthine has been effectively formulated. The sensor offered wide linear range with low limit of detection for these biomarkers. The practical utility, credibility and mechanistic aspects behind the processes have been investigated also.

Keyword: Electropolymerisation, Epinephrine, Uric acid, Xanthine and Hypoxanthine.

03-2

INFLUENCE OF DEFECT STRUCTURES ON THE POLARIZATION SWITCHING BEHAVIOUR IN $Pb(Zr_{1-x-y}Sn_xTi_y)O_3$ ANTIFERROELECTRIC SYSTEM

Anil Adukkadan[1*], Viswanathan Kumar[2] and Rajeev Ranjan[1*]

[1]Department of Materials Engineering, Indian Institute of Science,Bangalore, Karnataka, India-560012,
[2]Centre for Materials for Electronics Technology (C-MET), MeitY, Thrissur, Kerala, India-680581.

Background: The incommensurate modulated (ICM) phase with a pseudo-tetragonal lattice distortion in the $Pb(Zr_{1-x-y}Sn_xTi_y)O_3$ system is considered responsible for the pinched/antiferroelectric-like polarization-electric field (*P-E*) hysteresis behaviour. Our approach involves investigation of degree of pinching in *P-E* loops in a representative composition $Pb(Zr_{0.60}Sn_{0.30}Ti_{0.10})O_3$ after chemical modification by dopants; Cu and Mn.

Method: Temperature dependent x-ray diffraction, transmission electron microscopy in conjunction with *P-E* measurements on undoped, Cu and Mn-modified PZST as the systems pass through the temperature driven ferroelectric rhombohedral- ICM phase change. Electron

paramagnetic resonance spectroscopy used to probe the nature of the defect structure around the Mn and Cu sites.

Results: Mn-modified PZST behaves like a normal ferroelectric material even while in the ICM phase. The valence fluctuation of the manganese created structural disorder on the local scale significantly decreases the tetragonality of the intermediate pseudo-tetragonal phase, leads to small temperature durability.

Conclusions: The alignment of polar defect structure weakens the antiferroelectric correlation in the ICM phase and make the system behaves almost a ferroelectric like even while the ICM phase exists. A correlation between the pseudo-tetragonality and stability of intermediate the ICM phase in PZST systems is possible.

Keywords: Antiferroelectric, Ferroelectric, Pseudo-tetragonality, Polarization switching, Defect structure

03-3

A TRIAZINE BASED POROUS ORGANIC POLYMER FOR THE FLUORESCENT SENSING OF MERCURY

Aswathy P.V. and Kala R.

Department of Applied Chemistry, Cochin University of Science and Technology, Kochi, Kerala 682022, India

Background: Porous organic polymers have progress in sensing fields including explosive sensing, humidity sensing, pH sensing, bio-sensing, gas sensing, metal ion sensing, etc. Owing to high toxicity, trace heavy metal ions such as Hg^{2+}, Cd^{2+}, Pb^{2+}, As^{3+} etc., released into the environment can result in numerous diseases and consequently it is necessary to detect the trace heavy metal ions. Keeping this in mind we have fabricated a triazine based porous organic polymer material which could find application as fluorescent sensor for the detection of mercury.

Method: A simple nucleophilic substitution reaction was carried out between cyanuric chloride and adenine in the presence of diisopropylethylamine as the base in 1,4-dioxane solvent medium for about 48 hours yielding the resultant polymer POP CCAD.

Results: The synthesized POP CCAD was characterized by infrared spectroscopy, scanning electron microscopy (SEM), transmission electron microscopy (TEM), powder X-ray diffraction (PXRD), thermogravimetric analysis (TGA) and Brunauer–Emmett–Teller (BET) analysis techniques. Photophysical studies of POP CCAD was conducted by UV- Visible spectroscopy and fluorescence spectroscopy. Further it was observed that the fluorescence of the POP CCAD was quenched up on addition of Hg (II) ions and this quenching is linear within the range of $10x10^{-7}$ M to $1x10^{-4}$ M. Thus the synthesized POP CCAD can be used for the sensing of mercury ion with a detection limit of $8.6\ x10^{-9}$ M.

Conclusions: The synthesized porous organic polymer POP CCAD was well characterized by various techniques like FTIR, SEM, TEM, BET, PXRD and TGA. POP CCAD. This can be used for the sensing of mercury ion with a detection limit of $8.6\ x10^{-9}$ M. From fluorescence studies and life time decay studies we have identified that the presence of combined static and dynamic mechanism is involved in the sensing of mercury.

Key words: Porous organic polymers (POPs), Fluorescent sensing, Mercury sensing.

03-4

EXPLORING THE INTERACTIONS ON TETRAAMINOPHENYLPORPHYRIN BASED HYBRID SYSTEMS AND THEIR APPLICATION AS PHOTOSENSITIZERS IN DSSC

Athira Pallikkara and Kala Ramakrishnan

Department of Applied Chemistry, Cochin University of Science and Technology, Kochi-682 022, Kerala, India

Background: Amongst umpteen solar cells, dye sensitized solar cells (DSSCs) by their low cost and eco-friendly nature, have a seat of their own. Photosensitizers are the pioneer component of DSSC from which the entire process begins. A number of studies were done on these sensitizing part to improve the dye stability and to efface the problem of aggregation.

Method: Tetraaminophenylporphyrin (TAPP) hybrids in a series bearing with graphene quantum dots (GQDs), 1-pyrenecarboxylic acids (PCAs) and perylenetetracarboxylic acids (PTCAs) labeled as TAPP:GQDs, TAPP:PCAs and TAPP:PTCAs were used as photosensitizers in DSSCs. Incipiently, the photophysical studies of these systems have been carried out with the aid of various spectroscopic techniques such as absorption & emission spectroscopy and time correlated single photon counting analysis. Eventually, the DSSCs are fabricated using these hybrid sensitizers and J-V characteristics were measured by Keithely 2400 digital source meter and solar simulator as light source.

Results: Photophysical studies show that the increasing addition of GQD, PCA and PTCA to fixed concentration of TAPP engenders divergent characteristic changes to the systems. Noted a photoinduced electron transfer from TAPP to GQD as well as from TAPP to PTCA with dynamic and combined (static and dynamic) quenching mechanism respectively. Meanwhile, TAPP experiences a Forster resonance energy transfer from PCA along with a change in average lifetime value from 0.01 ns to 8.66 ns, whereas the incremental addition of PTCA to TAPP showed a decrease in the value from 0.05 ns to 0.01 ns. Application of these dye systems to DSSCs have the appraised efficiencies of devices, showing a pattern of TAPP:PCA>TAPP:PTCA>TAPP:GQDs with the corresponding efficiencies as 0.31%, 0.16% & 0.09%, respectively.

Conclusions: This work establishes the use of TAPP:PCA hybrids as efficient cosensitized dyes in DSSCs than TAPP:PTCA and TAPP:GQD. Presence of trap states/surface states in GQDs and the higher steric hindrance of carboxylic groups in PTCA are accountable for their lower efficiency than PCA.

Keywords: Dye sensitized solar cells, Porphyrins, Electron transfer, Photosensitizers

03-5

WATER SOLUBLE SILICON QUANTUM DOTS BASED FLUORESCENT IMMUNOASSAY FOR C-REACTIVE PROTEIN DETECTION

Deepa Sebastian[a] and Kala Ramakrishnan[a*]

[a] Department of Applied Chemistry, Cochin University of Science and Technology, Kochi-682022 India, Email: kala@cusat.ac.in

Background: Fluorescence immunoassay (FIA) defined as the one of the finest method developed for the detection of various biomolecules. Especially the early stage detection of clinically significant biomarkers such as C-reactive protein (CRP) is really needed in the current

scenario. Utility of a biocompatible fluorescence probe expands the applicability of FIA method. Among the various fluorescence materials known till, biocompatible silicon quantum dots (SiQDs) are the promising one with superior fluorescence features and better bio-conjugation allows their utility as a FIA probe.

Method: The method relies on the synthesis of SiQDs through hydrothermal approach followed by CRP antibody conjugation on SiQD via amidation reaction. Finally the variation in fluorescence intensity of SiQD containing CRP antibodies (CRPAb) upon the gradual addition of CRP antigen (CRPAn) within the concentration range of 0-300 nM is monitored by fluorescence measurements.

Results: High resolution transmission electron microscopy analysis (HR-TEM) and dynamic light scattering (DLS) analysis confirms the formation of SiQD and CRP-Antibody functionalized SiQD. The ability of CRP antibody functionalized SiQD against the detection CRP antigen was evaluated. The method relies on the decrease in fluorescence intensity of SiQD containing CRP antibodies (CRPAb) upon the gradual addition of CRP antigen (CRPAn). The fluorescence intensity of the antibody labelled fluorophore quenched linearly within the concentration range of 0-300 nM and the limit of detection (LOD) was as sensitive as about 2 pM. Detection mechanism was assigned further by evaluating the interaction insisted between SiQD-CRPAb and CRPAn.

Conclusions: This work establishes the effective use of biocompatible silicon quantum dot as a fluorescent immunoassay probe for the sensitive detection of C-reactive protein antigen (CRPAn) in aqueous media. Also this work highlights that SiQD can act as a promising alternative to conventional QDs and organic fluorophores. Integration of SiQD with lateral flow strips could result in powerful eco-friendly point-of-care device for *in vitro* diagnosis and the detection of other biomarkers also.

Keywords: Fluorescence immunoassay, Silicon quantum dots, C-reactive proteins, Fluorescence quenching

03-6

A SIMPLE AND FACILE TURN ON FLUORESCENCE SENSOR FOR THE EFFECTIVE DETERMINATION OF CARMINE

Devika S R and **K Girish Kumar**

Cochin University of Science and Technology, Department of Applied Chemistry, Kochi - 682022, Kerala, India.

Background: Living in an era of increasing food safety concerns, there is a colossal demand for the cost-effective determination of various classes of food adulterants. In this regard, the use of fluorescence techniques having advantages such as relative convenience, cost effectiveness and high sensitivity become extremely significant.

Method: This work describes the development of a fluorescence turn on sensor for the effective determination of the food colorant-Carmine (CRM). Biocompatible, water soluble bovine serum albumin stabilized copper nanoclusters (BSA CuNCs) was utilized for the development of the sensor. The characterization of the fluorophore was done using different techniques such as HR-TEM, UV-Vis, DLS

Results: As synthesized fluorophore exhibited strong emission at 405 nm when excited at a wavelength of 325 nm. The fluorescence intensity of BSA CuNCs get enhanced upon the concomitant addition of CRM within the range 2.00×10^{-5} M - 5.00×10^{-7} M with a limit of detection 2.28×10^{-7} M. Particles of BSA CuNCs with an average size 3 nm, get aggregated upon adding CRM suggests an aggregation induced emission enhancement (AIEE) based mechanism for the proposed sensor.

Conclusion: This work describes the use of a protein mediated copper nanoclusters as a simple and facile sensing platform for the effective determination of CRM. Proposed sensor exhibited good linear range and limit of detection. AIEE based mechanism was proposed.

Keywords: Carmine, Bovine serum albumin, Fluorescence, Turn on, Enhancement, Aggregation

03-7

INDOLO[3,2-*a*]CARBAZOLE BASED SMALL MOLECULAR MASS HOLE-TRANSPORTING MATERIALSIN PEROVSKITE SOLAR CELLS

Haritha, J. R,[1a]Nideesh Perumbalathodi,[1,b] Jith C. J,[3a] Parvathy O.C.[4a] Kiran James,[5a] Kala Kannankutty,[2b]Manoj, N,*[a] Tzu-Chien Wei,[*b]M. K, Jayaraj.*[d]

[a]Department of Applied Chemistry Cochin University of Science and Technology, Kochi-22, [b]Department of Chemical Engineering, National Tsing Hua University, Hsinchu City 300, Taiwan, [c]University of Calicut, Thenhipalam, Kerala, India.

Background: Perovskite Solar Cells(PSCs) have shown to be one of the greatest alternatives to silicon-based technology. To increase the PCEs, a major strategy adopted was in the development of an efficient hole transporting materials (HTMs), because HTM can extract photo-generated holes from the perovskite and transport these charges to the back-contact metal electrode in a manner minimizing recombination losses at the TiO_2/perovskite.

Method: The low molecular mass indolocarbazole (ICZ) based HTMs are synthesized according to standard synthetic routes. The thermal behavior, UV-visible absorption and photoluminescence (PL) spectra of ICZs were estimated. The theoretical calculations of the same are performed by means of Gaussian09 software.

Results: A series of ICZ based low molecular mass hole-transporting materials were synthesised. A systematic study of the impact on thermal, optical, photophysical, and photovoltaic properties are estimated, which is comparable with spiro-OMeTAD. Moreover, ICZ molecules exhibit excellent thermal stability up to 400 ^{o}C and are more environmentally stable than Spiro-OMeTAD. The ground state oxidation of ICZ derivatives is evaluated and ensure the efficient extraction of photo-generated holes.

Conclusions: The newly deloved HTMs are evaluated as a potential HTM for solid state perovskite solar cells. And can be considered as a frugal and providently competitive HTM as compared to the Spiro-OMeTAD, which is the benchmark HTM in perovskite based solar cells.

Keywords: Hole transporting materals, Low molecular mass HTMs, Perovskite solar cells, Spiro-OMeTAD.

03-8

g-C_3N_4/ GRAPHENE HYBRID NANOCOMPOSITE FOR FLUORESCENT SENSING OF COPPER

Haritha Valiyaveettil Padi[a,b], Shemeena Mullakkattuthodi[b], Vijayasree haridas[b], and Binitha N Narayanan[a,b]

[a]Department of Chemistry, University of Calicut, Thenhipalam, Malappuram, 673635, Kerala, India,
[b]Department of Chemistry Sree Neelakanta Govt. Sanskrit College (Affiliated to University of Calicut), Pattambi, Palakkad, 679306, Kerala, India

Background: Copper is present in trace amounts in both biological systems and the environment and is one of the major aquatic pollutants. Increased uptake of copper may lead to medical conditions like Wilson's disease, hypoglycemia, and gastrointestinal problems. Increased uptake of copper may damage neurological system. Hence the development of proper methods to ensure the tracking of misregulations in the levels of copper ions on a daily basis is highly demanding. Combination of g-C_3N_4 and graphene has enhanced optical properties due to interlayer coupling.

Method: g-C_3N_4/graphene nanocomposite is prepared by ball milling of graphite and melamine followed by calcination. Fluorescence sensing of copper is performed using a 1mg/50 ml dispersion of the composite using PERKIN ELMER FL 6500 spectrometer with 150W Xe lamp as the excitation source. Selectivity studies were also conducted.

Results: The prepared material was characterized using XRD, FT-IR spectroscopy, and TEM. In the sensing of Cu^{2+} ions, g-C_3N_4/graphene showed two linear ranges, i.e., from 1 - 10µM and 100 - 2000µM with a lower detection limit of 0.001µM. Other metal ions like$Mn^{2+}$and Co^{2+} only minorly affected the fluorescence sensing of copper ions.

Conclusion: g-C_3N_4/graphene hybrid nanocomposite prepared by a high-yielding ball milling method was effectively used in the fluorescence sensing of the copper ion with a minor interference from various ions.

Keywords: g-C_3N_4/graphene, fluorescence, copper sensing

03-9

NON LINEAR OPTICAL PROPERTIES OF MnO_2 NANOPARTICLES USING SSPM TECHNIQUE

Jayaprasad K V, Titu Thomas, Manu Vaishakh

International School of Photonics, Cochin University of Science and Technology, Cochin,

Background: The appearance of a set of concentric ring intensity distribution in the far field when a laser beam propagates through a nonlinear material is termed as spatial self phase modulation (SSPM). This effect is mainly due to the intensity-dependent refractive index. The number of rings obtained is directly related to the applied laser power which gives the nonlinear refractive index n_2 and third-order nonlinear susceptibility $\chi^{(3)}$ of the sample.

Method: The structural and morphological properties of MnO_2 nanoparticles prepared by precipitation method were investigated using x-ray diffraction technique (XRD) and transmission electron microscopy (TEM). The third-order nonlinear susceptibility $\chi^{(3)}$ was measured by counting

the number of rings in the SSPM pattern as the laser power is varied from 50mW to 125mW in steps of 25mW.

Results: JCPDS matching in XRD analysis confirms the formation of tetragonal shaped α-MnO_2 nanoparticles. TEM analysis reveals the morphology of the particles to be nanorods. The number of rings in the SSPM pattern increases with increase in laser power. Hence, the third-order nonlinear susceptibility $\chi^{(3)}$ of the nanoparticles was determined.

Conclusions: This work establishes the use of simple and effective method for determining the non linear optical properties of a sample. It can be applied to the broad spectrum-regime including the violet and ultra-violet regime, where third harmonic generation and four-wave mixing are ineffective. It can also be applied to situation when large single crystal is hard to achieve and absorption is hard to measure.

Keywords: SSPM, third order nonlinear susceptibility, MnO_2.

03-10

FLUORESCENT SENSOR BASED ON CARBON QUANTUM DOTS DERIVED FROM α-MANGOSTIN FOR THE DETECTION OF ZINC IONS

C. L. Lekshmi, U. S. Swathy and S. Sumalekshmy

Post Graduate and Research Department of Chemistry, TKM College of Arts and Science, Kollam

Background: The extensive use of heavy metal ions may cause environmental pollution and thereby adversely affect human life. So development of methods for the detection of heavy metal ions is a challenging issue. In this context we have utilised an analytical platform based on carbon quantum dots (CQDs) synthesised from α- mangostin for the sensing purpose.

Methods: α-mangostin was isolated from the pericarp of the mangosteen fruit and purified by column chromatography and characterised by different techniques. CQDs are synthesised from α-mangostin following a simple one step solvothermal method.

Results: The CQDs have been characterized by various techniques like Transmission Electron Microscopy (TEM), Fourier transform infrared (FTIR) spectroscopy and X-ray photoelectron spectroscopy (XPS). The optical properties are studied by UV-Visible and Photoluminescent spectroscopy. The fluorescence changes of CQDs are studied in the presence of various metal ions. Among the various metal ion studied, the fluorescence showed a decrease in the presence of zinc ion and can be exploited as a turn off sensor for the detection of zinc ion.

Conclusion: We have adopted a simple synthetic strategy for the preparation of highly photo luminescent CQDs using α-mangostin as the carbon precursor and it can be utilised for the detection of Zn^{2+} ion.

Keywords: α-mangostin, Carbon Quantum Dots, Fluorescence Quenching, Zinc ion.

03-11

GREEN Cu(II)-IODINE CATALYZED SYNTHESIS OF 2-AMINOTHIAZOLES VIA HANTZSCH CONDENSATION

Sankaran Radhika[a] and Gopinathan Anilkumar[a]

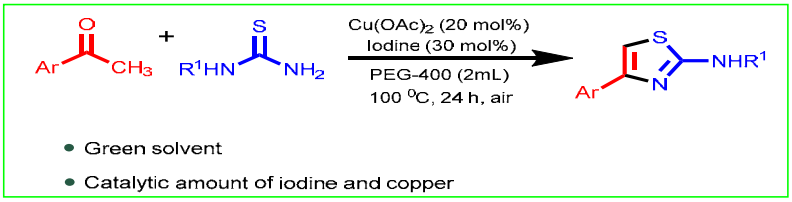
School of Chemical Sciences, Mahatma Gandhi University, Priyadarsini Hills, Kottayam, Kerala, 686560, E-mail: radhikasreekrishna@gmail.com

Abstract: The mounting consideration on heterocycles has been enthusiastic to the fabrication of thiazole derivatives. Among thiazoles, aminothiazoles plays very significant role in medicinal chemistry.[1] Drugs with 2-aminothiazole scaffold like Abafungin,[2] Cefdinir,[3] and Sudoxicam[4] are anti-microbial, anti-biotic and anti-inflammatory respectively. Hantzsch reaction is found to be as a good method for aminothiazoles synthesis and are often used.[5] Hantzsch protocols utilizing stoichiometric amount of iodine for the preparation of iodoketones were also known. But catalytic iodine used one pot synthesis of aminothiazole synthesis by hantzsch reaction is not known. We herein describe the first green method for the Cu(II)-iodine catalyzed synthesis of 2-aminothiazoles from aryl methyl ketones and thiourea. Under the optimized condition, 20 mol% of copper acetate and 30 mol% of iodine afforded 2-aminothiazoles in moderate to good yields using PEG-400 as the solvent at 100 °C for 24 h. Desired products from each substrates were characterized with ^{1}H NMR, ^{13}C NMR spectroscopy and HRMS analysis.

Methods: A 10 ml sealed tube was filled with aryl methyl ketone (0.5 mmol, 1 equiv.), thiourea (0.6 mmol, 1.2 equiv.), $Cu(OAc)_2$ (20 mol%) and iodine (30 mol%) in PEG-400 (2 ml). The mixture was stirred at 100 ^{o}C for 24 hours in an oil bath. The reaction mixture was cooled and then 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 afford the products.

Results:

Initially we started the reaction by opting acetophenone and thiourea as model substrates in acetonitrile with copper acetate and iodine as catalyst expecting corresponding 2-aminothiazole product. Further optimization showed PEG-400 as the best solvent and molecular iodine as the best iodine source. After completing optimization, we moved to substrate scope exploration and achieved various 2-aminothiazole derivatives in moderate to good yields. Electron-withdrawing substrates accomplished good yields than other substrates. Here, Cu(II) act as an oxidant to iodides formed.



Conclusion: In brief, we have developed a novel copper(II)/iodine-catalyzed strategy for the synthesis of 2-aminothiazoles through hantzsch reaction from aryl methyl ketones and thiourea using PEG-400 as the solvent. Under the optimized condition, 20 mol% of copper acetate, 30

mol% of iodine in PEG-400 at 100 °C for 24 h afforded 2-aminothiazoles. It is very vital to develop an inexpensive and green method for the synthesis of aminothiazoles, since they are significant in the synthesis of many biologically important molecules and drugs.

Keywords: Copper acetate, iodine, 2-aminothiazole, Green method, PEG-400.

03-12

SUPERHYDROPHOBIC AND ANTIBACTERIAL COATINGS THROUGH BIOMIMESIS: A STUDY ON THE SYNTHESIS AND DEVELOPMENT OF HYBRID SURFACES FOR THE HUMAN WELFARE APPLICATIONS

Reshma M. J[a]., Harishma[a], Shajesh P[b], Anas S[a]*

Department of Chemistry, T.K.M. College of Arts and Science, Research Centre, University of Kerala, Kerala, Kollam, India
[b]CNMS, Jain University, Bangalore

Background: The synergy between surface roughness and waxy coating produces a non-wetting state on the surface of plant leaves, allowing them to self-clean and easily shed water. In the present work, we demonstrate a simple biomimetic approach for producing nanoparticle metal oxide-polymer hybrid surfaces on glass substrates that will act as both superhydrophobic and antibacterial.

Methods: The methodology involves the culmination of a three-way process. Initially, a seed layer of metal oxide, ZnO, was prepared on the glass substrate by dip coating and calcination methods. Secondly, the glass slides were treated in equimolar amounts of zinc nitrate and HMTA in a Teflon-lined autoclave. Finally, the obtained coatings were modified with Methyltrimethoxysilane (MTMS) and polymer-nanoparticle hybrid coatings were prepared.

Results: The site-specific uniaxial growth and crystallinity of the samples were studied using XRD. The optical transparency of the coatings was evaluated with UV-Vis.-NIR Spectrophotometry. The functionality and bonding characteristics of the hybrid coatings were assessed using FTIR. The Unidirectional growth was confirmed using SEM. Superhydrophobic functional characteristics of the nanoparticle-polymer-based hybrid coatings were finally evaluated by using a Contact angle analyzer. The characterization studies and functional property assessment studies clearly reveal that the artificially prepared Metal Oxide-Polymer based hybrid coatings yield good superhydrophobic properties. The qualitative assessment and turbidimetric method further affirm the excellent antibacterial properties offered by the hybrid functional coatings.

Conclusion: The present investigation can be utilized to develop superhydrophobic surfaces that can exhibit a contact angle above 150°. The antibacterial functional property of these coatings finds immense potential in human welfare applications in the health, defense, and industrial sectors.

Keywords: ZnO-MTMS, Hybrid coatings, Superhydrophobicity, Antibacterial Surfaces

03-13

SELECTIVE DETERMINTION OF TUMOUR BIOMARKER USING A MOLECULARLY IMPRINTED POLYMER BASED VOLTAMMETRIC SENSOR

Sonia Sam and K. Girish Kumar

Department of Applied Chemistry, Cochin University of Science and Technology, Kochi-22, Kerala

Background: Determination of the biomolecule Vanillyl mandelic acid (VMA) is important since it act as a potent biomarker of the cancerous tumour neuroblastoma. Molecularly imprinted polymers (MIP) are excellent synthetic alternatives to the expensive biorecognition elements. A MIP of VMA has been developed for its selective determination with the aid of square wave voltammetry.

Method: A glassy carbon electrode was modified with the copolymer of taurine and glutamic acid and above which o-aminophenol has been electropolymerised along with VMA. MIP formation has been carried out by eluting the embedded VMA molecules using 0.5M H_2SO_4 and characterized.

Results: Under the optimized experimental conditions, determination VMA on MIP/TR-GA/GCE is possible in two dynamic linear ranges with a limit of detection as low as 1.66×10^{-7} M. Possible inferences from coexisting species got significantly decreased in the MIP sensor compared to that in TR-GA/GCE. Practical utility of the sensor has been proved by carrying out using spike recovery analysis VMA in artificial urine samples.

Conclusion: A MIP based voltammetric sensor for the determination of neuroblastoma tumour biomarker VMA has been developed.

Keywords: Vanillyl mandelic acid, copolymer, voltammetry, neuroblastoma, o-aminophenol

03-14

GREEN PREPARATION OF NiO/GRAPHENE FOR SUPERCAPACITOR APPLICATIONS

Suchitra V C [a,b], Thara T P [a], Nimisha V V [a], Akhila P U[a] and Binitha N.Narayanan [b]

[a]Department of Chemistry, Sree Neelakanta Government Sanskrit College (Affiliated to University of Calicut), Pattambi, Palakkad-679306, Kearala, India, [b]Department of Chemistry, University of Calicut, Thenhipalam, Malappuram-673635, Kerala, India

Background: NiO has been emerged as one of the most relevant transition metal oxides for supercapacitor applications due to its abundance, and well-defined electrochemical properties. The synergistic effect of NiO with graphene can overcome the above limitations thereby leading to the development of superior supercapacitor electrodes.

Method: Graphene is prepared from graphite via liquid phase exfoliation using isopropyl alcohol with the assistance of acetophenone. NiO is then introduced to graphene by a simple precipitation method. Material characterization results and electrochemical studies revealed the suitable use of the hybrid material as a supercapacitor electrode.

Results: NiO/graphene nanocomposite characterization using XRD and FTIR spectroscopy confirmed the existence of the face-centered cubic structure of NiO as the exclusive crystalline phase of Ni in the composite. Raman spectra indicate the less defective nature of graphene sheets

in the nanocomposite. The sheet-like surface morphology of graphene and NiO crystallites leading to roughness are analyzed through AFM. Supercapacitor performance is evaluated using cyclic voltammetry and charge-discharge studies. A high specific capacitance of 873 Fg^{-1} at the current density of 1 Ag^{-1} is obtained for the composite.

Conclusions: Green method of liquid phase exfoliation of graphite is successfully established here with the assistance of acetophenone. The developed NiO/graphene nanocomposite showed improved supercapacitor performance.

Keywords: Supercapacitor, Graphene, Liquid phase exfoliation, Acetophenone, Exfoliating agent.

03-15

IMPACT OF PROCESSING SCHEMES ON THE PROPERTIES OF NITRILE RUBBER/REDUCED GRAPHENE OXIDE NANOCOMPOSITES

Bhavya Bhadran[a], P.M Sabura Begum [b*], Rani Joseph[c*]

[a] Department of Chemistry, University of Kerala, Thiruvananthapuram, [b] Department of Applied Chemistry, Cochin University of Science & Technology, Kochi, [c] Department of PS & RT, Cochin University of Science & Technology, Kochi, bhvya001@gmail.com,

Background: Graphene, with its incredible properties, is emerging as the state-of-the-art material for manufacturing flexible elastomeric nanocomposites for high-performance applications. But one of the prime challenges faced during the processing of graphene/rubber nanocomposites is the effective dispersion of graphene in the rubber matrix. This can be achieved to a greater extent by choosing appropriate processing methods that helps in making well-dispersed systems for material fabrication.

Method: Surfactant supported latex compounding was adopted to prepare Nitrile Rubber based reduced graphene oxide nanocomposites. The mechanical and dynamic mechanical properties of the composites were tested. The surface morphology of the composites was also analyzed.

Results: The tensile strength and modulus of latex compounded composites improved by 63% and 72% respectively at a very low concentration of reduced graphene oxide. The storage modulus of the nanocomposites were also found to be excellent.

Conclusion: The significant improvement in mechanical, dynamic mechanical properties were due to the formation of a continuous interlinked reduced graphene oxide network around the rubber molecules. Thus, latex processing proved to more efficient than conventional methods.

Keywords: Reduced graphene oxide, Nitrile rubber, interlinked network

03-16

STRUCTURALLY MODIFIED DIFFERENTLY ARCHITECTURE ELECTROSPUN POLY(METHYL METHACRYLATE) [PMMA] NANOFIBERS WITH ADVANCED PROPERTIES FOR MANIFOLD APPLICATIONS

Princy Philip[1,2], Tomlal Jose E. [2]

[1] St. Thomas HSS, Pala, Kottayam, Kerala, India
[2] Department of Chemistry, SB College, Changanassery, Kottayam, Kerala, India

Background: Electrospinning is an amazing technique to produce nanofibers with ultrafine properties. Preparation of three types of PMMA nanofibers with different architectures like pure,

surface roughened and coaxial hollow forms through electrospinning of very rare combination of PEO – PMMA nanofibers are dealt here. The work carried out in order to explore the advantages of electrospinning.

Method: Pure PMMA nanofibers are prepared by dissolving PMMA in a mixture of chloroform and acetone, followed by electrospinning. Surface roughened PMMA nanofibers are prepared by selective dissolution of PEO from PEO–PMMA blend and coaxial hollow PMMA nanofibers are prepared by that of PEO from PEO–PMMA coaxial electrospun nanofibers. Structural modification and advanced structural and optical properties of PMMA nanofibers with different architectures are proved by FESEM, TEM, FTIR, AFM, PL etc. analyses.

Results: Pure PMMA nanofibers are 60-150 nm, PEO – PMMA blend nanofibers are 75-150 nm and PEO – PMMA coaxial nanofibers are 110 nm in diameters. Structurally modified PMMA nanofibers are found to be better host matrices than pure PMMA nanofibers for various nanoparticles, quantum dots etc. with magnificent applications.

Conclusion: Superiority of structurally modified PMMA nanofibers opens the door to replace pure PMMA with structurally modified PMMA which enhances the applications of PMMA nanofibers in various fields.

Keywords: PMMA, Nanofiber, Polymer, Structural Modification, Selective Dissolution

POSTER PRESENTATION

03-17

MULTIFUNCTIONAL GREEN INORGANIC TEMPLATE FOR GOLD NANOPARTICLE BASED NANOTHERANOSTIC SYSTEM FOR TARGETED CANCER TREATMENT

Aadithya Salbi[a,b], P. S. Sari[b], and G. S. Sailaja[a,b]

[a]Inter University Centre for Nanomaterials and Devices, CUSAT, [b]Department of Polymer Science and Rubber Technology, CUSAT

Background: Green synthetic approaches have recently revolutionized therapeutic options owing to better biocompatibility, stability, sustainability etc. Versatile green reducing agents including plant extracts have been identified as potential platforms for the synthesis and stabilization of various metallic nanoparticles. Gold nanoparticles, on account of their intrinsic physicochemical, optical, and biomedical properties, always stay in the frontiers of theranostics research. Although, a variety of greener approaches utilizing plant based organic templates have been found feasible for the synthesis of gold nanoparticle based theranostic systems, plant based inorganic systems remain quite exotic in this regard. Herein, we explore the scope of a multifunctional green inorganic template – a plant derived nanosilica for the development of gold nanoparticle based nanotheranostic system aiming cancer treatment.

Method: This work originally presents the design of a multifunctional nanotheranostic system from gold nanoparticles synthesized with the aid of plant derived nanosilica exploring unique functionalities of gold nanoparticles and nanosilica. Deviating from the conventional approaches of using organic reducing agents of plant, bacterial or animal origin, present work explores the scope of utilizing green biocompatible inorganic platform for gold nanoparticle synthesis. Herein, we report the facile synthesis of stable gold nanoparticles in aqueous medium by reducing $AuCl_3$ using rice husk silica *via* hydrothermal method without using any other chemicals/reagents. Reaction conditions were optimized by varying the temperature, reaction

time, precursor concentration: reducing agent ratio. The stable aqueous suspension of gold nanoparticles thus obtained was primarily characterized by UV- Visible spectroscopic analysis and further by FT-IR, XRD, DLS analyses and radiopacity measurements.

Results: Gold nanoparticle formation was visually confirmed by the change in color of the reaction medium (colorless to pink). The primary affirmation supporting the visual observation was backed up by the presence of surface plasmon resonance (SPR) absorption band characteristic for gold nanoparticles in the UV-visible absorption spectra. The SPR absorbance varied from 518 nm to 535 nm upon varying the synthesis conditions. The hydrodynamic diameter and stability of the Au-NP suspensions were assessed by DLS analysis. The x-ray diffraction pattern shows peaks at 2 θ values 38˚, 44˚, 64˚, and 77˚ representing the (111), (200), (220), (311) fcc planes characteristic for Au NPs along with the characteristic peaks of the nanosilica. Average crystallite size of Au NP calculated by Debye- Scherrer equation was found to be 50 nm which supports cellular internalization as well as suitable for exhibiting photothermal properties. Radiopacity measurements reveal the radiopaque nature of Au NP suspensions which make them suitable for x-ray guided imaging/diagnosis.

Conclusion: The major threat posed by the nanotheranostic systems is raised by the harmful chemicals used in their synthesis steps. Despite of using potential chemicals, present work explores the role of a green biocompatible multifunctional inorganic template – plant derived nano silica for the successful synthesis of Au NP suspension. The AuNP@nanosilica platform offers promising theranostic properties owing to its size, stability, biocompatibility, radiopacity, and drug conjugation potential.

Keywords: Gold nanoparticles (AuNPs), nano silica, surface plasmon resonance, hydrothermal method.

03-18

ENGINEERING NOVEL AND FLEXIBLE COVALENT MODIFIED Nb_2CT_X WITH TRIFLUOROACETIC ACID FOR ELECTROCHEMICAL SENSING OF ANTI-TUBERCULOSIS DRUG RIFAMPICIN.

Menon Ankitha[a], Neermunda Shabana[a,b], Pushpalatha V Vaishag[a,b], Pathath Abdul Rasheed[b,a]*

*[a]Department of Chemistry, Indian Institute of Technology Palakkad, Palakkad, Kerala, India-678 557, [b]Department of Biological Sciences and Engineering, Indian Institute of Technology Palakkad, Palakkad, Kerala, India-678 557, *abdulrasheed@iitpkd.ac.in (PAR)*

Abstract

In this work, we report the synthesis of highly stable trifluoroacetic acid (TFA) modified Nb_2CT_x MXene for the electrochemical detection of anti-tuberculosis drug rifampicin (RIF). The modification of Nb_2CT_x with TFA enhances the colloidal stability of Nb_2CT_x and the TFA@Nb_2CT_x nanosheets were characterized with SEM, XRD, XPS and FTIR. The developed sensor was able to detect RIF from 100 pM–1 µM with a limit of detection of (LOD) of 4.8 pM. Additionally, developed sensor exhibited superior selectivity in addition to its practical applicability by using pharmaceutical drug sample and human serum samples. This work explores a novel engineering strategy to develop highly stable and aggregation free Nb_2CT_x MXene for different applications.

Keywords: Nb_2CT_x MXene, trifluoroacetic acid, carbon cloth, Rifampicin, anti-tuberculosis drug, electrochemical sensor

03-19

PURIFICATION OF WASTE WATER FROM HEAVY METAL IONS USING LAYERED TWO-DIMENSIONAL MATERIALS

Arya Nair J.S, Saisree S, Sandhya K.Y*

Department of Chemistry, Indian Institute of Space Science and Technology
Valiyamala, Thiruvananthapuram 695547, Kerala, India.

Background: The pollution of the majority of the world's water sources and the consequent looming drinking water scarcity is one of the current concerns faced by the world. Amongst the contaminants, the heavy metal ions (e.g.: Hg (II), Pb (II), Cd (II), and As (III)) are highly toxic and are capable of causing life-threatening diseases to human. Adsorption-based techniques are meritorious to remove these metal ions from water and can be demonstrated in research setup because of their simplicity, speed, low cost, frugal setup, convenience, and mainly the versatility offered by the flexibility in choosing different materials. This work aims to synthesize and modify cost-effective sorbents using layered two-dimensional materials for removing heavy metals from water resources.

Method: This work explores the removal of toxic heavy metal ions from water through adsorption studies where the amount of metal ions before and after adsorptive removal were obtained using inductively coupled plasma mass spectroscopy (ICP-MS).

Results: Herein, we have developed different adsorbent materials based on graphene (Gr) and Molybdenum disulphide (MoS_2) to remove toxic metal ions such as Hg (II), Pb (II), and Ag (I) from water. The developed systems include MoS_2-hollow nano roses for the simultaneous removal of Hg (II), Pb (II), and Ag (I) from contaminated water within a time less than 30 minutes. Next, the partially reduced graphene oxide (prGO-MoS_2) for selective and ultra-rapid removal of Pb (II) ions from water in $\geq$ 3minutes. Further, the mechanism underlined in each adsorption study was analysed with different characterization techniques, explained in detail, and a few conclusions were drawn.

Conclusion: This work establishes the use of simple, cost-effective sorbents for removing heavy metals from water resources with high selectivity and speed.

Keywords: Graphene, Molybdenum disulphide, Adsorption, Heavy metal ions

03-20

NOVEL REUSABLE HETEROGENOUS CATALYST FOR CLICK REACTIONS UNDER AMBIENT CONDITIONS

Arya Suku [a], Saithalavi Anas [a]*

[a] School of Chemical Sciences, Mahatma Gandhi University,Kottayam, Kerala,India-686560
E-mail: anas@mgu.ac.in

Chemists have always been motivated by the urge to create complex molecules having therapeutic characteristics, but these are generally time consuming and expensive to produce. Recently, Barry

Sharpless, Morten Meldal and Carolyn Bertozzi shared The Nobel Prize for chemistry, formers laid the foundation to click chemistry and later developed orthogonal chemistry. Here we developed a novel functionalized polyacrylonitrile supported heterogenous copper catalyst and was characterized by using XRD, SEM, FTIR, EDAX, XPS techniques. The catalytic activity of as per synthesized catalyst were investigated through one pot three component reaction of alkyl halide, sodium azide and alkyne to obtain 1,4-disubstituted 1,2,3-triazole with excellent yield in environmentally benign conditions. The catalyst could be reused and recycled up to four cycles without any loss of catalytic activity.

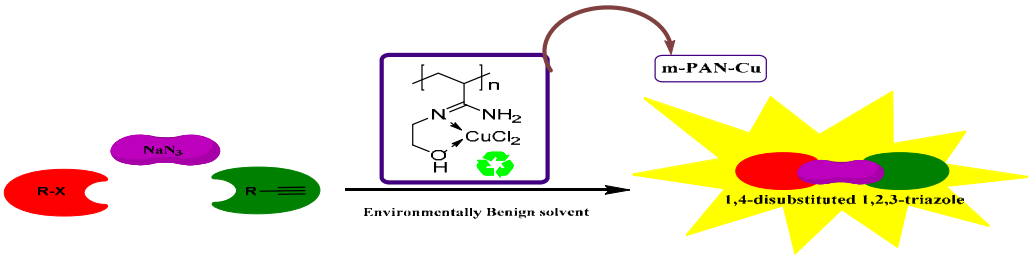


Figure1: Schematic representation of click chemistry using m-PAN-Cu

Keywords: Heterogenous catalyst, Click reactions, Green chemistry, 1,4-disustituted-1,2,3-triazole, Polymer support, Copper Catalyst

03-21

POLYVINYL ALCOHOL/MONTMORILLONITE/TiO_2 PHOTOCATALYSTS (PVA/MMT/TIO_2): A SCALE-UP FOR SUSTAINABLE ENVIRONMENTAL REMEDIATION

Bindu M*., Hareesh Pradeep and Pradeepan Periyat*

Department of Environmental Studies, Kannur University, Mangattuparamba Campus
**Corresponding authors; e-mail ID: binduscs@gmail.com; pperiyat@kannuruniv.ac.in*

Background: Semiconductor nanoparticles are the widely explored materials as photocatalyst, among which TiO_2 is the centre of attraction. For developing efficient TiO_2 photocatalysts, strategies such as metal and non-metal ion doping have been carried out. However, these methods have some limitations and synthesis of TiO_2 nanoparticles that can absorb the entire solar spectrum by a rapid strategy is unknown. Here we report the fabrication of a novel photocatalyst based on TiO_2 embedded onto hydrophilic polymer matrix PVA. MMT has been added in view of improving the mechanical properties of PVA. By this strategy, the catalyst removal is easy and also it offers cost effective way of recycling of the photocatalyst.

Method: PVA/MMT/TiO_2 photocatalyst has been synthesized by simple film casting method. Phase purity of the developed photocatalyst has been confirmed from XRD analysis (D5005, Bruker Germany) with a Ni-filtered Cu K_α radiation, possessing a wavelength of 1.54 A^0. Structural characterisations were done using an FTIR (JASCO FTIR- 4700). In order to find out the thermal stability of the systems, thermogravimetric analysis (TGA) was carried out, using a TG analyser (DuPont company, USA). The results of photocatalytic studies have been assessed by UV-Vis Spectrophotometer.

Results: We have varied the MG concentration from 20 ppm to 100 ppm. As the initial dye concentration increases from 20 ppm to 100 ppm, % removal efficiency decreases from 97.9 % to 87.65 %, however the dye adsorbed per unit mass follows an increasing trend. Also, MG adsorbed per unit mass increases with respect to contact time. Highest removal efficiency has been observed at MG concentration of 60 ppm and 180 minutes (99.89 %).

Conclusions: The work demonstrates the fabrication of an efficient photocatalyst based on PVA and TiO_2 *via* simple film casting strategy, for the removal of malachite green. The common problems associated with photocatalysis by semiconductor TiO_2 nanoparticles can be addressed by composite fabrication with PVA.

Keywords: Photocatalyst, TiO_2 nanoparticles, Malachite Green, PVA, Catalytic Efficiency.

03-22

CRYSTALLOGRAPHIC, STRUCTURAL, OPTICAL, AND ANTIBACTERIAL STUDIES OF CERIUM DIOXIDE NANOPARTICLES PREPARED THROUGH ASSISTED SOL-GEL METHODS

Gauri.S.S, Rekhachandran P R and Anas S*

Department of Chemistry, TKM College of Arts and Science, Kollam

Background

Based on the nanotechnological concepts and theories, the present work mainly discusses the solution-based syntheses of homogeneous spherical cerium oxide nanoparticles through microwave, sonochemical, reflux, and conventional heating-assisted sol-gel methods. Here, the antibacterial activity of cerium dioxide nanoparticles (CeO_2 NPs) was evaluated on a panel of gram-positive and gram-negative bacteria.

Methods

In the present work, microwave, sonochemical, reflux, and conventional heating-assisted sol-gel methods were used as facile methods for the easy and viable synthesis of CeO_2 NPs from cerium nitrate hexahydrate using ammonia and HNO_3 as reagents. The characterization studies were performed using XRD, SEM, TEM, UV-Vis-NIR spectroscopy, and FTIR spectroscopy. The antibacterial test was carried out in growth media against seven pathogenic microorganisms, namely S. aureus, Bacillus, Cons, Clostridium, S. pyogenes, Klebsiella pneumonia, and E. coli.

Results

Structurally pure and highly crystalline CeO_2 nanoparticles were prepared through wet chemical methods and confirmed through characterization studies. The antibacterial studies revealed that CeO_2 NPs show inhibition to gram-negative bacteria like Bacillus, Cons, and E. coli. But, it does not exhibit inhibitory effects on gram-positive bacteria like Streptococcus pyogeogenes and Staphylococcus aureus.

Conclusion

This work highlights the perspectives for the syntheses of CeO_2 NPs with controlled structural and optical characteristics and specificity in antibacterial properties, using a versatile and low-cost wet chemical solution method.

Keywords: CeO_2 NPs, Microwave, Sonochemical, Reflux, Sol-Gel, Antibacterial Effects

03-23

SYNTHESIS, CHARACTERIZATION AND APPLICATIONS OF SINGLE CRYSTALS OF LEAD AND DIGLYCOLIC ACID

Harisankar A[a], Preethi P C,Resmi Raghunandan*

Post Graduate Department of Chemistry and Research Centre, Mahatma Gandhi College, University of Kerala, Thiruvananthapuram 695004, Kerala, Email: harischemlab@gmail.com

Background: Photodegradation[1] studies draws keen attention of researchers due to the reason that photogenerated holes and electrons can easily degrade the toxic ions from aqueous medium irrespective of their chemical nature. Crystalline structures having regular geometry limits its activity towards antibacterial applications due to due to its low solubility, toxicity and abnormal behaviour when become contact with the bacterial cells.

Method: Single Crystal of Lead and Diglycolic acid is synthesized through gel diffusion method. Photo catalytic degradation efficiency of the same is analysed through UV Visible spectroscopy. Time bound absorbance value will give the idea about how a photocatalytic efficiency varies with change in concentration of methylene blue.

Results: Single crystal measurements explain that synthesized crystal is of R -3 :H space group with bimetallic structure. Presence of lattice chlorine atoms and unusual co-ordination environment of metals makes them versatile among other crystals. After attainment of Adsorption-Desorption equilibria, Crstalline degrade methylene blue with an efficiency of 46.43%. The antibacterial results confirmed that material is active towards bactria knnown as *Streptococcus mutans*.

Conclusions: The material synthesized is multirepsonsive in nature inerms of Photocatalysis of pollutants and Antibacterial activity.

03-24

VISCOELASTIC AND MECHANICAL PROPERTIES OF EPOXY NANOCOMPOSITES REINFORCED WITH MABS AND H-BN

Jomon Joy[a], Elssa George[a], S. Anas[a,b] and Sabu Thomas[a,c*]

[a]School of Chemical Sciences, Mahatma Gandhi University, Kottayam, Kerala, India
[c] Institute for Integrated Programmes and Research in Basic Sciences, Mahatma Gandhi University, Kottayam, Kerala, India, [c] School of Energy Materials, Mahatma Gandhi University, Kottayam, India

The effect of hexagonal boron nitride on the miscibility and viscoelastic properties of epoxy/ methyl methacrylate acrylonitrile butadiene styrene (MABS) cured with 4,4'-diamino diphenyl sulphone (DDS) was studied. The effect of hexagonal boron nitride on two different compositions (MABS 5 and MABS 10) of initially miscible epoxy/MABS system has been investigated. The viscoelastic properties of fully cured epoxy/MABS/h-BN nanocomposites were determined by dynamic mechanical analysis (DMA). The temperature sweep of epoxy/MABS/h-BN composites was done. The effect of h-BN loading on stiffening the cured polymer chain segments could be determined from storage modulus (G′) –temperature (T) plot. The chain relaxations from loss modulus (G") -temperature plot and tan δ-temperature plot confirms the phase separated structure in both blends and composites. The glass transition temperature (T_g) was determined from peak of loss modulus and tan δ curve. Mechanical properties of the epoxy/MABS/h-BN nanocomposites

were studied using tensile and impact testing experiments. The mechanical properties of epoxy resins were enhanced by the incorporation of both MABS polymer and h-BN nanofillers. The microstructure evolved after the phase separation in epoxy/MABS/h-BN composites was analyzed using scanning electron microscopy (SEM).

03-25

COMPARATIVE STUDY OF THE PERFORMANCE OF CHEMICALLY MODIFIED GLASSY CARBON ELECTRODE AND SCREEN PRINTED ELECTRODE FOR THE DETERMINATION OF BIOMARKERS

Keerthi Kodakat and K. Girish Kumar*

Department of Applied Chemistry, Cochin University of Science and Technology, Kochi 682022, India

Background:. In comparison to the complexity in instrumentation and requirement of trained personnel for conventional methods such as HPLC, electrochemical technique is simple and hence it is one of the widely used platforms for the determination of various clinically significant compounds due to its short response time, simplicity in operation, and possibility of miniaturisation.

Method: Here we propose the individual as well as simultaneous determination of Uric acid (UA) and vanillyl mandelicacid (VMA) based on a composite of electrochemically reduced graphene oxide (ErGO) and conducting polymer of L-threonine (pThr) modified screen printed carbon electrode (ErGO-pThr/SPCE). In an attempt to understand the effect of change in carbon substrate in the performance of the developed sensor, we have carried out the determination of UA and VMA on ErGO-pThr modified glassy carbon electrode (ErGO-pThr /GCE).

Results: Both of the modified electrodes enabled simultaneous determination of UA and VMA. Although the linear range for the determination of UA and VMA was comparable on GO-Thr/GCE and GO-Thr/SPCE, lowest detection limits were observed on GO-Thr/GCE. On the other hand, the decrease in overpotential of UA and VMA upon modification was greater on GO-Thr/SPCE than in GO-Thr/GCE.

Conclusions: Both GO-Thr /GCE and GO-Thr/SPCE can be used for the simultaneous determination of UA and VMA over wide linear ranges, with GO-Thr/GCE being more efficient for the sensitive determination of UA and VMA. Fabrication of sensor on SPCE was less time-consuming and more convenient as there were no cleaning procedures as in the case of conventional disc electrodes. Although GCE can be more advantageous in terms of reusability, SPCE finds more applications in terms of miniaturisation capability.

Keywords: Sensor, Voltammetry, Screen printed electrodes, Biomarkers

03-26

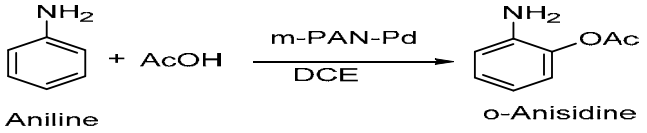
DIRECT ORTHO-ACETOXYLATION OF ANILINE USING A NOVEL REUSABLE HETEROGENEOUS PALLADIUM CATALYST

Malini Sivan[a], Saithalavi Anas [a]*

[a] School of Chemical Sciences, Mahatma Gandhi University,Kottayam, Kerala,India-686560
E-mail: anas@mgu.ac.in

C-H activation allows us to convert cheaper organic substrate into more valuable and versatile products which leading to the development of a wide range of reagents and catalysts that activate C-H bonds. The developed catalytic transformations provide access for production of a wide range of value-added products without using classical methods such as Friedel-Craft reactions, Heck coupling, etc., providing atom economical alternate and avoiding the toxic waste generation. Despite the considerable advances in the field of metal catalysed C-H functionalization under homogeneous conditions, these catalytic system featured notable disadvantages such as metal contamination in the final products, difficulty in the preparation and recyclability of the catalyst etc. Therefore the development of air and moisture stable, recyclable and easily recoverable heterogeneous catalyst is highly desirable. The use of polymer-supported reactants in organic synthesis is currently of considerable interest, especially in the context of combinatorial syntheses. Generally, synthetic modifications of polymers are done for improving their chelating properties and many of these modified polymers are widely used as catalyst or catalyst supporters. We received a patent for the monoethanolamine functionalised PAN supported Pd catalyst (Patent no. 391643)

Here we focused to carried out the C-H activation reaction using heterogeneous polymer supported Iron catalyst, which is prepared by the impregnation of iron complex on monoethanol amine modified polyacrylionitrile support(scheme1). For that we had choosen aniline and acetic acid as the model of the reaction in presence of as prepared catalyst and also we check the potency of the catalyst over the C-H activation reactions.



Scheme1

Keywords: CH activation, Heterogeneous catalyst, Polymer supported catalyst, Acylation reaction, PAN supported catalyst

03-27

SYNTHESIS OF IMIDAZO [1, 2-*a*] PYRIDINE DERIVATIVES VIA A NOVEL ZINC/IODINE-CATALYZED ORTOLEVA-KING TYPE PROTOCOL

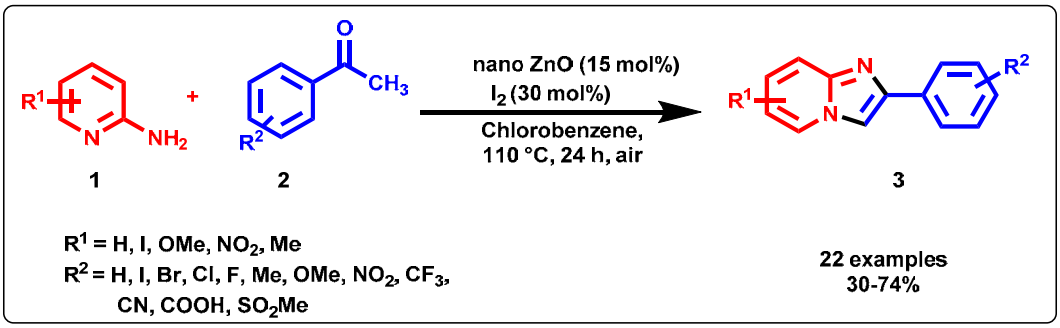
Mohan Neetha[a] and Gopinathan Anilkumar[a*]

[a] *School of Chemical Sciences, Mahatma Gandhi University, Kottayam*
e-mail: neethamohan131144@gmail.com

Background: Imidazo[1,2-*a*]pyridines form a class of nitrogen-based heterocyclic motifs comprising of a pyridine moiety fused to an imidazole ring. These scaffolds unveil various biological activities like- anti-inflammatory, anti-protozoal, anti-bacterial, anti-cancer, anxioselective etc. making them highly relevant in the field of organic chemistry [1-3]. Many synthetic strategies emerged for the synthesis of imidazo[1,2-*a*]pyridines owing to the structural allure of the moiety. Cyclocondensation reactions, transition metal-catalyzed multi-component reactions, intramolecular C-H amination, Ortoleva-King type reactions etc. are some of the synthetic strategies. [4-6] Recently, Ortoleva-King type reactions have gained much recognition. This involves the reaction between 2-aminopyridines, ketones and iodine. Conventional Ortoleva-King reactions employ stoichiometric amounts of iodine and there is a significant loss in the yield of the product due to the difficulty in product separation. Various investigations on the improvement of yields via *in situ* generation of iodine using iodide salts and catalytic amounts of oxidants were developed. The modified Ortoleva King-type reaction relies on the catalyst's oxidizing capacity to transform the iodide ion to iodine for various catalytic cycles. Zinc catalysis has advanced very lately and has gained acceptance due to their importance in pharmaceutical and biomedical domain. [7] Zinc is feasible and innocuous in comparison to copper and palladium. Zinc can be conveniently extracted form its mineral resources in high purity. Inspired by its charm, we were keen to explore the activity of zinc as an oxidant in Ortoleva-King type synthesis. Henceforth, we herein describe the first Zinc-catalyzed Ortoleva-King type synthesis of imidazo[1,2-*a*]pyridines.

Method: A dry round bottom flask was charged with 2-amino-4-methylpyridine (0.46 mmol, 1 equiv.), 4-nitroacetophenone (0.55 mmol, 1.2 equiv.), iodine (0.09 mmol, 0.2 equiv.) and zinc triflate (0.09 mmol, 0.2 equiv.) in chlorobenzene (3 mL). The mixture was stirred at 110 °C for 24 h in an oil bath under air atmosphere. The reaction was quenched and the mixture was cooles and then extracted with ethyl acetate (3x10 mL). The ethyl acetate layer was separated, dried using anhydrous sodium sulphate, concentrated and the product was purified by column chromatography using hexane-ethyl acetate mixture as the eluent. Similar fractions were combined basd on TLC (Thin Layer Chromatography) and the solvent was evaporated using a rotary evaporator to give products.

Results: The reaction of model substrates 2-amino-4-methylpyridine **1** and 4-nitroacetophenone **2** in presence of 20 mol% zinc triflate afforded the desired product 7-methyl-2-(4-nitophenylimidazo[1,2-*a*]pyridine **3** in 30% yield. The structure of the product was confirmed by ^{1}H-NMR, ^{13}C-NMR and HRMS analyses. We then tried to optimize the reaction conditions by screening the zinc salts, iodide sources, solvent, time, temperature and mol% of the catalyst and iodide sources. The optimized reaction design was observed as- 15 mol% nano zinc oxide as zinc salt, 30 mol% iodine as iodide source in 3 mL chlorobenzene at 110 °C for 24 h under air atmosphere. This condition could foster the product in 74% overall yield. With the optimized conditions in hand, we moved on towards the substrate scope analysis. We carried out about 22 examples and the reaction offered the products in moderate to good yields.



Conclusion

In short, we have developed the first zinc/iodine-catalyzed Ortoleva-King type protocol for the synthesis of imidazo[1,2-*a*]pyridines. The reaction uses easily accessible and efficient nano zinc oxide and molecular iodine as the catalytic system under aerobic conditions. A range of substrates of both aromatic ketones and 2-aminopyridines were analysed and these underwent the reaction successfully offering moderate to good yields.

Keywords

Imidazo[1,2-*a*]pyridines, nano zinc oxide, chlorobenzene, iodine, air.

03-28

NOVEL AND EFFICIENT POLYMER IRON CATALYST FOR PHOTODEGRADATION OF ORGANIC DYES

Rubina Shajahan[a], Saithalavi Anas [a,*]

[a]School of Chemical Sciences, Mahatma Gandhi University, Kottayam,Kerala, India-686560
E-mail: anas@mgu.ac.in

Dyes are a family of synthetic organic chemicals that are emitted by the paper, textile, cosmetic, plastic, food, leather, and pharmaceutical industries and cause environmental contamination. So dye removal is an important aspect of wastewater treatment. Among different chemical and physical processes photocatalytic degradation is thought to be a preferred, promising, cleaner, and greener method for the elimination of hazardous organic and inorganic pollutants from waste water. Photocatalysts are materials that, when exposed to light, modify the rate of a chemical reaction. Photocatalysis is the term for this occurrence. A polymer supported iron complex (m-PAN-Fe) is prepared and explored its potential application in the field of photocatalysis. The catalyst was prepared and characterized by FTIR, XRD, TGA, TEM and ICP-MS. Then the catalyst was studied in photodegradation of methylene blue, methyl orange and Rhodamine-6g in presence of H_2O_2 as oxidant. Then the effect of various reaction parameters are also investigated on the degradation of MB. The catalyst was found to be reusable up to 3 cycles of the reaction without significant loss in its activity. This is the first study involving an hydrazine modified PAN supported iron catalyst towards greener and efficient photocatalysis.

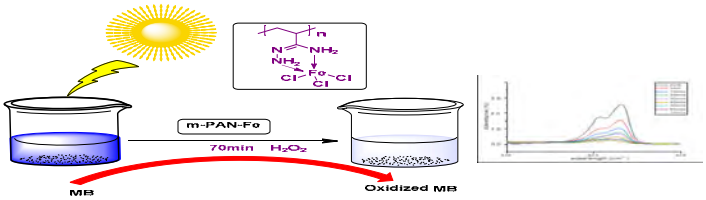


Figure 1: Photodegradation reaction of Methylene Blue (MB)using m-PAN-Fe

Keywords: Fenton Reagent, Green Chemistry, Heterogeneous Catalysis, iron, Photo Catalysis Polymer Support

03-29

SULFUR CO-DOPED NITROGEN-GRAPHENE QUANTUM DOT AS A VERSATILE ELECTROCHEMICAL SENSOR FOR HEAVY METALS

Saisree S, Arya Nair J S, and Sandhya K Y*

Department of Chemistry, Indian Institute of Space Science and Technology, Thiruvananthapuram-695 547, Kerala, sandhyaky@iist.ac.in

Background: Graphene quantum dots (GQDs) are highly versatile materials due to their unique combination of properties. Doping of GQDs with different hetero atoms such as boron, nitrogen (N), fluorine, and sulfur (S) has been effectively pursued to tune the intrinsic properties of GQDs, and chemical features and hence become a potential candidate for sensing, catalysis, imaging, and so on.

Method: This work explores a simple fool-proof hydrothermal approach for the synthesis of S and N co-doped GQDs (S,N-GQD). Polyaniline (PANI) was used as the precursor, which has in-situ N and sulfuric acid as the acid catalyst and S doping agent. Further, the EC sensing capability of S,N-GQD was explored towards toxic heavy metal ions.

Results: The HR-TEM images show that S,N-GQD possess uniformity in the structure and size distribution (3.5 to 4.5 nm). The presence of in-situ N in PANI facilitated effective N doping in the aromatic skeleton without much affecting the aromaticity, which upholds the merit of this synthesis method. The broad-band emission spectrum of S,N-GQD (~345, to ~ 600 nm) is responsible for the white light emission of S,N-GQD. The EC sensing studies were conducted on heavy metal ions. The S,N-GQD excihibited simultaneous sensing capability towards heavy metal ions cadmium (Cd(II)), lead (Pb(II)) and mercury (Hg(II)) with very sharp peaks and excellent peak-to-peak separation. The limit of detection values of Cd(II), Pb(II), and Hg(II) on S,N-GQD were 1, 10, and 1 pM and is the lowest reported hitherto for the simultaneous sensing of the metal ions.

Conclusion: This work demonstrates a simple hydrothermal synthesis of S,N-GQD with a very good graphitic structure and effective S and N doping. The EC sensing studies show its simultaneous sensing capability towards toxic heavy metal ions with commendable sensitivity and detection limits. This upholds the merit of the present work.

Keywords: white emissive, graphene quantum dots, electrochemical sensing, heavy metals

03-30

SYNTHESIS, CHARACTERIZATION, STUDY OF METAL SENSING, PHOTOCATALYTIC AND ANTI-MICROBIAL ACTIVITIES OF SYMMETRIC NAPHTHALENEDIIMIDE

Saranya C S

Department of Chemistry, Govt. College for Women, Thiruvananathapuram.

Background: Naphthalentetracarboxylic dianhydrides are commonly used precursor for the synthesis of Nphthalene diimides. Here we synthesized the symmetrically disubstitued B-NDI-B using butylamine by imidization reaction.The B-NDI-B displayed excellent fluorescence property which exhibits a fluorescence sensing towards the detection of Fe (II) ions. The present compound was exploited for the photocatalytic activity for the degradation of Methylene blue under visible light. The B-NDI-B has been screened for antimicrobial activity against Gram positive and Gram negative bacteria and the results are compared with activity of Ciprofloxacin.

Method: The B-NDI-B synthesised by imidization reaction between Naphthalene dianhydride (3g, 11.18mmol) and butylamine (0.81g, 11.18mmol) was added to this and refluxed at 130ºC for 5hrs. Different molar concentration of ferrous chloride solutions was prepared and 10mg of the compound dispersed and record the fluorescence emission of the solutions. The degradation of MB was measured using the UV–Vis spectrometer by monitoring the decrease in the UV–Vis absorption spectra as a function of irradiation time. The antimicrobial studies are done by Agar-Well Diffusion Method.

Results: The synthesized compound was characterized by IR, UV-Visible and proton NMR spectroscopy. Using these spectroscopic techniques confirm the formation of the compound. The difference in fluorescence intensity suggests the ability of the B-NDI-B toward the detection of metal ion in solution. The observed result clearly shows that, the B-NDI-B shows catalytic activity. B-NDI-B exhibited activity against Gram positive and Gram negative bacteria.

Conclusion: The synthesized compound exhibited some photo catalytic and antimicrobial activity. It can be used as a tool for the detection of Fe^{2+} ions.

Keywords: Imidization, Fluorescence, Methylene Blue, Antimicrobial.

03-31

A NOVEL IMMUNOMODULATORY SULFATED POLYSACCHARIDE FROM GREEN SEAWEED *ULVA LACTUCA* (ULVALES: ULVACEAE)

Shilpa Kamalakar Pai[1,2].* Kajal Chakraborty[1], Shubhajit Dhara[1]

[1]Marine Biotechnology, Fish Nutrition and Health Division, Central Marine Fisheries Research Institute, Ernakulam North P.O., P.B. No. 1603, Cochin-682018, Kerala, India

*[2]Department of Applied Chemistry, Cochin University of Science and Technology, South Kalamassery, Kochi-682022, Kerala State, India *Corresponding author. Tel.: +91 484 2394867; fax: +91 484 2394909. E-mail address: shilpa170398@gmail.com (Shilpa K Pai)*

Background: Escalating immune-weakening diseases called for a natural remedy for boosting immunity and developing an effective natural anti-inflammatory lead.

Methods: A sulfated (1→4) linked xylated rhamnoglucan type polysaccharide isolated from *Ulva lactuca* (family: Ulvaceae) was studied for its anti-inflammatory properties. The purified fractions from the crude polysaccharide were analyzed for their biochemical compositions, such as carbohydrate, protein, uronic acid, and sulfate contents, as a part of preliminary data acquisition. The fraction with the highest carbohydrate content (ULP-3) was selected for further studies including structural characterization as well as its effect on the inflammatory cytokine expressions via Enzyme-Linked Immunosorbent Assay (ELISA) and quantitative reverse transcription polymerase chain reaction (qRT-PCR).

Results. The immunomodulatory effect of ULP-3 (25-100 μg mL^{-1}) wasevaluated by quantifying inflammatory mediated cytokines, wherein interleukins (IL-1β, IL-6) secretion displayed a significant reduction (< 0.7 pg/mL, $p < 0.05$) in ULP-3 treated macrophages than LPS-induced cells (~ 1 pg/mL). Elevated tumor necrosis factor (TNF-α) and nitric oxide (NO) levels in LPS-induced macrophages were further downregulated (3.59 pg/mL and 3.83 μM, respectively) following ULP-3 treatment. The gene expression study of inflammatory cytokines along with *i*NOS also resulted in a noteworthy reduction for ULP-3 treated cells in comparison with LPS-induced macrophages.

Conclusion: The sulfated polysaccharide isolated from *U. lactuca* attenuates inflammatory cytokine expression on LPS-induced macrophages and could be utilized as a promising food-grade anti-inflammatory lead.

Keywords: Seaweed-derived polysaccharide, *Ulva lactuca,* anti-inflammatory property, immunomodulatory effect.

03-32

ANTI-HYPERTENSIVE SPIROKETALS FROM A BROWN SEAWEED

Shubhajit Dhara[1,2].* Kajal Chakraborty[1]

[1]*Marine Biotechnology, Fish Nutrition and Health Division, Central Marine Fisheries Research Institute, Ernakulam North P.O., P.B. No. 1603, Cochin-682018, Kerala, India*
[2]*Department of Chemistry, Mangalore University, Mangalagangothri- 574199, Karnataka State, India, *Corresponding author. Tel.: +91 484 2394867; fax: +91 484 2394909.*
E-mail address: shubhaj111@gmail.com (Shubhajit Dhara).

Background: Hypertension is a progressive disease leading to myocardial infarction and stroke. Angiotensin-I converting enzyme (ACE-I) inhibitors are considered one of the important therapeutic approaches to moderate pathophysiologic disorders of hypertension. Currently available ACE-I inhibitors with low lipophilicity could result in less bioavailability. Bioactive compounds with ACE-I converting enzyme attenuation potential are deemed as an alternative strategy to prevent hypertension and related disorders. Being an imperative source of bioactive metabolites, chemical investigation of the seaweed, *Turbinaria ornata* has resulted three spiroketals (Compound 1-3) with ACE-I inhibitory activity.

Method: Dried and powdered algal material was extracted with an organic solvent to prepare a crude extract of *T. ornata*. Bioactivity-guided liquid chromatographic fractionation of crude extract resulted in three spiroketal derivatives from the active fractions. Isolated spiroketal derivatives were subjected to free radical quenching and anti-hypertensive assays. Activity-structure correlation study validated the bioactive potencies. Pharmacokinetics and *in*

silico molecular docking study was performed to evaluate oral bioavailability and drug target interaction of the studied spiroketals.

Results: Compound 1 showed noticeably greater ACE-I inhibitory properties (IC_{50} 4.5 µM) compared to those exhibited by compound 2 (IC_{50} 4.7 µM) and 3 (IC_{50} 4.8 µM). Also, free radical quenching activities (IC_{50} 1.14-1.28 mM) exhibited by compound 1 were greater than those exhibited by other analogs (IC_{50} 1.25-1.71 mM). Structure-activity correlation studies showed that electronic properties (topological polar surface area, 71) and balanced hydrophilic-lipophilic parameters (partition coefficient of logarithmic octanol-water ~3.2) of compound 1 appeared to play a pivotal role in the inhibition of targeted enzyme with least binding energy (-10.5 kcal/mol) and acceptable bioavailability.

Conclusion: The study revealed that isolation and characterization of three spiroketal analogs, among which compound 1 could be developed as a promising marine-originated spiroketal-type compound for use against hypertensive diseases.

Keywords: Brown seaweed; Spiroketals; anti-hypertensive activity;

03-33

ANTI-INFLAMMATORY OXASPIRO INDICULIDES FROM MARINE OCTOPUS *CISTOPUS INDICUS*

Silpa Kunnappilly Paulose[1,2].* **Kajal Chakraborty**[1]

*[1]Marine Biotechnology Division, Central Marine Fisheries Research Institute, Ernakulam North P.O., P.B. No. 1603, Cochin-682018, [2]Department of Chemistry, Mangalore University, Mangalagangothri- 574199, Karnataka State, *Corresponding author. Tel.: +91 484 2394867; fax: +91 484 2394909. E-mail address: silpakp25@gmail.com (Silpa K P)*

Background: The catalytic properties of pro-inflammatory enzymes cyclooxygenases and 5-lipoxygenase involve the conversion of arachidonic acid to inflammatory prostaglandins (PGs) and leukotrienes (LTs), respectively, which trigger the inflammatory cascades which act as a pathological link to metabolic disorders, such as obesity, cancer, diabetes, atherosclerosis, and other cardiac events. Synthetic non-steroidal anti-inflammatory drugs with a number of adverse side effects, such as gastric ulcers and renal impairment, triggered an urge to focus on the search for effective and antioxidant dietary food supplements as alternative medications in treating inflammatory disorders. The biochemical examination of an economically important seafood marine octopus, *Cistopus indicus* has resulted in structurally diverse oxygenated spirocyclic compounds indiculides A-B.

Method: Edible tissues of freeze-dried octopus samples were extracted with an organic solvent to prepare a crude extract of *C. indicus*. Bioactivity-directed chromatographic fractionation of the organic extract resulted in isolating two oxygenated spiro heterocyclic compounds, indiculides A and B analogs. Isolated metabolites were subjected to free radical scavenging and anti-inflammatory assays using *in vitro* models. Physicochemical molecular parameters performed structure-bioactivity correlations. *In silico* molecular modeling analyses against lipoxygenase were performed to evaluate attenuation potential and drug target interaction in the active site of the enzyme.

Results: Among the isolated secondary metabolites, indiculide A exhibited considerably greater dual attenuation properties against cyclooxygenase isoforms (COX-1/COX-2; IC_{50} 3.36/3.02 µM)

and lipoxygense (IC_{50} 2.57 μM) than that displayed by indiculide B (IC_{50} 3.45/3.22 μM). Indiculides A-B exhibited a greater selectivity index (anti-COX-1/anti-COX-2, 1.11) than the anti-inflammatory drug diclofenac (0.96), showing larger specificity to COX-2. Greater antioxidant properties of indiculides against free radicals also supported its potential anti-inflammatory activity. Larger electronic parameters along with optimum lipophilic-hydrophobic balance (log $P_{OW <5}$) along with lesser binding energies (~ -11 kcal mol^{-1}) and inhibition constants (K*i* ~ 15 μm) manifested the potential anti-inflammatory activities of the studied indiculides. The *in vitro* bioactivity assessment and *in silico* docking results were further validated by a greater drug-like characteristic of indiculide A (drug-likeness score DLS, 0.21) than B analog (DLS -0.21).

Conclusion: The study demonstrated that the previously undescribed oxygenated spiro heterocyclic derivative, indiculide A, isolated from an economically important marine octopus, *Cistopus indicus* could be used as a promising anti-inflammatory pharmacophore as a promising lead against inflammatory diseases.

Keywords: Marine octopus; *Cistopus indicus*; oxygenated spirocyclic; indiculides A-B; cycloxygenase; lipoxygenase

03-34

A VIOLOGEN BASED REDOX POLYMER FOR FLUORESCENT TURN OFF SENSING OF Fe(II) IONS

Sithara Soman and Kala R.*

*Department of Applied Chemistry,Cochin University of Science and Technology, Kochi-682 022 India, *Email: kala@cusat.ac.in*

Background: Fluorescent sensing is a sensitive method which can be used towards the analysis of various metal ions and other impurities in water. Viologen based redox polymer material can show excellent fluorescent properties, which may be tuned by functionalization. In the presence of the analyte, the fluorescence emission of the probe shows quenching or enhancement in intensity according to which a turn off or turn on sensor can be developed.

Method: A naphthalene diamine based Viologen polymer is synthesized and is used as the fluorescent probe in this work. The fluorescent intensity of the probe is measured by standard addition of the analyte metal ions. From the relation between the concentration of ions and the corresponding peak intensity, real sample analysis can be analyzed.

Results: In the presence of Fe^{2+} ions the emission intensity of naphthalene diamine based Viologen polymer is quenched. Other metal ions cause no change in the emission intensity of the probe. The redox activity of the material is analyzed using cyclic voltammetry.

Conclusions: The naphthalene diamine based Viologen with redox properties can be used towards the sensing of Fe^{2+} ions with a limit of detection $12.6x10^{-8}$ M with good selectivity.

Keywords: Fluorescence sensing, metal ions, Viologen, redox polymer

03-35

POLYETHYLENEIMINE CAPPED COPPER SILVER BIMETALLIC NANOCLUSTERS BASED TURN OFF ON FLUORESCENCE SENSOR FOR THE DETERMINATION OF GLUTATHIONE

Swathy S and K Girish Kumar*

Department of Applied Chemistry, Cochin University of Science and Technology

Background: Fluorescence sensor measures the changes in optical properties of the recognition element induced by an analyte. Fluorescent sensing is a fascinating field of research due to its versatility and simplicity. The recent progress in nanotechnology and nanomaterials has been incorporated into analytical chemistry for the design of highly sensitive fluorescent sensing probes. Any phenomenon that results in a change of fluorescence intensity, lifetime or anisotropy can be used for sensing. Analyte induced luminescence emission intensity is the basic principle of fluorescent sensors.

Method: The present work explores the development of a turn-off/on fluorescence sensor for the determination of glutathione (GSH). Fluorescence quenching of PEI-Cu/Ag BNCs was happened in the presence of a fixed concentration of Cu(II) solution. The emission intensity got recovered by keeping the volume of the fluorophore and copper solution a constant with the incremental addition of GSH solution. The emission spectra were recorded in the range of 370 to 600 nm upon exciting the sample at 350 nm. A calibration plot was made between I/I_0 and concentration of GSH, where I_0 and I are the fluorescence intensity of BNCs in the absence and presence of GSH, respectively.

Results: Under specific analytical conditions, the linear working range of the sensor for the determination of GSH was 3.0×10^{-6} M to 1.0×10^{-4} M with a detection limit (LOD) of 8.0×10^{-7} M. Selectivity studies were done with co-existing as well as structurally similar species and application studies were done in synthetic urine and blood serum.

Conclusions: The quenching of fluorescence intensity of PEI-Cu/Ag BNCs by Cu(II) might be occurred due to the complex formation between Cu(II) and BNCs. After adding GSH to PEI-Cu/Ag BNCs, the bond between Cu(II) and PEI-Cu/Ag BNCs has been broken and a new bond is formed between Cu(II) and GSH formed resulting in the release of PEI-Cu/Ag BNCs hence its fluorescence recovery. Under optimal conditions, a linear concentration range has been obtained for GSH determination from 3.0×10^{-6} M to 1.0×10^{-4} M with a detection limit of 8.0×10^{-7} M. Application study of the proposed sensor has been done in artificial urine and blood serum.

Keywords: Fluorescence sensor, glutathione, bimetallic nanoclusters, turn-off/on fluorescence sensing.

03-36

VISIBLE LIGHT TRIGGERED RADICAL HYDROARYLATION OF ALKYNES TO ACCESS 2-VINYL PHENOLS

Valmiki Praveen Kumar[1,2,] and Sasidhar B. Somappa*[1,2]

[1]Chemical Sciences and Technology Division, CSIR - National Institute for Interdisciplinary Science and Technology (CSIR-NIIST), Thiruvananthapuram 695 019, Kerala, India. [2]Academy of Scientific and Innovative Research (AcSIR), Ghaziabad 201002, India, Email: drsasidharbs@niist.res.in drsasidharbs@gmail.com

Background: In recent years, visible-light-initiated organic reactions have gained copious attention and often provided better alternatives compared to the similar conventional counterpart protocols in terms of cost effectiveness, operational simplicity, reusability and environmental benefits. Among various photocatalysts, Triarylpyrylium salts have gained special interest because of their outstanding photophysical and chemical properties. They exhibit strong absorption within the visible spectrum (λ_{max} = 410 to 450 nm) and are strongly oxidizing in both the singlet and triplet excited states. These properties make them particularly appealing for PET applications.

Method: To a 5 dram glass vial equipped with a magnetic stir bar Phenyl acetylene**,** Phenol in 1 mL of DCM solvent and photocatalyst were sequentially added. The solution was stirred at a distance of ~3 cm from LED light source at room temperature. After the completion of reaction monitored by TLC and was purified by column chromatography.

Results: The synthesis of substituted 2-hydroxy styrenes via one step C-H hydroarylation of alkynes is achieved. Thus formed 2-Vinylphenol moiety constitute the structural motifs for many bioactive compounds and also serve as versatile synthetic intermediates for various organic transformations. Further, this transformation features a broad substrate scope with high functional group tolerance on both phenols and alkynes offering good yields.

Conclusion: In conclusion, we have developed a visible light promoted strategy for the alkenylation of naphthols and phenols using pyrylium salt as a photocatalyst. This strategy occurs under mild and metal-free conditions upon irradiation with simple household LEDs and averting the use of extra ligands and additives.

Key Words: Photoredox, Photocatalyst, Hydroarylation, Alkenylation.

03-37

MULTICOMPONENT SYNTHESIS OF SPIRO-DIHYDROPYRIDINE OXINDOLES *VIA* CASCADE SPIRO-CYCLIZATION OF KNOEVENAGEL /AZA-MICHAEL ADDUCTS

Basavaraja D [a,b] and Sasidhar B. Somappa [a,b,]*

[a] Academy of Scientific and Innovative Research(AcSIR), New Delhi, India.
[b] Chemical Sciences and Technology Division, CSIR-National Institute for Interdisciplinary Sciences and Technology(NIIST), Thiruvananthapuram, India.

Background: Aza-spiro heterocyclic oxindoles are those with spiro ring fusion at the 3-position of the oxindole core. Often, they constitute an essential scaffold in many natural and unnatural products and have drawn tremendous interest in synthetic and medicinal communities due to their wide range of biological activities. For instance, naturally occurring spiro-oxindole, Pteropodine has anti-inflammatory and antimutagenic properties, and many synthetic compounds exhibit

antiviral, anti-malarial, and anticancer properties. Thus, we have designed the one-pot four-component approach toward the synthesis of biologically potent aza-spiro heterocyclic oxindoles *viz* spiro-dihydropyridine oxindoles.

Methods: All the synthesized spiro-dihydropyridine oxindoles are characterized by different spectroscopic and analytical techniques such as IR, HRMS, ^{1}H NMR, ^{13}C NMR, etc. The stereochemistry of products is unambiguously confirmed through single-crystal x-ray analysis.

Results: We have synthesized spiro-dihydropyridine oxindoles by the four-component assembly of isatin, malononitrile, allenoates, and amines under mild reaction conditions. The reaction is triggered by the formation of Knoevenagel /aza-Michael adducts as intermediates followed by spiro-cyclization leading to expected products. The broad substrate scope and tolerance to a wide range of functionalities are the highlighting features of this protocol. And we have also explored the late-stage diversification of some selected spiro-dihydropyridine compounds

Conclusions: This protocol provides a robust synthetic route for the synthesis of pharmaceutically relevant spiro-dihydropyridine oxindoles by readily available isatin, malononitrile, allenoates, and amines as starting precursors under mild reaction conditions.

Keywords: Spiro-dihydropyridine oxindoles, Isatins, allenoates, and Knoevenagel /aza-Michael adducts.

03-38

COMPARATIVE TOUGHENING STUDIES OF MALEIMIDE AND NADIMIDE END-CAPPED POLYETHER TELECHELICS - UPER BLENDS

Jeemol. P. A,*[a] **Suresh Mathew, and [a] C. P. Reghunadhan Nair [b]**

School of Chemical Sciences, Mahatma Gandhi University, Kottayam, Kerala-686 560
Department of Polymer Science and Rubber Technology, Cochin University of Science and Technology, Cochin-682022, Kerala, Research Department of Chemistry, MES Mampad College (Autonomous), Malappuram, Kerala jeenoureen@gmail.com

Polyether telechelics based on ethylene glycol, 1,2-propylene glycol and 1,4- butylene glycol each of molar masses 400,1000 and 2000 Daltons and bearing at both terminals groups such as maleimide, itaconimide and nadimide were synthesised and individually examined as a toughening agent for an unsaturated polyester resin (UPR). On varying the end functionality of polyethers, they exhibit diverse toughening proficiency on the UPR. The difference in toughening efficiency arose from the varying reactivity of the telechelic's end groups with the reactive diluent, styrene. Among maleimide /nadimide end functionalised polyether telechelics-UPER blends, the polyether bearing maleimide end groups showed the best toughening effect. In the maleimide case, the high reactivity of the maleic groups with styrene, providing a strictly alternating copolymer sequence led to an apparent accumulation of the polyether segments along the polyester chain in the matrix [i,ii]. This, though permitted strong dipolar interactions among the polyether segments, localising the crosslinks and gave more toughened resin. The nadimide end groups were found to be reactive for copolymerisation but its reactivity ratios didn't favour the distribution of the polyether to permit a good interaction among themselves. These aspects were quantified in terms of their efficacy factor. The efficacy factor is highest for maleimide systems. This confirms the high efficiency of maleimide end capped polypropylene glycol for the toughening of the UPR matrix. The efficacy factor decreased in the order maleic> nadic groups.

03-39

SALEN BASED SCHIFF BASE PROBE FOR THE NAKED EYE DETECTION OF L-ARGININE

Nithya Mohan*[a,b], S.S. Sreejith[c] , M. R. Prathapachandra Kurup[a], P.V.Mohanan[a]

[a]Department of Applied Chemistry, Cochin University of Science and Technology, Kochi-682 022, [b]SCMS School of Engineering & Technology (SSET),Vidya Nagar, Palissery, Karukutty - 683 576, Kerala, India.[c]Department of Chemical Sciences, IISER-K, WB 741246, nithyanedumpilly@gmail.com

L- Arginine is a conditionally essential amino acid and have great biological significance. Herein, we designed and prepared a dual probe involving Schiff base and hydroxyl group, which showed high response and specificity for Arginine (Arg) among normal amino acids. The developed sensors have dual responsive nature. Both absorption and emission peaks show significant change on the addition of analyte L-Ar. The proposed sensors can detect L-Ar rapidly and accurately but also show appreciable detection limit. Lifetime studies were done in order to propose the mechanism of recognition. DFT calculations done at the B3LYP/TZVP level of theory corroborated the experimental findings and further established the proton transfer from the probe to the analyte during the complex formation.

03-40

QUANTUM MECHANICAL MODELING OF COHERENT ULTRAFAST CHARGE TRANSFER IN A PENTACENE-FULLERENE ORGANIC PHOTOVOLTAIC NANOSTRUCTURED COMPLEX

Dr. Saju Joseph,

School of Nanoscience and Nanotechnology, Mahatma Gandhi University, Kottayam-686 560, Kerala, India

The growing energy requirements of human society and the depletion of conventional fossil-based energy sources necessitate the development of a renewable, secure, and inexpensive energy sources. Organic photovoltaics (OPVs), the technology that converts sunlight into electrical energy by employing organic semiconducting materials. In this work, In this work, we discuss the dynamics of coherent ultrafast charge transfer of the lowest excited state in a pentacene/C60 model donor-acceptor nanostructured complex on the femtosecond time scale, via a combination of ab initio molecular dynamics and time-dependent density functional theory (TD-DFT). We analyse the correlations between the molecular vibrations of the complex and the oscillations in the electron-transfer character of its lowest excited state. The quantum-chemical results are found to be in good agreement with the experimental data related to the exciton dissociation and charge separation at donor/acceptor interfaces. These results offer a new framework to model the processes of exciton dissociation and charge separation and their contributions to the overall efficiency of organic photovoltaics.

03-41

CHITOSAN-TITANIUM DIOXIDE NANOCOMPOSITES AS AN INTEGRATED PHOTOCATALYST-ADSORBENT SYSTEM FOR THE REMOVAL OF NITRATES FROM WATER/WASTEWATER

V. S. Smitha,* P. Athulya, M. Sudheesh, P. Manjula, T. R. Resmi

*Centre for Water Resources Development and Management (CWRDM), Kunnamangalam P. O., Calicut, Kerala, India, Email: *smithavs@cwrdm.org*

Background: Excessive input of nutrients to the water bodies caused by industrial and agricultural activities is one of the major environmental problems faced globally. Among the different nutrients, nitrate, due to its high-water solubility, is possibly the most widespread groundwater contaminant in the world, imposing a serious threat to human health and contributing to eutrophication. Among several treatment technologies applied for nitrate removal, adsorption/photocatalysis has been explored widely and offers satisfactory results especially with mineral-based and/or surface modified adsorbents/photocatalysts. Chitosan, a linear copolymer of glucosamine and N-acetyl glucosamine biopolymer is an efficient bio sorbent for nitrate removal and has gained much interest due to its low cost and biocompatibility. The major shortcomings of chitosan such as its poor chemical stability and mechanical strength can be solved when it is appropriately incorporated in a nanocomposite as it may result in tunable properties and synergistic effects.

Method: Chitosan-tianium dioxide nanocomposites were synthesized by dropping chitosan solution in 0.5 M NaOH and the obtained hydrogel beads are then cross-linked with glutaraldehyde solution followed by impregnating in microwave-treated Ag, N-doped titania sol for about 1 hour. The coated beads were then dried in an oven at 65°C overnight and the functional beads were used further for the adsorption cum photocatalytic reduction of nitrates in model contaminated water and groundwater samples. A continuous flow fixed bed column adsorption cum photocatalysis experiment was carried out with the help of an experimental setup fabricated in-house under varying conditions. The experiments were performed in dark for 1 hour before switching on the visible light so that adsorption equilibration is attained. Photocatalytic experiments were performed for 4-9 hours of visible light exposure during which samples are collected at definite intervals and measured the nitrate concentration.

Results: Ag and N doped TiO_2 crystallized in the anatase phase with size less than 10 nm gets coated uniformly over the porous surface of chitosan. A nitrate reduction efficiency of 87.6 % and an adsorption capacity of 7.9 mgg^{-1} were obtained for the nanocomposite beads in the continuous flow adsorption cum photocatalysis experiment for up to 8 hours when using an inlet concentration of 100 ppm, bed height 12 cm and flow rate 5.0 $mlmin^{-1}$. Fixed bed column adsorption alone experiment also shows promising results for a real groundwater sample with 85.9% nitrate reduction efficiency.

Conclusions: Chitosan-TiO_2 nanocomposite beads were successfully synthesized by a sol-gel method. The superior adsorption cum photocatalytic characteristics of the chitosan-titanium

dioxide nanocomposite beads makes it a suitable candidate for the removal of nitrates from water/waste water through an integrated nanocomposite approach. Thus, the novel integrated system developed in the present work offers superior functional features due to the synergistic effect of chitosan and titanium dioxide and has potential practical applications.

Keywords: Chitosan, titanium dioxide, doping, photocatalysis, adsorption, nitrate

03-42

SYNTHESIS OF THE HIGH-PERFORMING PSEUDOCAPACITIVE ELECTRODE USING ILrGO-MoS_2 EXFOLIATED SHEETS

Sreelakshmi Rajeevan[1,2], Sam John[3] and Soney C George[1]

[1]Amal Jyothi Engineering College, Koovapally P O, Kerala, India 686518
[2]APJ Abdul Kalam Technological University, Thiruvananthapuram, Kerala, India 695016
[3] St. Berchmans College, Changanassery, Kerala, India 686101

Background: The combination of graphene with 2D Transition Metal Dichalcogenides (TMDCs) has always gotten great attention in the field of energy storage due to the resemblance in their structure (two-dimensional), with exceptional physical, chemical, electrical, mechanical, and thermal properties. Among TMDCs, Molybdenum disulfide (MoS_2) is a potential candidate due to the abundance of its elemental constituents, nontoxicity, and ease of synthesis via cost-effective techniques. But, the restacking of layers is the major concern associated with graphene electrodes, while volume expansion and pulverization during the charging-discharging period are problems related to MoS_2 electrodes. In the present work, we attempted to synthesize an ionic liquid (IL) modified graphene (PIR) electrodes and an ionic liquid (IL) modified graphene/ultrathin MoS_2 sheets (PIRM) hybrid electrodes using polyvinylidene fluoride (PVDF) as polymer binder via solvent evaporation.

Methods: Graphene oxide, the precursor material for the preparation of graphene was synthesized via a modified Hummer's method. It is modified with imidazolium-based ionic liquid (IL) at different concentrations and reduced chemically using hydrazine to obtain IL-modified graphene (IL-rGO). The MoS_2 ultrathin sheets are prepared by solvent exfoliation. The IL-rGO electrodes are prepared using polyvinylidene fluoride (PVDF) binder by solvent evaporation. The hybrid electrodes are synthesized by tuning the concentration of MoS_2 ultrathin sheets in the IL-rGO system. The structural, morphological, and electrochemical studies of the electrodes are conducted using Raman spectroscopy, X-ray Diffraction, Transmission Electron Microscopy (TEM), Cyclic Voltammetry (CV), and Galvanostatic charging-discharging analysis.

Results and Discussion: XRD and Raman studies demonstrated that the modification of graphene with an imidazolium-based ionic liquid effectively increased the interlayer spacing between graphene sheets and prevented their restacking. The increased interlayer spacing facilitated the easy accumulation of ultrathin sheets of MoS_2 between the graphene sheets. The TEM images of the hybrid electrode clearly depict the insertion of MoS_2 sheets between the graphene layers. The optimum concentration of IL for improving the electrochemical properties of graphene is 1.5 wt%. The synthesized hybrid electrode of the IL-rGO/MoS_2 ultrathin sheet possesses an elliptical-shaped voltammogram and a non-linear charging-discharging profile. From the electrochemical

studies, a 93.27% pseudocapacitive nature with a specific capacitance of 955 F/g was obtained for the fabricated best-performing IL-rGO/MoS_2 hybrid electrode.

Conclusion

The ionic liquid-modified graphene/MoS_2 ultrathin sheet hybrid electrode is synthesized. The fabricated hybrid electrode showed superior pseudocapacitive behaviour with a specific capacitance of 955 F/g at a scan rate of 100 mV/s.

Keywords

Graphene, MoS_2 ultrathin sheets, Ionic liquid, pseudocapacitors

04 –EARTH & PLANETARY SCIENCES

ORAL PRESENTATION

04-1

IMPACT ORIGIN FOR RAMGARH STRUCTURE, INDIA: NEW INSIGHTS FROM PETROGRAPHY, GEOCHEMISTRY AND GEOCHRONOLOGY

J. Aswathi[1*], **Saranya R. Chandran**[1], **S. James**[1], **Devika Padmakumar**[1], **R.B. Binoj Kumar**[1]

[1] *Department of Geology, University of Kerala, Thiruvananthapuram 695 581, Kerala, India*
**Corresponding author: aswathygeology@keralauniversity.ac.in*

Background: Ramgarh structure, with its nearly circular-shaped topographic high, has captivated geologists since the nineteenth century, with the recent studies proving it as an impact crater, thus, up-ticking the total Indian craters to three, the others being Lonar and Dhala. Ramgarh crater lies in a flat sedimentary terrain within the vast soil-covered plains of Neoproterozoic Vindhyan Supergroup in Baran district of Rajasthan, India. Ramgarh is carved into Lower Bhander and Upper Rewa Groups of Upper Vindhyans. Major evidences of shock features namely planar deformation features (PDFs) and planar features (PFs) in quartz grains, has been repetitively claimed by researchers.

Method: Here, we studied target lithounits of Ramgarh using a multi-proxy approach viz., petrographic, geochemical, and geochronological methods to assess Ramgarh's impact origin and to provide more convincing evidences.

Results: From petrographic study, the lithounits show multiple cracks, intense fracturing, growth of shock-induced micro-fabrics like breccia, PFs and PDFs, melted quartz grains, diaplectic quartz glass, and amorphous and vitrified matrix; each being strong indicators of impact origin. Geochemically, Cr, Ni, and Cu concentrations in the lithounits are high, and chondrite-normalised concentrations show noticeably higher levels than crustal averages. The target's interaction with an extra-terrestrial object is indicated through these elevated levels of Cr, Ni, and Cu. Also, inter-element ratios in the target lithounits show positive correlation, indicative of a differentiated achondrite projectile at Ramgarh. The zircon U-Pb geochronology study on two samples, did not reveal any noticeable Pb-loss or U enrichment. Nevertheless, a small discrepancy in Pb isotopic ratios with large U concentrations, corresponds to an age between 528 and 395 Ma. Hence, impact event is postulated within this age limit. The age falls within the range of mid-Ordovician Meteor Event (OME) (467.5 ± 0.28 Ma) and is substantially closer to Precambrian Cambrian Boundary.

Conclusions: The results from petrographic study like PFs and PDFs, melted quartz grains, diaplectic quartz glass, and the presence of multiple sets of decorated PDFs provides clear-cut evidence for supporting the impact origin of the Ramgarh Crater. Differentiated achondrite is supposed to be the potential projectile at Ramgarh based on the geochemical data and its comparison to the geochemistry of several other meteorites. From the geochronological study, the age limit of impact event falls between 528 and 395 Ma. Thus, the Ramgarh crater age can be further constrained to non-OME duration, as the latter event is associated with a L-Chondrite impactor, unlike the differentiated achondrite impactor at Ramgarh.

Keywords: Ramgarh, Impact Crater, PDF, PF, Deformation features.

04-2

QUALITATIVE SPECTROCHEMICAL GRADE ESTIMATION OF TERRESTRIAL CHROMITES AND ITS COMPARISON WITH LUNAR SPINELS.

V. Deepchand[1], V. J. Rajesh[2], R. B. Binoj Kumar[1]

[1]Department of Geology, University of Kerala, Thiruvananthapuram-695581, India
[2]Department of Earth and Space Sciences, Indian Institute of Space Science and Technology, Thiruvananthapuram-695547, India

Background: Chromite [(Fe^{2+}) $(Cr^{3+})_2O_4$] is a potential resource of metallic chromium that belongs to spinel group minerals and is considered as an important petrogenetic indicator. The present study focuses on the characterisation of chromite deposits from the Nuggihalli Schist Belt (NSB) of the Western Dharwar craton based on their chemical, spectral, and textural properties and compares the results to the lunar scenario. Understanding the chemical and spectral characteristics of terrestrial chromites might aid in identifying and interpreting remotely detected lunar spinel deposits.

Method: The representative chromite samples from NSB were analysed using petrographic observation to characterise the textural variations. The reflectance/absorption spectral signatures in different wavelengths and X-ray diffraction patterns were obtained using XRD, VNIR, Laser Raman, and FTIR techniques. The available mineral chemistry data of NSB chromites and lunar spinels obtained from the existing database are reproduced here for the comparative study. Spectral signatures of NSB chromites were compared with the orbital data of Fe/Cr spinels from the Sinus Aestuum (SA) basin that have been previously published.

Results: NSB chromite deposits have occurred in different forms and shapes in the field. Representative samples from each form show significant variations in their textural properties. Variations in textures control chromite modal abundance, chemistry, and hence its grade. Diffraction patterns and absorption/reflectance spectra obtained from various analysis shows characteristic band positions and considerable shifts with respect to the texture. The geochemical comparison between NSB chromites and lunar spinels shows a small overlapping range. The NSB samples in the overlapping region can be considered analogous to lunar spinels. Spectral signatures of NSB samples also show a similarity with spinels identified through orbital data from the SA region of the moon.

Conclusions: The comparative textural-chemical-spectral characterisation of chromites from NSB provides valuable information on exploring chromite quality using these techniques. The chemical and spectral similarity between lunar spinel and NSB chromites opens the possibility of using the NSB chromite deposits as a potential model for exploring minerals with a similar composition on extra-terrestrial surfaces.

Keywords: Chromite, Nuggihalli Schist Belt, Sinus Aestuum, Spectral Analyses, Space Mining

04-3

WHETHER THE CONTRASTING ISOTOPIC SIGNALS IN GROUNDWATER SOURCES OF THE BHAVANI RIVER BASIN ARE SIGNATURES OF MOUNTAIN BLOCK RECHARGE? A STUDY FROM THE ATTAPPADI CZO

Gayathri JA, Vipin T Raj, Sreelash K, Maya K and Padmalal D

National Centre for Earth Science Studies (NCESS), Thiruvananthapuram-695011

Background: Groundwater is the major source of potable water in the arid /semi-arid regions of many developing countries. To effectively manage groundwater resources, it is of utmost essential to have a better understanding of its sources and recharge mechanisms. This is particularly important in mountainous domains where Mountain Block Recharge (MBR) contributes a significant portion of water to the groundwater pool in the downslopes and plains where human settlements are most common. But the discrimination of MBR from the surface component of the Mountain Front Recharge(MFR) is a difficult task. Herewe use stable isotopes of δ^2H and $\delta^{18}O$ in groundwater in open well and bore well to trace out the influence of MBR, taking the Attappadi Critical Zone Observatory (CZO) of NCESS as a case study site.

Method: The isotope data of open well and bore well waters of the Upper Bhavani River Basin (UBRB), which is identified for Critical Zone studies by NCESS, were obtained from systematic sampling and laboratory analysis. The δ^2H and $\delta^{18}O$ isotopes of water samples were estimated using the Off-Axis Integrated Cavity Output Spectroscopy (OA-ICOS) laser absorption spectroscopy at NCPOR, Goa and the other parameters were determined following APHA (1991). The results were studied in detail for identifying the possible sources of groundwater and its recharge mechanisms.

Results: The seasonal evaluation of the isotopic values of the open well and bore well samples reveals that the values are generally more depleted in the monsoon season than pre-monsoon and post-monsoon seasons. Compared to open well waters (δ^2H -21.48‰ ; $\delta^{18}O$ -4.50 ‰), bore well waters (δ^2H –34.43 ‰ ; $\delta^{18}O$ -5.85‰) are characterized by more depleted isotopic values. The process of mountain block recharges and direct recharge from precipitation make the open well waters isotopically heavier than the bore well waters thatare recharged mainly through MBR. The occurrence of highly depleted isotopic composition in the mountain front areas at higher elevations of the Nilgiri hills is a testimony to this view. The results indicate that the isotopic characteristic of groundwater in the UBRB shows marked spatial and temporal variations. The progressive depletion of the isotopic composition and increase in TDS with depth will not only indicate the higher residence time of water in the aquifers but indicate the recharge of isotopically depleted waters from the mountain fronts through the interconnected lineaments and/or fracture systems within the crystalline rock massifs as MBR.

Conclusion: The lateral flow of groundwater from the mountain fronts as MBR constitutes a significant part of the deep groundwater aquifers (bore wells) in the UBRB. But, the shallow groundwaters in the open well result from mixing of MBR waters with the infiltrated local rain water with heavier isotopic compositions.

Keywords: Attappadi CZO, Upper Bhavani river basin, Stable isotopes, Mountain Block Recharge

04-4

SPECTRAL AND STABLE ISOTOPIC STUDIES OF MAGNESITES FROM SALEM, SOUTHERN INDIA: IMPLICATIONS FOR THE ORIGIN AND POTENTIAL INDUSTRIAL APPLICATIONS

Haritha A[a, *]., and Rajesh V.J[a,]

[a] Department of Earth and Space Sciences, Indian Institute of Space Science and Technology, Thiruvananthapuram 695 547, India,*Presenting author: harithaanil1994@gmail.com

Background: Magnesite ($MgCO_3$) is a carbonate mineral that has significant economic uses and is considered to retain carbon dioxide in geological formations. The three most prevalent kinds of magnesite are sparry or macro-crystalline (also known as the Veitsch type), cryptocrystalline (also known as the Kraubath type), and fluviatile-limnic (Bela Stena type). In the present study, we investigate the chemical and spectral characterization of the magnesite deposits of the Salem mafic-ultramafic Complex (SMUC). We characterize the magnesite mineralization using a combination of techniques such as EDS, XRD, hyperspectral, Laser Raman, FTIR and stable isotope analysis to understand their characteristics features and genesis.

Method: The magnesite samples were collected from mines in and around the Salem region. The samples were cleaned and prepared into chips, thin sections, and powders at labs in the Indian Institute of Space science and Technology (IIST) and National Centre for Earth Science Studies (NCESS) Thiruvananthapuram. Spectroscopic analyses such as XRD, EDS (Energy Dispersive), FTIR, Laser Raman, and hyperspectral and stable isotope analysis using IRMS (Isotope Ratio Mass Spectrometer) have been carried out on the magnesite samples to understand their spectrochemical characteristics and genesis.

Results: The hyperspectral analysis showed characteristic absorption bands at 1.4µm, 1.9µm, and 2.3µm. These absorptions features are caused by the stretching and bending of the C-O bond in the CO_3^{2-} ion. Laser Raman spectra showed the intensity peaks at 212cm^{-1}, 327cm^{-1}, 735cm^{-1}, 1092cm^{-1} and 1445cm^{-1} which are attributed to the translational and liberational vibrations. The FTIR data showed the peaks at 1434cm^{-1}, 880cm^{-1} and 747cm^{-1} corresponding to the Mg-O bond stretching and asymmetrical C-O stretching. The XRD spectra showed intensity peaks at 32.69°, 35.9°, 43.03°, 46.87°, and 53.92°. Stable isotope analysis of the magnesite samples yielded a δ13C value in the -2 to 6‰ range and $\delta^{18}O$ value ranging from 24‰ to 26‰.

Conclusions: We propose a genetic model that invokes the percolation of meteoric water through weak planes and fractures into the dunite of SMUC through four stages of formation. The carbon required for the mineralization of magnesite is derived from the leaching of limestone deposits of the surrounding area. The meteoric water/superficial water enriched in carbon dioxide percolate through weaker planes of the ultramafic rocks. The low temperature (~ 49 ± 3.3˚C) substitution reaction between the high Mg olivine of dunite and the carbon dioxide enrich fluid are the key requirements of mineralization. Therefore, serpentinization, weathering, and downward percolation of CO_2-rich meteoric water that interacted with the host rock under conditions of normal temperature and pressure would have resulted in the formation of the Salem magnesite deposits.

Keywords: magnesite, stable isotopes, hyperspectral, Laser Raman, FTIR

04-5

BIF AS PROXIES OF EARLY EARTH ENVIRONMENT: REDOX OCEAN CONDITIONS ABET IRON FORMATION IN CALICUT

R. Radhika, R.S. Prasanth, A.P. Pradeepkumar

Department of Geology, University of Kerala, Trivandrum 695 581, India
Email: radhikar@keralauniversity.ac.in

Background: Banded iron formations (BIFs) have been recognized as the ideal lithology for reconstruction of the Early Earth conditions during the Archean and are good palaeoproxies for reconstructing Archaen–Proterozoic Ocean water conditions. This study looks at the most important iron ore deposit in Kerala, India in and around the Kozhikode district, formed 2.49 Ga, and tries to characterise the BIFs and their transformation to high grade iron ore, using the tools of petrography and geochemical signatures.

Methods: To decipher the mineralogical and textural variations of BIFs, ore petrography and Scanning Electron Microscopic (SEM) analysis were done. Detailed geochemistry of samples to decipher the environmental conditions of BIF formation was obtained from XRF and High Resolution Inductively Coupled Mass Spectrometer (HR-ICP-MS).

Results and conclusions: The analysed samples preserve sedimentary textures of their formation. These are mostly worn out by secondary fluid alteration due to tropical weathering that in turn helps enrich the primary iron content of BIFs, thereby forming high-grade ores. The sequence of ore formation and the corresponding textural variation in this region is defined and categorized in four stages, from BIF to martite–goethite assemblages. The major, trace and REE geochemistry of samples, normalized with Post Archean Australian Shale (PAAS) composition indicated the paleoenvironmental condition of deposition from a hydrothermal solution in a reduced environment before the Great Oxygenation Event (GOE) from ancient seawater. Thus, the iron formations in Kozhikode are recognised as Algoma type of deposit, based on their primary textures and geochemical behaviour.

Keywords: Banded Iron Formation, Early Earth conditions, Archean, iron ore, petrography, geochemistry, GOE, Algoma, Palaeoenvironment

04-6

SHORT-TERM LAND-USE CHANGES: WHETHER A REASON FOR TRIGGERING LANDSLIDES IN KERALA?

A. Rajaneesh[1], K. S. Sajinkumar[1,2], A.P. Pradeepkumar[1]

[1] Department of Geology, University of Kerala, Thiruvananthapuram 695581, India
[2] Department of Geological and Mining Engineering and Sciences, Michigan Technological University, Houghton, MI 49931, USA

Background: Land-use changes are considered as one of major reasons facilitating landslide occurrences. Modification of land surface, such as topography and vegetation, by human activities increase the probability of landslide occurrences. Furthermore, assessment of land-use changes manifests the human activities in landslide prone areas. During 2018 anomalous rainfall, extensive landslides are seen all over the Western Ghats mountain chain in the state of Kerala.

Method: Here we are analysed a short-term land-use change (2010-2018) to assess its influence on the 4728 landslides that occurred during 2018. The land-use information was extracted for landslide initiation regions (scarps) from the high-resolution Google Earth images for 2010 and 2018.

Results: It is found that 58% of landslides occurred in densely vegetated areas. The destructive landslides mainly originated in forest plantations and followed by built up areas (50% and 25%).

Conclusion: The short-term land-use analysis shows 90% of landslides does not undergone land-use changes and indicates less influence on landslide occurrence.

Keywords: Land-use change, Landslides, Kerala, Anthropogenic activities

04-7

ISOLATION AND CHARACTERIZATION OF ALKALOIDS FROM THE MANGROVE PLANT *RHIZOPHORA APICULATA*

Resmi. P and Anu Gopinath

Kerala University of Fisheries and Ocean Studies, Panangad Road, Kochi, 682506

Background: Mangroves are a rich source of bioactive compounds. Alkaloids are one of the phytochemicals present in mangroves, but its isolation, purification, and identification are very scarce in literature. The aim of this study is the characterization of alkaloid from the mangrove plant *R. apiculata* and to carry out its antidiabetic activity.

Method: Dried powered bark of the mangrove plant *R.apiculata* was used for the alkaloid isolation by the acid base extraction. Alkaloidal fraction was purified by silica-gel column chromatography and size exclusion chromatography (Sephadex LH20). The purified compound was identified by FTIR, LC MS QTOF, H-NMR, and COSY analysis.

Results: The mass spectral characteristics showed that molecular weight of the compound is 402.0535 and the molecular formula of the compound is $C_{20}H_{16}N_2O_3Cl_2$. IR spectrum showed the presence of lactum and lactone moiety. The absorption for -NH and -OH protons was absent in the molecule. HNMR and COSY NMR spectrum gives the specific information about the hydrogen nuclei. From the spectral information the compound is identified as "3-chloro-9-(2-chloro-1-oxo-1,2,3,4-tetrahydroisoquinolin-5-yl)-5,6,7,8-tetrahydrofuro[3,4-b]quinolin-(3H)-one". Antidiabetic activity of the compound by α-glucosidase inhibition assay was carried out and the IC50 was calculated as 1.09 mg/ml.

Conclusion: An alkaloid "3-chloro-9-(2-chloro-1-oxo-1,2,3,4-tetrahydroisoquinolin-5-yl)-5,6,7,8-tetrahydrofuro[3,4-b]quinolin-1(3H)-one" was identified from the bark of *R. apiculata* and its IC50 for α-glucosidase inhibition assay was calculated as 1.09 mg/ml.

04-8

GEOLOGICAL MANIFESTATIONS OF DINOSAUR KILLING EVENT IN INDIA

S. James*, Saranya R. Chandran, J. Aswathi, Devika Padmakumar and K.S. Sajinkumar

*Department of Geology, University of Kerala, Thiruvananthapuram 695581, Kerala, India *Email: shaniajames80@gmail.com*

Background: The Cretaceous-Paleogene Mass Extinction, triggered by the asteroid impact at Chicxulub (Yucatan Peninsula) at 66 Ma, is responsible for the extinction of 76% living species globally, including the dinosaurs. The ecological and climatic changes gave way to an intense biotic stress owing to the break-down of the primary production on a global scale. Additionally, the globally-identified Cretaceous-Paleogene Boundary (KPB) clay is a consequence of the impact-event. In India, the KPB can be expected across seven different locations. Today, the KPB stands at the best-known indicator of the dinosaur killing Chicxulub Impact Event.

Method: India hosts a series of potential KPB sites and transition locations namely, Um-Sohryngkew, Anjar, Jhilmili, Barmer, Rajahmundry, Ariyalur and Nagpur (Sial et al., 2016). The elevated concentration of Platinum-Group of Elements (PGE), especially Ir, is indicative of projectile (carbonaceous chondrite) with target units. Across the locations, concentrations of PGE and siderophiles will be evaluated, in conjunction with variation in major, trace and REE geochemistry of boundary layer, underlying Maastrichtian and overlying Danian lithologies. Furthermore, petrological, and geomorphological associations of the boundary layer will also help in establishing the influence of dinosaur-killing event in India as well.

Results: At the Um-Sohryngkew section, an Ir-anomaly of 12 ppb is ascertained, though a range of 7-12 ppb is also observed across the closest lithologies marking the KPB (Bhandari et al., 1993; Gertsch et al., 2011). At the Anjar section, the Ir anomaly is 1.333 ppb (Shukla et al., 1997). At Takli in Nagpur, a Ir-concentration of 0.027 ppb is reported by Morgan (1978).

Conclusions: At 66 Ma, India was at distances 14000-16000 km from the impact site. The higher Ir-concentrations at Um-Sohryngkew and Anjar are almost on par with values reported at Stevns Klint South (~7200 km from impact site) and Alamedilla (~6500 km). The presence of the KPB is confirmed in sites of Meghalaya and Gujarat, but the direct evidences of the same remain uncertain across the rest five localities. The presence of KPB is indicative of the humongous extent of the Chicxulub Impact Event and its unparalleled contribution in forcing the extinction of dinosaurs.

Keywords: Dinosaur Extinction; K-Pg Boundary; Impact Ejecta; Meghalaya; Gujarat

04-9

STUDY OF AEROSOL INTERACTIONS WITH WARM CLOUDS OVER EASTERN INDO-GANGETIC PLAIN DURING WINTER SEASON USING SATELLITE DATA

Thejas K V[1], Vijayakumar S. Nair[2], P.R. Sinha[1]

[1]Department of Earth and Space Sciences, Indian Institute of Space Science and Technology, Valiamala, Thiruvananthapuram, India, [2]Space Physics Laboratory, VSSC, Thiruvananthapuram, India

Background: The interactions between aerosols and clouds have a significant effect on Earth's radiation budget. Aerosols serve as CCNs for the formation of warm clouds and are well known to

have impact on the cloud micro-physical properties (Twomey, 1977; Albrecht, 1989). This interaction of aerosols and clouds is termed highly uncertain in the estimation of radiation budgets (IPCC AR6 2022) and hence needs to be understood with more studies. The aerosol concentrations due to anthropogenic emissions has increased significantly in the modern times. Study of long-term MODIS aerosol data (2006-2021) shows a presence of relatively higher AOD concentrations over eastern Indo-Gangetic plain region compared to other Indian subcontinent regions during winter season.

Methods: The present study has used MODIS Aqua Level 3 Daily Data for studying aerosol-warm cloud interaction over the region during winter months (DJF).

Results: The preliminary results from the study indicates an existence of anti-Twomey effect in the region, that is, an increase in CER with increase in AOD towards the lower Liquid Water Path (LWP) regimes. The results also indicated the occurrence of higher Cloud Fraction values with increase in AOD suggesting a stronger relation between the two. The study holds significance as the increase in Cloud Fraction with AOD might compensate for the anti-Twomey effect observed. However, the case needs further investigation with consideration of other meteorological parameters.

Keywords: Aerosols, Clouds, Aerosol-Cloud Interactions, Indo-Gangetic Plain

04-10

THE UNPRECEDENTED STRATOSPHERIC WATER VAPOR SIGNAL AND THE MERIDIONAL CIRCULATION

Veenus Venugopal[1,2] and Siddarth Shankar Das[1]

[1]Space Physics Laboratory, Vikram Sarabhai Space Centre, Thiruvananthapuram, 695022, India,
[2]Department of Physics, University of Kerala, Thiruvananthapuram, 695034, India

Background: The Hunga Tonga-Hunga Ha'apai (Tonga) eruption has shown an unprecedented water vapor injection. It also differ from other volcanic eruption since most of the sulfur dioxide in the plume were converted in to sulfate particles and was washed out from the atmosphere. Since the water vapour signal from the Tonga eruption accounts for over 10% of the stratospheric water vapour budget, it has provided an opportunity to examine the Brewer-Dobson circulation (BDC).

Method: The most recent COSMIC-2 temperature data and wind observations from the ERA5 global reanalysis are used to compute the BDC metrics. In order to explore the transport of the water vapour plume in the stratosphere and subsequent changes in stratosphere composition, measurements from the Microwave Limb Sounder on-board Aura have been used.

Results: The strong water vapor signal following the Tonga eruption was analysed to evaluate the speed of ascending and meridional branch of BDC. The meridional transport from equator to pole is evident in the evolution of latitude distribution of water vapor. The effect of the water vapor injection and following chemical changes in the stratosphere is also investigated. **Conclusion:** The speed of BDC have been analysed from the strong signals from the Tonga eruption. Changes in the stratospheric composition have been observed. The detailed results will be presented in the upcoming symposium.

Keywords: Tonga Eruption, Water Vapor, Brewer-Dobson Circulation.

04-11

SOLAR FLARE INDUCED DISTURBANCES ON GLOBAL THERMOSPHERIC NEUTRAL DYNAMICS: QUANTITATIVE ANALYSIS

Aswathy R P & Krishna Prakash K R

Department of Physics, University of Kerala, Thiruvananthapuram

Abstract: Even though there have been innumerable studies on the effect of solar flare on Earth's ionosphere, there is not much understanding regarding the neutral dynamical aspects. The present study provides valuable information on this unexplored aspect. Effect of solar flares (X class) on thermospheric neutral density and wind components and on the generation of the dominant wave perturbations are analysed & quantified (Tabulated as in fig.1a) and the corresponding physical mechanisms are investigated, using satellite-based observations and upper atmospheric models, in the present study. The thermospheric neutral mass density, Variation in density, Latitude gradient of density, Longitude gradient of density (Fig.1b) and zonal-meridional-vertical components of thermospheric winds are significantly higher in solar flare days compared to non-flare days and are quantified and the physical mechanisms are looked in to. The neutral temperature is observed to be higher in flare day (~885 K corresponding to 400 km) compared to non-flare day (~845 K corresponding to 400 km). This suggests that the absorption of the spectrum of EUV and X radiation must first be converted to the appropriate heating effect through photo-absorption and molecular excitation, photo-dissociation, photo-ionization, and collisional processes. This could raise the thermospheric temperature and hence the scale height and the density. The density gradients are also higher in flare days, both latitude-wise and longitude-wise. This could generate stronger winds in flare days compared to non-flare days. The dominant wavelength bands observed in conjunction with the X- class solar flares are analysed (Fig.1c) and it includes (2700 – 3300 km), (750 – 1250 km) and (300 – 700 km). The (2700 – 3300 km) wave is observable from -66 deg to +66 deg. latitude, while the other two waves become weaker at ~ 34 deg. latitude. Among the three bands, the (750 – 1250 km) wave is the strongest one with maximum amplitude of ~10^{-12} kg m^{-3}.

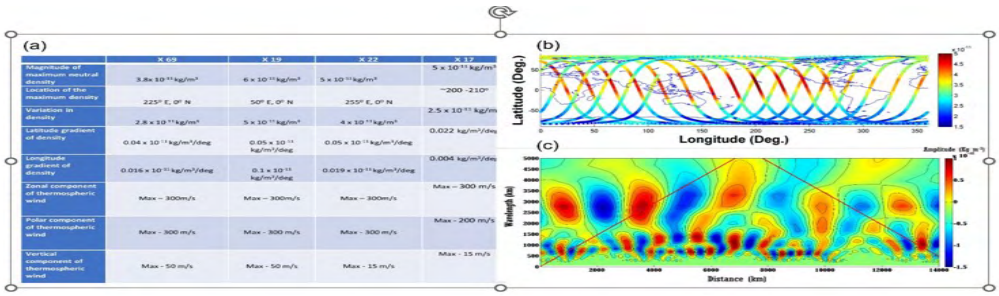


Fig.1: (a) Tabulated parameters of thermosphere (b) Global pattern of thermospheric density for X17 flare (c) Wavelet diagram for the thermospheric density for the X17 flare

Keywords: solar flare, thermosphere, wave perturbations, thermospheric wind

04-12

TROPICAL COASTAL ATMOSPHERIC BOUNDARY LAYER HEIGHT: VARIABILITY AND CAUSATIVE MECHANISMS

Edwin V Davis, and K. Rajeev

Space Physics Laboratory, Vikram Sarabhai Space Centre, Thiruvananthapuram, 695022

Background: The daytime development of atmospheric boundary layer (ABL) is a controlling factor that governs the exchange of aerosols and trace species between the ABL and free-troposphere and their subsequent long-range transport. However the evolution of ABL are further modified by the prevailing background conditions and near surface meteorological parameters. Quantifying the effect of these factors in the temporal variation of ABL is essential for the better understanding of the physical processes and modelling of the ABL development.

Method: The present study make use of vertical profiles of water vapour and temperature observations from a ground based passive multi-frequency microwave radiometer profiler (MRP) from which the virtual potential temperature profiles are estimated. Parcel method is applied to the virtual potential temperature profiles for the estimation of ABL height (ABLH). Collocated observations of near surface meteorological parameters are used for investigating their effect on the evolution of ABLH.

Results: The ABLH undergo significant diurnal variation during all seasons with rapid growth during forenoon hours and weak decay in the afternoon hours. The daytime ABLH peaks at around noon time during all seasons. In addition, it undergo intraseasonal and inter-annual variations also. Intraseasonal variations of ABLH is associated with the distinct changes in the synoptic scale circulation. The effect of clouds is to reduce the ABLH with maximum reduction during noontime and with varying magnitudes depending on seasons. Interestingly, the effect of clouds on ABLH during offshore flow is almost a factor of 2 greater than that during onshore flow. This is mainly because the offshore flow represents the development of continental ABL. On average, the onshore-wind-induced local cooling is at least 1.5 to 2°C in the forenoon during winter and pre-monsoon seasons. Among the various parameters, the ABLH is found to be strongly correlated with the virtual potential temperature lapse rate.

Conclusions: This study presents the diurnal, intraseasonal, and inter-annual variations of ABLH over a tropical coastal region Thumba (8.5°N, 77°E) from MRP observations and quantifies the effect of background and near-surface meteorological parameters on the ABLH.

Keywords: Diurnal variation, Tropical coastal atmospheric boundary layer, Microwave Radiometer Profiler, Onshore flow

04-13

REMOTE SENSING OF AEROSOLS IN THE FREE-TROPOSPHERE USING A COMBINATION OF LIDAR AND MICROWAVE RADIOMETER

Lakshmi N B, Sumesh R K and Resmi E A

National Centre for Earth Science Studies, Thiruvananthapuram

Background: Assessment of free-tropospheric aerosols assumes great importance in the context of aerosol-cloud interaction as well as their impact on radiation budget. Understanding aerosol

processing under diverse meteorological conditions is challenging as it depends on a wide range of physical factors. This necessitates the coordinated use of advanced instrumentation for in-depth process investigations.

Method: Long-term continuous high-resolution observations of the ceilometer are coupled with observations of meteorological parameters by microwave radiometer to examine aerosol processing in the free-troposphere. Measurements are carried out over the topical coastal observatory operated by National Centre for Earth Science Studies at Thiruvananthapuram.

Results: The present study focuses on understanding the hygroscopic growth of aerosols in the free troposphere by coupling simultaneous remote sensing of aerosols and water vapor in the atmosphere. The Rayleigh method is used to calibrate the ceilometer backscatter signals and forward iterative method is used to retrieve aerosol back-scattering profiles over the study region. Vertical profiles of water vapor measured by the microwave radiometer are coupled with retrieved aerosol backscattering coefficients to study the hygroscopic growth of aerosols in the free troposphere. The study quantitatively analysed the hygroscopic growth factor of tropospheric aerosols in the real atmosphere using simultaneous direct measurements of aerosols and water vapor over the Indian region. Monitoring of real atmosphere hygroscopic aerosol growth has been carried out for the first time over the Indian region.

Conclusion: The present study demonstrates characterization of aerosols in the free-troposphere and investigates the variability of aerosol hygroscopic growth factor which is crucial to understand role of aerosols in cloud formation and showing the capability of ceilometer observations, which has a relatively low signal-to-noise ratio in determining the hygroscopicity of aerosol.

Keywords: Lidar, ceilometer, Aerosols, hygroscopic growth factor, microwave remote sensing

04-14

A STUDY ON IONOSPHERIC IRREGULARITIES OVER COCHIN USING RADAR AND ANCILLARY INSTRUMENTS

Sreekumar Haridas[1], Rakesh V.[1], M G Manoj[1], K. Unnikrishnan[2], and Binu Paul[3]

[1] Advanced Centre for Atmospheric Radar Research, *Cochin University of Science and Technology, Cochin-682022, Kerala, India.[2] Research Department of Physics, N S S Hindu College, Changanacherry, Kerala-686 102, India.[3]* School of Engineering, *Cochin University of Science and Technology, Cochin-682022, Kerala, India.E Mail / Contact Details: sreekuttanarackal@gmail.com/ Mob No. +91-9567858403*

The 205 MHz VHF radar at Cochin is unique and in fact, is the first wind profiler radar operating in the far VHF range of 200 MHz band. The radar is capable of detecting ionospheric irregularities that could lead to range errors, loss of lock problems in satellite-based communication, and reliability concerns in positioning & navigation systems. The results of the observations and investigations of the Indian near-equatorial ionospheric plasma irregularities over the Kerala region during different geomagnetic and geophysical conditions are presented in this communication. In addition to the 205 MHz VHF radar and other supporting instruments or datasets like Global Navigation Satellite System (GNSS) receiver, Swarm satellite constellation and automatic weather stations (AWSs) are also utilized. Almost 40 quiet-time (Ap<10) F-region irregularity events between 01st July 2020 and 30th April 2021 have been observed. Bottom-type and bottom-side irregularities were observed in this period, but no large-scale topside ones at F-region heights. The nighttime irregularities were most commonly observed at average heights of 200–250

km, accounting for 50% of the total events, and 27.5% of the irregularities preferentially occurred after sunset between 19 and 20 LT. The ionospheric storm effects due to the equatorward and poleward shifting of the EIA attributed to moderate and weak geomagnetic storms (Ap>10) are also investigated. Finally, the effects of the volcanic eruption in Tonga, which occurred on January 15, 2022, on the ionospheric F-region over the Indian near-equatorial sector, are observed in order to study the lower atmospheric-ionospheric coupling process. The acoustic or gravity waves associated with the Tonga volcanic eruption that reached the Indian sector at post-sunset hours could have enhanced the polarization electric field created by equatorial plasma depletions. It is confirmed that under extreme geomagnetic and geophysical circumstances, 205 MHz VHF radar can monitor near-equatorial ionospheric disturbances over the Indian equatorial ionization anomaly (EIA) trough region.

04-15

LONG TERM VARIABILITY OF SOLAR FLARE EFFECTS OVER IONOSPHERE

Sreeraj M S and Sumod S G

Space Science Group, Department of Physics, Sacred Heart College, Thevara, Kochi – 682013

Background: The enhanced radiations during solar flares can affect the entire Earth's atmosphere, especially the ionosphere. Several investigations have been made to understand the different aspects of ionospheric response to solar flares. Nevertheless, most of these studies only focused on some particular aspects. The present work is an attempt to understand different aspects of solar flares statistically, by analysing the variability of TEC and flare induced radiations at different wavelengths along with other parameters representing the flares.

Method: EUV radiation in 26 – 34 nm band and X ray radiation in 0.1 – 0.8 nm band bands were analysed and the enhancements during the flare peak time are calculated. TEC data from IGS and IMPC networks were analysed. Tec enhancements during flare peak time is calculated. The enhancements are studied in connection with Central Meridian Distance (CMD).

Results: From the spatial distribution of TEC enhancements, it was observed that enhancements are more near the subsolar point. TEC enhancements are also plotted against cos (CMD). The linear regression line shows that for decrease in CMD, enhancements decrease. That is central flares cause more enhancements than a limb flare.

Conclusion: The flare location dependence of flare induced TEC is due to the variation in solar radiation which again depends on CMD. The effect is more prominent for X rays than EUV.

Keywords: solar flares, EUV, X ray, TEC, central meridian distance (CMD).

04-16

STUDY ON THE SPATIO-TEMPORAL VARIABILITY OF THE ABSORBING AEROSOLS OVER INDIA

Thanaya Pradeep[1] **and Dr.Abish B**[2]

[1] Department of Climate Variability and Aquatic Ecosystems Kerala University of Fisheries and Ocean Studies, Kochi, Kerala.[2]Kerala University of Fisheries and Ocean Studies (KUFOS) Kochi, Kerala

This study examines the influence of the El Nino Southern Oscillation (ENSO) on the transport deposition, and distribution of Aerosol concentration over the Indo-Gangetic plain from 2006 to 2022, a span of around 16 years. The analysis shows that the influence of El Nino and La Nina has reduced in determining the distribution and its movement. The Previous studies till 2010 have shown that the ENSO causes an increase in aerosol concentration during El Nino and a decrease during La Nina. As a result, measured levels of AOD ought to indicate a rise during El Nino and a decrease during La Nina. However, the observation shows that the aerosol concentration is not affected by El Nino and La Nina .There are other aspects that depend on the concentration of aerosol in IGP, as evidenced by the AOD obtained, which exhibits high values even during the La Nina phase and lower levels during El Nino. It is seen that several years with La Nina, including 2008, 2020, and 2021, have strong winds over the Arabian Peninsula assisting long-range aerosol transport towards the Indo-Gangetic Plain. This is done by comparing the zonal wind meridional with respect to the backward wind trajectory. As a result, even during the La Nina event, aerosol concentration has increased over the Indo-Gangetic Plain. During the 2015–2016 El Nino, the wind is stronger in the Arabian Peninsula but weakens as it enters India. The amount of aerosol decreased as a result of less long-range transport to the Indo-Gangetic Plain.

POSTER PRESENTATION

04-17

INFLUENCE OF PALEOCLIMATE IN ERODING TERRESTRIAL METEORITE IMPACT CRATERS

Devika Padmakumar, Saranya R. Chandran, S. James, J. Aswathi, K.S. Sajinkumar

Department of Geology, University of Kerala, Thiruvananthapuram, Kerala 695581
Email: devikapadman1998@gmail.com

Background: Weathering and erosional processes govern the rates and patterns of landform evolution. Mean relief, lithology, climate, and time are the most important factors that affect the rate of erosion and vary from place to place. In this study, we calculated the erosion rates and long-term erosion of 22 meteorite impact craters across the globe that is carved within different climatic zones.

Method: Meteorite impact craters were selected based on the availability of data required for quantifying erosion. Furthermore, previously established equations are used with suitable modifications. Since the rate of erosion is proportional to the relief of the region, we employed two different methods to calculate the relief, which was quantified based on paleoclimatic data spanning from 100 million years' time period.

Results: The study resulted in calculating modified erosion efficacy values. Two different methods were adopted for the estimation of relief. Based on the relief values obtained using 2

methods, the erosion rates and long-term erosion of selected 22 impact craters have been determined. In method 1 and 2, simple craters like Henbery, Boxhole and Hickman showed lowest erosion rate (0.01 km/Myr) whereas Colonia showed the highest rate of erosion (0.18 - 0.16 km/Myr, 0.16 - 0.14 km/Myr). In addition, the complex craters' lowest rate of erosion is shown by Bigach (0.07 - 0.06 km/Myr) in method 1 and Goat Paddock and Beyenchime-Salaatin (0.06 - 0.05 km/Myr) in method 2. Higher erosion rate is shown by Bosumtwi (0.48 - 0.45 km/Myr) in both the methods.

Conclusion: The erosion rates derived through method 1 and method 2 show similarities and the data also concur with the earlier studies.

Keywords: Meteorite impact craters, erosion rates, total erosion, paleoclimate

04-18

INVESTIGATING THE POTENTIAL OF 1-D HYDRODYNAMIC MODELING FOR FLOOD INUNDATION MAPPING IN TWO GEOMORPHOLOGICALLY DISTINCT RIVER REACHES

Jesna[1], S M Bhallamudi[1], K P Sudheer[1,2]

[1]Department of Civil Engineering, Indian Institute of Technology Madras, Chennai, India
[2]Department of Agricultural and Biological Engineering, Purdue University, West Lafayette, Indiana, USA.

Background: Floods have become more recurrent and intense over the recent decades and are anticipated to exacerbate their negative impacts in the future due to climate change. Managing flood risk requires the estimation of potential flood hazards in terms of inundation extent, depth, etc. Hydrodynamic models are commonly employed to predict flood hazards. The model structures generally used to generate the flood maps are one-dimensional (1-D) or two-dimensional (2-D). One of the primary concerns in flood inundation modelling and mapping applications is selecting an appropriate model structure under input data availability and computational cost constraints.

Method: This study analyses the potential of flood predictions by a 1-D hydrodynamic model for two distinct river reaches: the Adyar River, Chennai, India, and the Brazos River, Texas, USA. The results are benchmarked against the simulation results of a 2-D hydrodynamic model. An open-source hydraulic modelling tool, HEC-RAS, with both 1-D and 2-D modeling capabilities, is employed for flood inundation modeling and mapping.

Results: It is observed that the inundation pattern predictions by the 1-D model vary significantly in the case of the Brazos River as compared to those for the Adyar river. The discrepancies in the flood inundation boundary simulated by the 1-D model are also translated to the computed depth values in the case of the Brazos River reach, showing systematic under-prediction of depth values. The depth values are observed to be well-predicted in the case of the Adyar river reach.

Conclusions: The study suggests that the simulations of flood inundation extent and maximum flow depth are influenced by the 1-D modeling assumption on flood plains in river reaches characterized by wide flood plains with complex local topographical variations. In contrast, for reaches with relatively less wide and complex floodplains, 1-D models can generate robust simulations of flood inundation extent and spatial variation in maximum flood depth for high flood events.

Keywords: flood inundation mapping, hydrodynamic modelling, HEC-RAS

04-19

A STUDY ON EARTH SURFACE TEMPERATURE

Karthika M[a,b] and Roxy M S[b]

[a] *SAS SNDP Yogam College, Konni, Pathanamthitta, Kerala*
[b] *Post Graduate and Research Department of Physics, Sree Narayana College, Kollam, Kerala, 691001*

Background: The composition of naturally occurring soil changes over time, owing to the constantly varying temperature field of the soil. Understanding soil thermal properties is critical for quantifying surface temperature and heat storage requirements in agriculture, germination rate and in energy balance applications such as land surface modeling, numerical weather forecasting and climate prediction.

Method: The data required for the study was collected from 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 of 2 weeks from 1st August 2008 to 15th August 2008.

Result: Diurnal thermal wave shows a sinusoidal wave nature and the amplitude is exponentially attenuated as the depth increases. Using the regression analysis, a one factor parameterization relation is proposed. From calculated mean thermal conductivity and diffusivity values, the diurnal variation of heat flux is found to be characterized by a cross over from negative to positive value in the morning, peaking around evening and return to negative values in the late evening. During day time the heat flux decreases as the depth increases and at night it shows an opposite trend.

Conclusion: The amplitude of the thermal wave decreases as the depth increase and practically become zero at a depth of 0.50m. Mean soil temperature shows maximum fluctuations in the near surface layers. Higher value of mean thermal conductivity obtained could be attributed by the high moisture content of soil during the monsoon season. Diurnal variation of heat flux is driven primarily by incoming radiations. Heat radiations are absorbed during the day time and emitted from deeper soil layers during the night time.

Keywords: Diurnal thermal wave, Thermal diffusivity, Thermal conductivity, Soil heat flux

04-20

SOLAR WIND VARIABILITY ON LUNAR SURFACE COMPARED TO NEAR EARTH ENVIRONMENT: INTRIGUING ASPECTS

Meenu. G & Aswathy R P

Department of Physics, University of Kerala, Thiruvananthapuram,pin:695581

Background: The solar wind is a continuous stream of charged particles like electrons and protons, alpha particles, and trace heavy ions with energies up to approx. 10 MeV that are emitted constantly from the Sun's corona that will flows out of the Sun in all direction. The variability of the solar wind speed on the lunar surface in comparison with the near Earth environment is analysed for the first time in the present study. Further, quantified variability in solar wind speed on the lunar surface is associated with the activity of the sun.

Method: The study uses the solar wind observation on the lunar surface from Apollo satellites and in the near-Earth Environment observations from multi satellites. The F10.7 index is taken as a proxy for solar activity. The study period is from 1970 to 1976, which encompasses the high, moderate and low solar activity conditions. The variations in the solar wind speed in the lunar surface and near-Earth environment is compared and the change is quantitatively deducted for the different solar activity conditions.

Results: The study reveals that the solar wind velocity varies as it approaches the lunar surface compared to the near-Earth environment. In 1970 (F10.7 =169.8), the change in solar wind velocity at the lunar surface was 37 km/s and was increased to 70 km/s in 1976 (F10.7 =169.8) [Fig.1]. The change in solar wind velocity is inversely related to the activity of the sun and is systematic for the years considered. This relation is inverse in nature. Further, the magnitudes of solar wind velocity at the lunar surface as well as at near Earth environment are inversely linked with the activity of the sun.

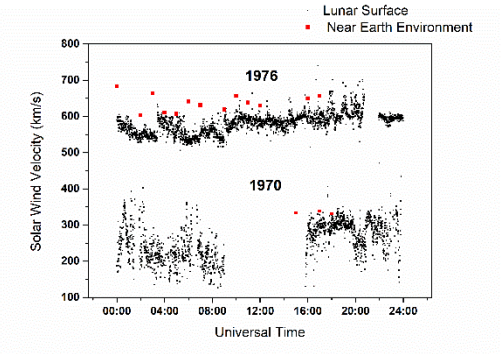


Fig.1: Solar wind velocity at the lunar surface and near-Earth environment for the years 1970 and 1976

Conclusions: The present study identifies for the first time that the speed of the solar wind changes at the lunar surface regime in comparison with the near Earth environment and the corresponding changes are quantified. The association of the above mentioned changes, and solar wind velocity magnitudes at the lunar surface and near Earth environment are established.

Keywords: Solar wind, Solar activity, lunar surface, F10.7

04-21

SPATIAL VARIABILITY OF HEAT WAVES OVER INDIA DURING A CHANGING CLIMATE

Neethu C S and Abish B

Department of Climate Variability and Aquatic Ecosystems, Faculty of Ocean Science and Technology Kerala University of Fisheries and Ocean Studies (KUFOS), Kochi, Kerala.

Human adaptations depend heavily on the local climate. Temperatures have a major impact on a man's health, adaptability, behavioural patterns, food, shelter, and clothes. As a result, a study is conducted to examine the spatial distribution of heat waves across the nation. In this paper, the statistical properties of heat waves across India are discussed.Gridded daily temperature data sets

for the period 1981-2020 were used to compute the arithmetic mean (AM), standard deviation (SD).The heat wave were identified using the criteria given by India Meteorological Department (IMD) i.e., a heat wave is recognized when the daily normal maximum temperature of a station is less than or equal to (greater than) 40 °C than it will be considered as a heat wave if the daily maximum temperature exceeds the daily normal maximum temperature by 5 °C (4 °C). The analysis was confined to the three summer months of March, April and May. The spatial distribution of the AM shows higher values during May, and the core hot region with temperatures exceeding 42°C lies over central India extending towards the northwest. The SD distribution shows higher values over the northeast of central India decreasing towards the southwest. Soil temperature data confirm the regions of the maximum temperatures and the heat waves indicating the emphasis due to local radiative heating.

Keywords: heat waves; maximum temperatures; climate; statistical metrics;

04-22

FLOOD MODELLING OF FLUVIAL OUTFLOW CHANNELS IN JOVIS THOLUS REGION, MARS

Sadeeda Marjan. T, Devika Padmakumar, Sajin Kumar K.S, R. B. Binoj Kumar.

Department of Geology, University of Kerala, Thiruvananthapuram-695581, Kerala, India

Background: Mars, one of the solid bodies in the solar system, has experienced high-energy megafloods in its early history. Polar ice-caps, together with huge dried-up channel-like features in its northern hemisphere, emphasize the existence of water on Mars. These channels are believed to be originated by the catastrophic floods that occurred due to the melting of subsurface ice, and probably by precipitation.

Method: HEC-RAS, a dynamic hydraulic modelling software used widely for studying terrestrial floods, has been used in this study for 2D modelling and recreation of paleo-flood channels near the Jovis Tholus on Mars. HEC-RAS simulations were performed by using MOLA DEM and CTX imagery. In order to study the paleo flood scenario, this work was focused on the possibility of simulation of a constant water flow, i.e., 1×10^6 for a Manning's value of 0.097 and the total surface occupied by flood water. Flow depth, velocity and arrival time were calculated by solving 2D diffusion wave equations using HEC-RAS software. We also investigated and studied the CRISM mtrdr image cube of the study area.

Results: Jovis Tholus outflow channel peak discharge is estimated at 1 x 10^6 m3 s^{-1}, with a mean flow velocity of 11.31 m s^{-1} and a stream power of 67540; the greater stream power indicates greater stream competence and capacity for sediment transport and stream erosion, which concurs previous works. The total water volume modelled for the best-fit peak discharge is 1.4 x 10^3 million cubic meters. The obtained CRISM spectra and the library spectra of some carbonate minerals show diagnostic absorption bands at 2.8 and 3.28 μm, which are centered and matched.

Conclusions: The results obtained show that Jovis Tholus outflow channel would be one of the potential channels for paleo-hydraulic studies and, definitely, which can provide a major contribution to the planet-scale understanding of Martian flood events and associated processes.

Keywords: Catastrophic floods, Mars, Jovis Tholus, HEC-RAS 2D Modelling

04-23

HORIZONTAL EXTENT AND VERTICAL EXPANSE OF TERRESTRIAL METEORITE IMPACT CRATERING: A LONAR PERSPECTIVE

Saranya R. Chandran[1], S. James[1], J. Aswathi[1], R. B. Binoj Kumar[1], K. S. Sajinkumar[1,2]

[1]Department of Geology, University of Kerala, Thiruvananthapuram 695581, India
[2]Department of Geological and Mining Engineering and Sciences, Michigan Technological University, Houghton, MI 49931, USA

Background: Meteorite impact cratering is a dominant surface modification process prevalent in all solid planetary bodies across the solar system. The extent of meteorite impact reaches the depths and the resulting impact ejecta traverse a great distance from the point of impact. Lonar Impact Crater in India is one of the well-preserved, simple, bowl-shaped crater emplaced in Deccan tholeiitic flood basalts. The crater being carved in a basaltic terrain has the potential of analog studies and hence provide avenue to explore more about extra-terrestrial impact craters. Impact cratering modifies the depths and surface of terrain and such notable modifications have observed in Lonar crater.

Method: The horizontal extent of Lonar impact event has been delineated by observing the areal distribution of impact ejecta around the crater with the aid of field observation, and published data whereas remotely sensed images of lunar and martian surfaces were used for correlation. The vertical extent of impact has been explored through analysis of impactites, where exotic grains of quartz were seen in a basalt dominated impact melt-bearing rock. This rock was subjected to detailed petrographical, mineralogical, geochemical, and geochronological studies along with an analysis of morphology of separated zircon grains.

Results: The most noticeable feature of impact craters is the distribution of ejecta materials around and away from the crater besides possessing characteristic impact-related features. In the case of Lonar crater, the ejecta distribution is found to a distance of less than ~3R (R is the crater radii from the rim crest). However, for similar sized lunar and martian craters the ejecta reach to a distance of ~10R and ~15R respectively. Tracking the vertical extent of Lonar impact event zircon grains separated from a melt rock yielded U-Pb age of 3.0 to 3.1 Ga, confirming the melting of Archean basement rocks resting ~550 m beneath multiple basaltic flow units in Lonar.

Conclusions: Meteorite impact events, whether small or large, has its impact on planetary surfaces, which equally reflect the horizontal vertical extent as is evident from Lonar Impact Crater.

Keywords: Meteorite impact, Lonar Impact Crater, Remote sensing, U-Pb geochronology

04-24

GEOGENIC POTENTIALLY TOXIC ELEMENTS (PTES) IN GROUNDWATER: AN ANALYSIS FROM KASARAGOD DISTRICT, KERALA SOUTHERN INDIA

K V Sarath [1], E Shaji [1] and V Nandakumar[2]

University of Kerala, Kariavattom campus, Thiruvananthapuram, Kerala, India
National Centre for Earth Science Studies, Ministry of Earth Sciences, Government of India, Akkulam, Thiruvananthapuram, Kerala, India

There is a considerable imbalance in the availability of freshwater among the population of Kasaragod district in northern Kerala. In the district, the drinking water supply largely relies on groundwater, which is being extracted by dug wells and bore wells. Generally, the bore wells tap fractured crystalline aquifers and the dug well tap both alluvium and weathered crystallines. The paper elucidates the trace elements and heavy metal concentrations of groundwater resources of the area. They are referred here as potentially toxic elements (PTEs). The result shows that some of the groundwater samples have excess Cr (> 50 µg/L) and Fe (1 mg/L), Mn (>300 µg/L), Ni (>20 µg/L), Pb (> 10µg/L), F^- (1.5 mg/L) and Ba (600 µg/L). However, in majority of the samples, As, Co, Cd, Cu, Zn, Se and Te are within the acceptable limits, Q-ICPMS technology were used to measure trace elements at the ppb level. The result shows that the water is characterised by elevated alkali metal concentration in the case of Barium (value ranges from 10 to 1085 µg/L), alkaline earth metals K (>12 mg/L), Li (0.1 to 15 µg/L) and Sr (10 to 600 µg/L). Since WHO, so far, not prescribed any standard permissible limit of Sr and Li in drinking water, the excess concentration of such elements needs special attention. The major ions in some samples show higher concentrations of total Na+, K+ and shortage of calcium in drinking water. Our study indicates that the high concentrations of the major and PTEs elements were observed as a result of the rock water interaction with the surrounding alkaline and ultra-mafic rocks. This study reports the occurrence of such PTEs in the groundwater resources of different area of Kasaragod district. The study is in progress and proposes to generate more data on these aspects and a health survey is also proposed to correlate the water quality issue.

Keywords: Geogenic, Trace elements, groundwater, permissible limit

04-25

A CASE STUDY ON EXTREME RAINFALL EVENTS OVER A COASTAL STATION KOCHI

Selja Saji & Abish B

Department of Climate Variability & Aquatic Ecosystems, Faculty of Ocean Science & Technology, Kerala University of Fisheries and Ocean Studies (KUFOS), Kochi, Kerala

The occurrence of exceptionally heavy rainfall events and the associated flash floods in many areas over Kerala has increased significantly in the recent years. A coastal station in Kochi, Kerala has witnessed an abnormally heavy rainfall of shorter duration during the pre-monsoon season in 2022. Based on the rainfall measurements from the station data, the study domain has received 817.9 mm rainfall from 11 May-26th May. These changes in the precipitation are probably associated with deep convection since the study domain is located over the tropical region. However, the underlying physical properties for the observed increase in rainfall over the region

are not clear. The present study was aimed to investigate the effects of cloud properties on the increase in rainfall over the region under study. Ground and satellite based measurements of rainfall and cloud parameters are analyzed for the location under study to find an interrelation between Cloud Top Pressure, Cloud Optical Thickness, Cloud Top Temperature, Cloud Effective Radius and rain. The study shows that most of the days that recorded high rainfall are associated with deep convective clouds. From the analysis, there exists a positive relation of rainfall with cloud properties as observed at the location under study.

04-26

ANTECEDENT CONDITIONS FAVOURING EXTREME RAINFALL EVENTS OVER THE SOUTH-WEST COAST DURING MONSOONS

Ajil Kottayil[1], Prajwal K[1], Prince Xavier[2] and Roshny Antony[3]

[1]Satellite Remote Sensing and Applications, Advanced Centre for Atmospheric Radar Research, Cochin University of Science and Technology, [2]UK Met Office, Exeter[3]Department of Atmospheric Sciences, Cochin University of Science and Technology

Background: Hydrological extreme events such as flood and drought have a profound influence on human life and living which are further aggravated by anthropogenic global warming. The frequency of monsoon rainfall extremes is now on a rise (Roy and Balling, 2004). Goswami et al. (2006) have shown that during monsoon season, the frequency and intensity of extreme rainfall events show an increase, whereas there is a decrease in moderate events over central Indian region. In recent years, the south west coast of India has witnessed an unprecedented pattern of rainfall activity during the monsoon season. The torrential rains and subsequent deluge of 2018- 2022 wreaked havoc in the state of Kerala causing huge loss to life and property. Therefore, it is imperative that large scale factors causing such high impact weather events are identified which can enhance an accurate prediction of extreme events. This study investigates the background conditions which trigger extreme rainfall over the south west coast of India using long -term observations and re-analysis datasets.

Method: The IMD daily mean rainfall is calculated over the west coast (9–20°N, 72–78°E) from June to September over several years (1979–2018), and the 95th percentile of the rainfall is inferred from the area averaged time series. The days with values above the 95th percentile are considered as extreme heavy rainfall days. The TRMM rainfall is used to infer the diurnal cycle of rainfall during the active and inactive phases of Madden Julian oscillation (MJO).
Results: The extreme rainfall events are linked to the development of monsoon depressions and the associated largescale dynamics. Strengthening of these parameters intensifies the monsoon low-level circulation over the Arabian Sea and the west coast via steepened meridional pressure gradient. The intensification of the low-level jet stream speed and its extension in the vertical causes an increase in the humidity flux in the lower and mid- troposphere. The consequent ascending motion is from the mid-troposphere to the upper troposphere, resulting in the formation of deep convective cloud clusters over the west coast and eastern parts of the Arabian Sea. This results in the incidence of extreme heavy rainfall over the south west coast of India. Active MJO phases help in the formation of mesoscale convective cloud systems with much more spatial extension and temporal duration than that in suppressed phase. This kind of convective organization is observed especially during the active MJO phases of monsoon and post-monsoon seasons. The overall modification of tropospheric dynamics, thermodynamics and deep convection by MJO can cause extreme rainfall activity over the south west coast.

Conclusions:

- MJO can cause an anomalous increase in the diurnal cycle of rainfall over the south west coast of India
- Changes in large-scale features associated with monsoon depression can cause extreme rainfall over the south west coast.

Keywords : Monsoon, MJO, diurnal cycle, convection

04-27

GEOSPATIAL APPLICATION IN NEW GENERATION WATERSHED DEVELOPMENT STUDY OF SULTHA BARTHERY BLOCK, WAYANAD DISTRICT

Suraj R[1], Nizamudeen A[2], Anilkumar N.C[3], Sheeja R.V[1]

[1]Senior Scientific Assistant, [2]Director, [3]Scientist, Kerala State Remote Sensing & Environment Centre (KSREC), Vikas Bhavan, Thiruvananthapuram-33
E-mail-surajravi@yahoo.com

Background: A watershed refers to an area of land that comprises a set of streams or rivers that drain into a larger waterbody like a ocean or river. The New Generation Watershed Development projects (WDC - PMKSY 2.0) is planned with an aim of integrated sustainable eco-friendly development of the rural areas of the country. The study area consists of four micro- watersheds in Kabani River Basin, viz. 27K1aa, 27K1V, 27K1w1 and 27K1z falling in Nenmeni and Noolpuzha Grama Panchayaths of Sulthan Bathery Block.

Methodology: At first, Online meetings were conducted with Block/panchayath Presidents,BDO, members, Secretaries, representatives of Kudumabasree and MGNREGS to identify the schemes for water and Soil Conservation in the study area. Reconnaissance survey conducted in 4 microwaterheds and interacted with Block/Panchayath Presidents and members to finalise schemes. The study also involves geotagging of schemes, estimates and thematic maps preparation using high resolution satellite data and Geographic Information System(GIS) for preparing Detailed Project Report(DPR).

Results &Discussion: Spatial data of Wardwise details of finalised schemes in 4 microwatersheds prepared. After discussion, schemes were put in Natural Resource Conservation & Management (NRM) Plan for 263.99 lakhs, Livelihood support system for assetless/landless (84.25 lakhs) and Production Plan (84.25 lakhs). Estimates for implementing the schemes were prepared with the help of Engineers. NRM activities include Avenue planting, Well recharging, Earthen bunds, desiltation of drains, Lift irrigation, Pond renovation, channel construction and Check dams construction etc. where as livelihood activities suggested are Bee keeping, Milk processing units, Spices processing units, Cow rearing etc. Production system includes Integrated farming system, Fallow land cultivation, Banana cultivation, vegetable cultivation in grow bags, distribution of coconut seedlings etc. Thematic maps such as administrative, watershed, microwatershed, cadastry, drainage network, relief slope, groundwater prospect, lithology, soil, land use, land capability and land irrigability maps were prepared.

04-28

REVEALING THE TRANSITIONS FEATURES OF THE PRECIPITATION MICROPHYSICS DURING ONSET PHASE OF SOUTHWEST MONSOON

Resmi E.A.[1], Sumesh R.K.[3], Unnikrishnan C.K.[1], Manoj M. G.[2], Nita Sukumar[1]

[1]Atmospheric Science Group, [1]National Centre for Earth Science Studies, Thiruvananthapuram, Kerala, India, [2]Advanced Centre for Atmospheric Radar Research, Kalamassery, Ernakulam, [3]Department of Atmosphere Science, Cochin University of Science and Technology, Cochin.

Background: The onset phase of Indian summer monsoon is characterised by changes in large scale circulation in the lower troposphere and associated rainfall distribution over Kerala. Numerous scientific studies had been conducted to understand the monsoon dynamics and to improve the forecasting efficiency of the monsoon rainfall; still, the underlying mechanisms governing the transition of pre-monsoon convective rainfall, its variability and intensity needs better understanding. The present study focuses on the microphysical changes in the rainfall, distribution of clouds, orographic influence of Western Ghats and changes in the local convective activity associated with large scale monsoon circulation during the onset period of southwest monsoon over Kerala.

Method: The transition of rainfall and clouds during the onset phase are examined with in-situ measurements taken from two representative locations; one at Advanced Centre for Atmospheric Radar Research (ACARR; 40 m above msl), Cochin University of Science and Technology (CUSAT) and another at High-Altitude Cloud Physics Observatory (HACPO; 1820 m above msl), Rajamallay, Munnar in Kerala. The measurements were taken during the onset period of 2017 and 2018. The changes in wind pattern associated with monsoon onset are analysed using the wind data from stratosphere-troposphere (ST) radar at ACARR. The synoptic circulations and thermodynamic conditions for the study period are analysed using satellite and reanalysis data set.

Results: The distribution pattern of rainfall shows distinct features in both locations, with very light rainfall prior to onset days at ACARR, followed by moderate to rather heavy rainfall days in the onset phase. While at HACPO, light to moderate rainfall is observed during the onset of monsoon season and further moderate rainfall prevailed over the region. The higher occurrence of wind speed and core height of the low-level jet (LLJ) is found between 1.5 and 2.5 km with an average wind speed of 12 ms^{-1} at ACARR location and over HACPO, core height is noted at the near surface level with wind speed of 13 ms^{-1}. ACARR location is registered with a rainfall of 187 mm (2017), 62 mm (2018) and HACPO location with, 132 mm (2017), 123 mm (2018) during onset days. Moreover, the mean distribution of cloud layers is also showing slight increase in the mid-level clouds (8%) at ACARR where low and mid-level clouds equally contribute to the precipitation at HACPO location.

Conclusions: The regional scale interaction of low level winds with mountain slopes of the Western Ghats leads to the formation of shallow cloud layers producing distinct diurnal cycle in precipitation during the onset phase of monsoon over Kerala. The evolution of rainfall over the ACARR location is influenced by the microphysical processes associated with deep convective precipitating clouds during the transition phase, whereas over the high-altitude location, more stratiform participation are generated due to the preconditioning of the atmosphere prior to the onset of monsoon and also abrupt moisture advection by the low level winds.

Keywords: Monsoon, Low-level jet, Stratiform clouds, Western Ghats

05 - ENGINEERING AND TECHNOLOGY

ORAL PRESENTATION

05-1

$AgTiO_3$ SYNTHESIS AND PHOTOCATALYTIC DEGRADATION OF AZO DYES

Alvina Joseph[1] and Vishnu M[1]

Department Of Chemical Engineering
Amal Jyothi College of Engineering, Kanjirapally 686518, India.

In this study, a novel photocatalyst silver titanate perovskite ($AgTiO_3$) were successfully green synthesized via sol-gel auto combustion using lemon juice extract as a chelating agent. The prepared nanoparticle was characterized by XRD, SEM and EDX. Photocatalytic degradation of azo dye were investigated under both UV and solar irradiation, $AgTiO_3$ nanoparticle degraded more the 90% of azo dyes in 30 min.

05-2

DEEP LEARNING-BASED SPEECH DISORDER ASSESSMENT

Amlu Anna Joshy and Dr. Rajeev Rajan

APJ Abdul Kalam Technological University, Thiruvananthapuram 695016, Kerala, India

Background: People affected by speech disorders rely on speech-language pathologists for their assessment and treatment. Dysarthria is a neuro-motor speech disorder resulting in articulation and phonological errors. Its severity estimation provides insights into the patient's improvement, assists pathologists to plan therapy, and aids automatic dysarthric speech recognition systems.

Method: To reduce the subjectivity in clinical evaluations, we build an automated dysarthria severity classifier. Deep neural networks are used for mapping the speech deficits present in dysarthric utterances to the correct severity level. Mel-frequency cepstral coefficients(MFCCs), i-vectors calculated on them, prosody, articulation, phonation, and glottal functioning-related features are used for acoustic parameterization.

Results: Speaker-dependent classification analysis shows that MFCCs perform the best with the least computational complexity. Thus, they can be used when testing a speaker-adapted system on known speakers, if the system is developed into a mobile application. Speaker-independent analysis shows that the i-vectors work best, and this framework can be adopted for the evaluation of unseen speakers in remote rehabilitation.

Conclusions: This work provides scope for an automated system to provide an unbiased judgment of dysarthria severity. Insights can be taken for the automatic assessment of other speech disorders as well.

Keywords: Deep learning, dysarthria, i-vectors, severity assessment.

05-3

SILVER NANOPARTICLE CONJUGATED NATURAL RUBBER FILM WITH ANTIBACTERIAL, ANTIBIOFILM AND CONTACT KILLING EFFECIENCY

Anmiya Peter[a], Sarita G Bhat[b,c], Abhitha K[a,b]

[a] Department of Polymer Science and Rubber Technology, Cochin University of Science and Technology, Kerala 682022, [b] Inter University Centre for Nanomaterials and Devices (IUCND), Cochin University of Science and Technology, Kerala 682022, [c] Department of Biotechnology, Cochin University of Science and Technology, Kerala 682022, India

Background: The colonization of bacteria and the development of biofilms on indwelling medical devices can cause severe infections. Medical devices that prevent germs from growing and biofilms from forming are in high demand. Natural rubber is widely used for biomedical purposes, including urinary catheters, gloves, tubing, and stethoscope diaphragms, and these rubber films can be economically coated with silver-based antibacterial coatings.

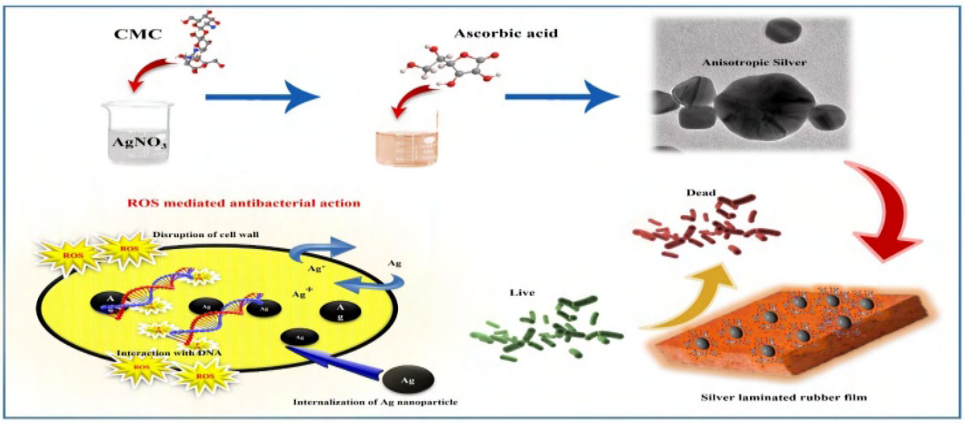
Methods: A biocompatible porous-rubber film was developed, and silver nanoparticles with excellent antibacterial properties were made to absorb into the rubber pores by immersion. The chemical reduction method was used for synthesizing silver nanoparticles by selecting carboxymethyl chitosan as a stabilizing agent.

Results: UV-visible spectroscopy, XRD, and TEM analysis confirmed the silver nanoparticle formation. The stabilizing agent influenced the nanomaterial's morphology and antibacterial activity. The ROS-mediated antibacterial action of Ag nanoparticles was analysed by the DCF-DA method. SEM-EDX analysis confirmed the absorption of silver nanoparticles on rubber film, and antibacterial activity was evaluated. The biofilm reduction of silver-conjugated rubber films was checked by Crystal-violet assay and contact-killing studies.

Conclusion: This work develops a simple and economical strategy for developing antibacterial nanoparticle-coated rubber film. This antibacterial natural rubber will be a suitable replacement for other rubber-based medical devices.

Key words: Nanoparticle, Natural rubber, antibacterial, antibiofilm

Graphical Abstract



05-4

ECO-FRIENDLY SUSTAINABLE GREEN TYRE TREAD COMPOUND WITH HIGH WET GRIP, LOW ROLLING RESISTANCE, AND LOW HEAT BUILD-UP CHARACTERISTICS

Bijina V, Abhitha K, Honey John*

Department of Polymer Science and Rubber Technology,
Cochin University of Science and Technology, Kochi-682022, Kerala, India
** Email: honey@cusat.ac.in*

Background: The term sustainability got widespread significance in the present global scenario due to the increased impact of carbon foot printing and its detrimental effect on the ecosystem. More than 50% of carbon foot printing arises from tyre usage and production/processing of its raw materials. Eco-friendly green tyre treads are basically derived from sustainable materials exhibiting peculiar characteristics of very low rolling resistance, improved wet grip and lower heat build-up properties which reduce the emission of greenhouse gases to the atmosphere thereby contributing to carbon neutrality and sustainable development.

Method: NR/BR blend formulations with a ternary filler system comprising carbon black, silica and thermally exfoliated graphite are prepared using a brabender plasticoder and two roll mill. the mechanical and tyre performance properties are optimized through the incorporation of epoxidized natural rubber as a compatibilizer and silane coupling agent. Thermal exfoliation of graphite was conducted at 500˚C and it is characterized by XRD and TEM analysis. Further, the composites are prepared using the ternary filler system within the optimized green tyre tread formulation. Characterizations of the rubber composites were done using FE-SEM, DMA, and the rheological, mechanical, thermal, viscoelastic, and fatigue testing properties were evaluated.

Results: The introduction of a ternary filler system comprising 10 phr of thermally exfoliated graphite, 10phr of precipitated silica and 12 phr of carbon black, resulted in a significant reduction of low rolling resistance to tan δ at 60^{o} equal to 0.03951. The increased wet grip property measured in terms of tan δ at 0˚C is found to be as high as 0.07763. A significant reduction of heat build-up upto 50% from the base formulation (13 ˚C) enhances the durability of the tyre treads. The formulation also shows an excellent abrasion resistance index (158.2%) and tensile strength (24.07±1.91) which are essential aspects affecting the performance of the tyres.

Conclusion: An eco-friendly green tyre tread formulation is successfully prepared by incorporating the ternary filler system of carbon black, silica and thermally exfoliated graphite. Partial replacement of carbon black with thermally exfoliated graphite and silica exhibits a great impact on the mechano-tribological properties of the rubber compounds. Very promising results in terms of low rolling resistance (Tan δ@60˚C of 0.0391), improved wet grip property (Tan δ@0˚C of 0.07763) and very low heat build-up (13 ˚C) clearly indicate the future application perspective of these compounds.

Keywords: Green Tyre, Low Rolling resistance, Heat Buildup, Silica, thermally exfoliated graphite.

05-5

TRAFFIC CONGESTION ANALYSIS UNDER HETEROGENEOUS CONDITION

P S Chandhana[1*], T Ajitha[2] and S Shaheem[3]

[1]Department of Civil Engineering; Rajiv Gandhi Institute of Technology; Kottayam; India; Pin: 686501; chandhanasajeev@gmail.com, [2]Department of Civil Engineering, Rajiv Gandhi Institute of Technology, Kottayam, India; Pin: 686501; ajithat@rit.ac.in, [3]Principal Scientist; KSCSTE – NATPAC; Akkulam; Thiruvananthapuram; Pin:695011; Kerala; India; shaheems@yahoo.co.in*

Background: The increase in traffic congestion on roads are becoming a major problem for efficient movement of people and goods. Therefore, it is essential to quantify traffic congestion in order to avoid it. This study attempts to quantify traffic congestion in terms of Relative Congestion Index (RCI), Travel Time Index (TTI) and Planning Time Index (PTI).

Method: This study aims to identify various factors contributing to the cause of congestion and select suitable congestion indices for heterogeneous traffic conditions. The study area selected for the study was a 1km M.G. road stretch in Thrissur district that extends from Sankarayya, located in Poothole to Naduvilal. The entry point is at Sankarayya and the exit point is at Naduvilal in which traffic in one direction is considered. Data collection in this study was mainly focused on morning hours between 8:30 AM to 10:30 AM and evening hours between 4 PM to 6 PM. The required data is collected from a video graphic survey and moving car observer method. Detailed information regarding all parameters that affect congestion such as traffic volume, traffic composition, pedestrian crossing, merging, diverging and crossing movements of vehicles, and dwell time of buses was collected. In this study, the effect of side roads is quantified and included in terms of the number of vehicles merging, diverging, and crossing. The effect of the bus stop is measured as the average time delay due to each bus stop coming under the road stretch. The congestion Index Model was developed to predict the congestion levels in the given study stretch in terms of Relative Congestion Index (RCI), Travel Time Index (TTI), and Planning Time Index (PTI) where, RCI is the ratio of delay time and free-flow travel time, TTI is quantified by comparing travel time in the free-flow condition and the travel time in peak hours and PTI demonstrates the ratio of the 95th percentile travel time of the free-flow travel time. The model was then validated with respect to the field data.

Results: The model has been developed in SPSS 26.0 software at a 95% confidence interval. In RCI and TTI models, the number of pedestrian crossings, the volume of diverging traffic, the volume of merging traffic, volume of traffic flowing through the stream are obtained as significant variables. For the PTI model, the volume of traffic crossing, and the volume of traffic on the traffic stream are obtained as significant variables. MAPE values obtained for models are 6.584%, 3.3654%, and 7.266% respectively for RCI, TTI, and PTI models which is less than 10%. The models are validated accurately, and hence the developed model predicts the congestion accurately.

Conclusions: In this study, the Relative Congestion Index, Travel Time Index, and Planning Time Index give more generalized conclusions, and they are easy to comprehend. They were found to be the most suitable congestion measures and show more clarity and simplicity compared to other indices. RCI model, TTI model, and PTI model were developed using stepwise multiple linear regression in SPSS with a limited amount of data. The RCI model shows the number of pedestrian crossings, diverging traffic volume, merging traffic volume, the volume of vehicle crossing, and the volume of vehicles on the traffic stream as significant variables.

Also, in the TTI model, the number of pedestrians crossing the traffic stream, volume of merging traffic, volume of diverging traffic, and volume of traffic flowing through the stream as significant variables. For the PTI model, the significant variables are the volume of traffic on the stream, and the volume of traffic crossing the stream. When these significant variables of RCI, TTI, and PTI increase, traffic congestion also increases. Road widening, installing improved traffic signalling devices, providing separate bus lanes, bus bays, well-conditioned footpaths, and foot-over bridges for pedestrian crossings, prohibiting entry of heavy vehicles and overtaking, etc. will help to reduce congestion on the selected study stretch.

Key words: Traffic congestion, Relative congestion index, Travel time index, Planning Time Index, SPSS

05-6

SELF-POWERED SEAT MONITORING SYSTEM BASED ON NYLON-6,6/ TiO_2 ELECTROSPUN LIGHTWEIGHT TRIBOELECTRIC NANOGENERATORS

Dhanu Treasa Mathew[a], **Manoj N**[b,c] and **Honey John**[a,c*]

[a]Department of Polymer Science and Rubber Technology, Cochin University of Science and Technology, Kerala 682022, [b]Department of Applied chemistry, Cochin University of Science and Technology, Kerala 682022, [c]Inter University Centre for nanomaterials and Devices (IUCND), Cochin University of Science and Technology, Kerala 682022, Corresponding author E-mail address: honey@cusat.ac.in

Background: Triboelectric nanogenerator (TENG) is an innovative energy-scavenging technology that bestows electronic devices with the chance to be "self-powered". A revolutionary breakthrough in energy conversion and utilization technology, TENG is capable of converting ubiquitous mechanical energy, which is otherwise ignored in the environment, such as walking, ocean waves, movement of leaves, etc., even in the low-frequency form, into electrical energy. Apart from the energy production due to any mechanical form of energy, mere contact and separation between any two materials can spark such unlimited power flow.

Method: This work focuses on the construction of a TiO_2/Nylon-6,6 composite nanofiber film-based energy scavenger and seat monitoring system. The nylon composite film act as the tribopositive frictional layer, and the copper thin film act as both the tribonegative frictional layer as well as the electrode, endorsing a cost-effective approach with minimalized materials forming the desired miniaturized device.

Results: The self-powered energy harvesting and seat monitoring system was successfully devised and evaluated. The TENG could derive an exceptional electric output of more than 300 V and 100 μA current from an area of 4 cm^2. Moreover, the output signals generated upon occupying the TENG-fitted seats were analysed via a microcontroller (Arduino uno) from the respective seats, followed by displaying the occupation status (number of passengers and available seats) using an LCD.

Conclusion: This work explores the feasibility of developing a self-powered seat-occupation monitoring system comprised of energy harvesting capability from a commercial perspective.

Keywords: Triboelectric nanogenerator (TENG), self-powered seat occupation monitoring system, Nylon-6,6/ TiO_2 composite nanofiber mat.

05-7

ENGINEERING PROPERTIES OF PA80/EPDM BLENDS

Sujith Nadarajan and Siby Varghese

Technical Consultancy division,
Rubber Research Institute of India, Kottayam, Kerala, 686009

Background: The master batch form of superior processing rubber (SPR), PA 80 (80% vulcanised rubber particles) is a pre-crosslinked form of natural rubber which could be added to both natural and synthetic rubbers to impart the required degree of processing characteristics.

Method: In the present work, PA80 is straight blended with a medium molecular weight EPDM terpolymer in different proportions via a two-stage mixing procedure- initial mixing of all the ingredients in an internal mixer followed by the incorporation of curatives using a two-roll mill. The processability and physicomechanical properties of the compounds were studied to identify the ideal blend proportion suitable for extrusion applications.

Results: In the proposed PA80/EPDM blend systems, extrudates with higher PA80 content produced smoother surfaces with lower die swell under the same conditions which were found satisfactory for the blends with 50-70 parts of PA80. The tensile strength, tear resistance, abrasion rate index, compression set, hardness and retention properties of the material were found to be within acceptable limits. The viscosity mismatch and the relative solubility difference of curatives in PA80 and EPDM rubbers were found to be minimum.

Conclusion: Blending of PA80 with EPDM substantially improved its processability characteristics (lower die swell and smooth surface finish) without sacrificing the technical properties and the replacement of EPDM with PA80 will be an effective way to reduce the production cost of beading and channels based on EPDM.

Keywords: Die swell, EPDM, extrusion, PA80, processability

05-8

ALKALI-ACTIVATED CONCRETE: A STEPPING STONE TO 'NET ZERO' GREENHOUSE GAS EMISSION

Thomas John .V[1] and Roy M.Thomas[2]

[1] SOE, CUSAT, thomasjohnv1963@gmail.com [2] Dr. Roy M.Thomas Co-Author, SOE, CUSAT, Email: roymthomas2007@gmail.com

Background: Alkali-activated concrete is popularly known as geopolymer concrete. Alkali-activated binders are derived from alumino-silicate materials by activation with an appropriate alkaline solution. Commonly used alumino-silicate materials are Fly ash, Ground granulated Blast Furnace Slag (GGBS), rice husk ash, red mud, bagasse ash, metakaolin, etc. Usually, industrial waste materials like Fly ash and GGBS are activated by an alkaline solution, which is generally a combination of sodium silicate and sodium hydroxide. If appropriately designed GGBS with or without fly ash can be activated using sodium silicate alone of appropriate modulus. This type of binder is a substitute at par with cement for plain concrete applications. Likewise crushed iron or steel or copper slag can be used as aggregates. These substitutions have got many economic, engineering, and environmental benefits.

Method: In the analysis of cost-benefit, the average cost of material at source, indirect cost, and direct and indirect benefits are taken into consideration. While analyzing cost, the cost of material, loading & unloading charges, etc are taken into account as a direct cost, in addition, the indirect cost of rectifying or compensating environmental damages need to be considered. The transportation cost is not taken into account as it is location specific and is the same for both conventional cement concrete and alkali-activated concrete. The savings in the cost of material, labour, engineering benefits, etc. counts the direct benefits. Indirect benefits account for savings in embodied energy, natural resources, benefits out of carbon trading, etc. While working out carbon footprint cradle-to-gate condition is taken into account since the transportation distance is a variable. The quantity of materials required for making alkali-activated concrete and cement concrete is taken from our previous studies. The cost of materials is taken from the market rate. The embodied energy (EE) as well as embodied carbon dioxide emission (ECO_2e) are calculated based on the literature. The alkali-activated concrete being cured at ambient temperature saves a large quantity of water required for water curing of cement concrete.

Results and Discussion: The use of industrial waste materials as such as GGBS and Fly ash as binder material as an alternative for cement and broken slag as aggregate substitution, considerably reduces the embodied energy of alkali-activated concrete and CO_2 emission due to construction activities. It is also beneficial in economic terms.

Conclusion: The repurposing of industrial waste materials has multiple advantages recycling waste into useful products, reducing the embodied energy of building materials, achieving a reduction of CO_2 emissions, and conservation of natural resources such as water, limestone, and clay. Localized use of appropriate substitute materials can reduce transportation costs and problems. Guidelines or approval for such substitution by way of standards and specification is the need of the hour to attain the objective of 'Net Zero' GHG emission.

Keywords: Cost-Benefit, Geopolymer, Green Concrete, Carbon footprint, Carbon trading

05-9

ROLE OF COMPOUNDING INGREDIENTS IN TYRE TREAD APPLICATION USING RESPONSE SURFACE METHODOLOGY

Vaishak Nambiathodi[a], Siby Varghese[a], Meera Balachandran[b]

[a]Technical Consultancy Division, Rubber Research Instituteof India, Rubber Board P.O., Kottayam, Kerala-686009, [b]Department of Chemcical Engineering and Material Science, Amritha Vishwa Vidyapeetham, Coimbatore-641105

Background: Developing a rubber compound with a specific end use is a complex task in the field of rubber technology. In conventional technique, mostly in tyre components, the formulation is designed by physically adjusting the various ingredients, one factor and another. This approach is time consuming, cover the whole parameter space very poorly and does not disclose whether there are interactions between specific factors. Statistical approaches such as Response Surface Methodology (RSM) can be employed to maximize the production of a special substance by optimization of operational factors. Accordingly, RSM has been used to optimize a tyre tread with maximum properties.

Method: Response surface methodology (RSM) can be utilized to study the effect of additives on the tyre tread properties using multiple variables as necessary at the same time. Accordingly one can reach the most appropriate formulation for a declared set of properties quickly.

Results: The study has successfully identified the effect of commercially relevant additives in the rubber formulation for tyre tread applications. On the basis of experimental inputs, the role of 4 additives- butadiene rubber, carbon black, aromatic oil and antioxidant (TDQ) on mechanical and cure properties which can be used to discern the most appropriate rubber formulation for tyre tread were predicted.

Conclusion: The validation of experiments had confirmed the predictions of mechanical properties and the suitability of RSM for optimizing the formulation for tyre tread. The DoE methodology used in this work will be useful in tyre tread design to tyre developers and manufacturers, in particular.

Keywords: Butadiene rubber, natural rubber, response surface methodology, tyre

05-10

INCULCATING FLOOD RESILIENCE IN RIVERS BASIN OF KERALA: FLOOD FORECASTING SYSTEMS

[1] Ashok B Jacob and Arun C, [2]Praseed N.S, [3]Priyesh R.

[1]Assistant Director, [2]Team Lead, Flood forecast and Integrated Reservoir Operations System, [3]Chief Engineer (FAC)
Irrigation Design and Research Board, Vikas Bhavan,
Thiruvananthapuram, Kerala, India-695033

Background: Operational flood forecasting systems form a key part of 'preparedness' strategies for disastrous flood events by providing early warnings several days ahead, giving flood forecasting services, civil protection authorities and the public adequate preparation time and thus reducing the impacts of the flooding. A flood forecasting system is developed for the Greater Pamba Basin of Kerala, on pilot basis. It is intended to be extended to all basins of Kerala, with further refinement.

Method: The flood forecasting framework consists of data acquisition from observed (GPM, KWRD gauges) and forecasted rainfall datasets (NOAA GFS and IMD GFS), application of the same to a rainfall-runoff model (HEC-HMS) and finally, coupling it with a hydraulic model (HEC-RAS) so as to simulate inundation. Outputs include flood hydrograph, time of arrival of flood peak, flood inundation depth and extent.

Results: The HEC-HMS and HEC-RAS models for Greater Pamba Basin were calibrated and validated using the precipitation and discharge measured on two monsoon seasons for the year 2003 and 2011 and validated against the monsoons in years 2010, 2014, and 2017.Forecast results are encouraging at this stage, but can be further refined.

Conclusions: The implemented flood forecasting system can be extended to other basins of Kerala with prediction accuracy improved with ensemble datasets and high resolution DEMs

Keywords: Flood forecast, Runoff, Flooding, Integrated flood management, Flood modelling

05-11

MICROFLUIDIC CONTINUOUS FLOW POLYMERASE CHAIN REACTION WITH NANO-ENHANCED PHASE CHANGE MATERIALS ASSISTED ANNEALING

B. Indulakshmi and Ranjith S. Kumar

Micro/nanofluidics Research Laboratory, Department of Mechanical Engineering
College of Engineering Thiruvananthapuram, Kerala, India-695016, Email indulakshmi.d@gmail.com

Background: Advent of microfabrication methods fostered research and development of microfluidic continuous flow polymerase chain reaction (CF-PCR), a promising nucleic acid amplification method for pathogen detection. A quick temperature reduction and sustenance of constant temperature is essential for the annealing phase of sequential thermal cycling involved in CF-PCR process. Phase changing material (PCM) based passive thermal control methods in microfluidic platforms are gaining research interest due to rapid prototyping possibilities. Nanoparticle-enhanced phase changing material (NePCM) is a novel thermal property enhancement method for improving the thermal response of PCMs. A numerical analysis of the novel microfluidic CF-PCR module with Al_2O_3 and CuO based NePCM laden annealing flow path is discussed in this paper.

Methodology: A two-dimensional transient incompressible fluid flow and heat transfer in a microfluidic CF-PCR system with NePCM boundary is simulated using a finite volume solver based on SIMPLEC algorithm. A detailed parametric study is carried out by varying the volume fraction of the nanoparticle in PCM. The development of the axial fluid temperature in the microchannel and consequent thermal performance aspects have been analysed.

Results: A well-illustrated numerical simulation study could exhibit the spatio-temporal temperature developments in microfluidic annealing path of the CF-PCR and melt-front advancements in the bounding capsule filled with NePCM. A quick reduction towards the pre-set annealing temperature has been achieved with increase in the volume fraction of the nanoparticle in PCM. A detailed thermal analysis has been performed to study the heat transfer coefficient variation in the microfluidic thermal convection with the boundary phase changing effects.

Conclusions: Melt progression studies indicated that 10% volume fraction CuO based NePCM is found to perform better. Present results provide vital input for the microfluidic thermal management design endeavours for the development of CF-PCR systems with minimal electrical energy support as point of care pathogen detection systems.

Keywords: Nanoparticle-enhanced phase changing material (NePCM); Continuous flow polymerase chain reaction (CF-PCR); Computational Fluid Mechanics (CFD); Passive thermal control.

05-12

THERMAL PERFORMANCE ANALYSIS OF A NANO-PARTICLE ENHANCED PHASE CHANGING MATERIAL (NEPCM) BASED ELECTRONICS COOLING MODULE

M. Deepu and Mulani Feroz Osman

Department of Aerospace Engineering, Indian Institute of Space Science and Technology, Thiruvananthapuram-695547, India
Corresponding author: deepu@iist.ac.in

Background: Numerical simulations and thermal analysis of an electronics cooling module containing nano-particle enhanced phase changing material (NEPCM) is presented. Conventional electronic cooling methods are insufficient for high-performance electronic devices used in thermally harsh environments such as spacecraft, weapons, laser diodes, etc. Though, recently PCM based electronics cooling modules are becoming common, poor thermal response of organic PCMs prevents technologists for its extensive usage. Heat diffusion, convection, and latent energy transfer are the basic heat transfer aspects involved in melting/solidification of a PCM enclosed in a confinement. Heat transfer molecular diffusion can be considerably enhanced with the addition of nano-particles of highly conducting metals. However, beyond a certain limit the addition of nanoparticle adversely affects the convection heat transfer due to increase in viscous effects. The development of convection currents and its intensification during melting plays a vital role in PCM based electronics cooling modules. Convection process depends on the location of the heat dissipating surface and overall orientation of the cooling module with respect to the direction of the gravity. Present research focus on the detailed thermal analysis of a NEPCM based finned electronics cooling module to identify the optimum amount of nano-particle volume fraction with paraffin wax for various geometric orientation.

Method: Computations are performed for a two-dimensional finned electronics cooling module consisting of NEPCM for various nano-particle volume fraction and geometric orientation. Computations are performed using SIMPLE algorithm based finite volume solver available in a commercial package (Ansys Fluent). A second-order upwind scheme to solve momentum and energy conservations. NEPCM is treated as a single-component homogeneous fluid by introducing effective thermal properties of both constituents. Numerical procedure is validated against results reported for standard natural convection process.

Results: The finned electronics cooling module filled with NEPCM is found to provide the best thermal performance with nanoparticle concentration of 2% and for 60º inclination of the heater surface. The nanoparticle concentration beyond 2% is not thermally effective since thermal convection current development is adversely affected due to increase in viscosity. PCM adjacent to the heat transferring surface melts and a large amount of molten PCM gets accumulated on top part. Bottom part of the heater surface gives better heat transfer effects due to strong upward draft. Inclination of the heater surface alter the melt dynamics and switch over to the Rayleigh–Bénard convection mode. Present study evidences the thermal performance improvement of electronic cooling devices with nano-particle enhanced phase changing material.

Conclusions: The present evidences the thermal property enhancements that promotes thermal response in NEPCM based finned electronics cooling module. Geometry and orientation of the domain is also playing a vital role in natural convection dominated melting process

Keywords: Electronics cooling; Computational heat transfer; NEPCM; Heat convection; Melting/Solidification

05-13

ASSESSING TRAFFIC DEMAND FOR COASTAL HIGHWAY

[1]Goutham M N,[2] Sanjana N,[3] Arun Chandran

TPED , KSCSTE – NATPAC , Thiruvananthapuram, Kerala, India gouthamnatpac@gmail.com

Background: This paper accentuates the Integrated Development of coastal highway in Thiruvananthapuram, Kollam and Alappuzha districts. The proposed coastal highway in Thiruvananthapuram, Kollam and Alappuzha covers 185 km between Pozhiyur at South and Chellanam at North, as an alternative route to National Highway 66. There will be savings in time and fuel if vehicles can ply over the new road without stopping and waiting. The study emphasizes on the possibility of diversion of traffic from NH 66 to the proposed coastal highway, determining the total traffic expected to be ply over coastal highway, forecasting Average Daily Traffic and determining the year up to which the design service volume for two lane road with Level of Service (LOS) 'B' exceeds.

Method: The categorized traffic volume count survey was conducted to generate an exhaustive database of the traffic volume plying on the existing road network, and this was instrumental in understanding the efficiency at which the system works, and the general quality of service offered to road users. Classified traffic volume counts and Link Volume survey were carried out at important intersections. Classified traffic volume counts were carried out at important intersections and mid blocks (Link Volume Survey) along the proposed coastal highway. Major intersections in the study area were identified and a classified traffic volume count survey was conducted for 16 hours for all turning movements at these junctions. Link volume survey was conducted for 3 days. Roadside Interview method, as detailed in IRC: 102-1988, is used for conducting Origin and Destination survey at seven points at NH 66 for both passenger and goods vehicles for 24 hours (in both directions) on a typical working day. Travel information which includes trip origin, trip destination, Occupancy, Trip Purpose, Occupation, Willingness to shift to coastal highway etc. were collected. In addition, commodity details for goods vehicles were also collected.

Results: Based on the review of analysed data, base year traffic is estimated and has been used to arrive at the traffic forecast for horizon years. Existing traffic, diverted traffic and Induced traffic were determined. Diverted traffic is defined as the component of traffic that will get diverted from the existing NH 66 to the proposed new coastal highway for taking its advantages. National Highway 66 is expected to be widened to 6 lanes with the application of Toll. Since the proposed coastal highway does not demand any toll for the travel, vehicles, especially commercial vehicles can travel freely by saving time, money and fuel. Percentage of each vehicle classes, which were currently using the existing NH 66 and likely to divert to the proposed coastal highway once it is functioned were found out using the Cost Ratio factors and Diversion equations as per IRC: 108-2015 Guidelines for Traffic Forecast on Highways. An inhouse program was conducted on Microsoft visual basic to eliminate the duplications in OD matrix calculations to find the percentage diversion of each vehicle classes from NH 66 to proposed coastal highway in Thiruvananthapuram, Kollam and Alappuzha districts. It was found that 17% of cars and three wheelers, 16% of the two wheelers, 8% of the LCVs, 11% of goods autos, 13% of trucks and 12% of minibuses were likely to be diverted from NH 66 to proposed coastal highway from Thiruvananthapuram to Alappuzha. KSRTC buses were not expected to be diverted from their existing route. Average Daily Traffic (Existing Traffic + Diverted Traffic + Induced Traffic) was obtained for the base year. Based on the recommended growth rates, traffic forecast of Average Daily Traffic has been done for proposed coastal highway for the most-likely scenario. At two

locations, it was observed that the Average Daily Traffic exceeds the design service volume for two lane road with Level of Service (LOS) 'B' at the base year itself i.e., 15,000 PCU/day as per IRC:64-1990, Guidelines for Capacity of Roads in Rural Areas.

Conclusion:

From this study following conclusions were obtained.

- Since the proposed coastal highway offers comfortable travel for all the vehicles without any toll, people were interested to travel through the coastal highway once it is functioned. Saving of time and fuel will also force them to use the coastal highway.
- More than 15% of cars, two wheelers and three wheelers were likely to be diverted from NH 66 to proposed coastal highway between Thiruvananthapuram, Kollam and Alappuzha districts.
- An average of 8 to 13% of commercial vehicles may shift from NH 66 to the coastal highway which provide a toll-free travel for them.
- All sections were found to be exceeding the design capacity for two lane road with LOS B on 2031 beyond which it is advised to upgrade the road to four-lane under LOS B itself.
- At Rosmini Asram road section where the traffic volume exceeds the design service volume for two lane road with LOS B at the base year itself, it is necessary to design the road section as four lanes with LOS B.
- At Thangassery, traffic volume exceeds the design service volume for two lane road with LOS B at the base year itself. However, the existing carriageway in this section is already occupied with four lane, no further improvement is required at base year.

Keywords: Level of Service, Origin and Destination Survey, Traffic Diversion, Traffic Projection, Average Daily Traffic, Coastal Highway, NH 66

05-14

ANALYSIS OF SEDIMENT TRANSPORT CHARACTERISTICS FOR THE SUSTAINED EXTRACTION OF FLOOD SEDIMENT DEPOSITS - A CASE STUDY IN CHALIYAR RIVER

Prajith V[1*] Ihjas K[1]

[1] Centre for Water Resources Development and Management, Kozhikode, India-673571
** Corresponding Author*

Background: Kerala witnessed highly destructive floods in 2018 and 2019. In consequence to these events, enormous quantities of sediments are transported through the river and it is deposited in the bed and banks of the river. The natural flow of the river can be restored only if the deposits of the floods are removed in a sustained manner. This scientific study intends to quantify the flood deposits to be removed from the river and the recommendations will help to prevent uncontrolled mining.

Method: The movement of suspended sediment through 4 locations in the main stretch of Chaliyar River such as Myladi, Edavanna, Elamaram and Feroke was monitored and observed data along with the CWC sediment data of Kuniyil station was used to approximate the sediment

transport rate using the rating curve. The hydrological model developed using SWAT and the sediment rating curve was used to compute the total volume of sediment transport.

Results: It is estimated that the suspended sediment transport during the flood period (June 2018-December 2019) at Myladi, Edavanna, Kuniyil, Elamaram and Feroke is 0.69, 3.5, 1.5757, 0.4527, 0.4529 M-tonnes respectively and the bed load transport through the same sections is 0.084, 0.42, 0.189, 0.054, 0.054 M-Tonnes respectively.

Conclusions: The total quantity of sediment deposit to be removed from the main stretch of Chaliyar (from Beypore to Chaliyar mukku) is 4.4738 M-tonnes and from Iruvazhinjipuzha (from Koolimad to Agasthyamoozhi) is 0.0730 M-tonnes.

Keywords: Sediment rating curve, SWAT model, flood frequency, stable channel dimensions

05-15

AN EDIBLE ANTIMICROBIAL FILM FROM AGRO-WASTE FOR FOOD PACKAGING APPLICATIONS WITH NOTABLE UV SHIELDING PROPERTIES

Sandhya Alice Varghese [a] Harikrishnan Pulikkalparambil[a], Jyotishkumar Parameswaranpillai[b], Suchart Siengchin[c]

[a] Department of Packaging and Materials Technology, Faculty of Agro-Industry, Kasetsart University, Chatuchak, Bangkok,Thailand,[b] Department of Science, Faculty of Science & Technology, Alliance University, Chandapura-Anekal Main Road, Bengaluru , Karnataka, India, [c] Department of Materials and Production Engineering, King Mongkut's University of Technology North Bangkok, Bangkok, Thailand.

Background: The packaging industry is tremendously growing in order to meet the emerging consumer needs. The past few decades have witnessed the emergence of various innovative packaging technologies including active, intelligent, and biodegradable packaging. Such systems intend to provide the customers with food products of improved shelf life and quality. Since most of the food packaging are meant for single-use applications, the replacement of petroleum based non-biodegrable plastics with biodegradable ones are highly recommended. Various biopolymers have been successfully used as packaging films. The biodegradable matrices have been used in conjunction with active ingredients to develop sustainable packages that meet consumer demand and at the same time is eco-friendly.

Method: In the current study, eco-friendly edible packaging films based on PVA/starch functionalized with two different types of extracts from nutmeg pericarp and Malabar tamarind has been developed by solvent casting method.

Results: The developed films showed excellent antimicrobial properties against two tested pathogens. The UV-blocking capacity was outstanding in UV-B and UV-C region. The films were hot water soluble and real-time packaging test were carried out on fresh chillies which showed that after 7 days of storage the chilly appears intact and perfect for use.

Conclusion: Novel antimicrobial UV barrier food packaging films were developed from PVA/starch by incorporating nutmeg and tamarind.Such films are recommended for use as antimicrobial packaging films for perishable vegetables and fruits.

Keywords: Antimicrobial, UV-shielding, Edible, Food packaging

05-16

A CONCEPTUAL DESIGN FOR CLIMATE-RESILIENT ROAD INFRASTRUCTURE FOR WETLAND REGIONS -AN EXPERIENCE FROM THE AUGUST 2018 FLOOD EVENT IN KERALA, INDIA.

[1]C V Sundara Rajan, [2]Navya TeJ Gorji

The project road in question the Adoor–Chengannur (23.58km) is one of the finest road developed with the World Bank (WB) loan assistance under the banner of Kerala State Transport Project (KSTP). Due to the unprecedented flood event in month of August 2018, there had been phenomenal damages to the road infrastructure. Occasionally, due to the afflicted damage, it has led to complete closure of the roads for a definite period till it was made trafficable. Barring this, the road is currently rated as one of the best road sections of the state. In fact, KSTP a WB project was a major breakthrough in the state government approach to road works in the state. The entire project was constructed under stringent E&S requirements of WB coupled with the country regulatory requirements. Although overall sustainability part of project road was well addressed by KSTP, the Engineering design of the project road was inadequate to address the Climate resilience part of this road infrastructure. This is evident from the impact of 2018 flood (that got repeated in 2019) hence solely attributed to Climate Change. This kind of extreme event was totally unexpected and unanticipated during design and construction phases of the project. Interestingly the designs were originally carried out with the flood return period of 100 years. This 2018 flood event however has exposed the design inadequacy to meet the climate resilience requirement of the road. There were a total of 12 flooded sections along this road. Further the road was taken up under Rebuild Kerala Initiative (RKI) to address the climate resilience of the road design for reconstruction. Therefore, this paper is an innovative approach to propose a new conceptual design for the most flood impacted sections that are in fact located across wetlands locally known as Puncha (or Chiras in General). The normal tendency of raising the road embankment after Hydrological data analysis alone cannot be a holistic solution for achieving Climate resilience in all locations like wetland areas. This paper unravels a unique way to address the climate resilience design by flood profiling followed by provision for Cluster Cross drainage (CCD) structure at selected locations along major wetlands. Although the Cluster Cross Drainage (CCD) or half bridge design could act like a full bridge in terms of its function; the cost involved could be substantially lower in comparison to a bridge for the same functional requirements thus addressing the issue of Climate resilience on a long term basis for road infrastructure.

POSTER PRESENTATION

05-17

CARBON NANOTUBES AS ADSORBENTS FOR THE ADSORPTION OF PHARMACEUTICAL POLLUTANT FROM WASTEWATER

Ahalya M[1] and Vishnu M[1]

Department Of Chemical Engineering
Amal Jyothi College of Engineering, Kanjirapally 686518, India.

Large amount of pharmaceutical products are been manufactured, consumed and disposed off into the waterbodies which leads to huge pharmaceutical pollution. In this study, Carbon nanotubes (CNT) are used as adsorbents for the adsorption of pharmaceutical pollutants. Batch studies for the

optimization of different parameters of adsorption are done and along with-it characterization studies of the CNT before and after adsorption is also done.

05-18

POLY(VINYLIDENE FLUORIDE-*CO*-HEXAFLUOROPROPYLENE) (PVDF-HFP)/SILICA BASED COMPOSITE GEL POLYMER ELECTROLYTES SYNTHESIZED VIA *IN-SITU* METHOD FOR SODIUM ION BATTERIES

Akhila Das[1], Prasanth Raghavan [1,2,*]

*[1] Department of Polymer Science and Rubber Technology, Cochin University of Science and Technology (CUSAT), Cochin-682022, [2] Department of Materials Engineering and Convergence Technology, Gyeongsang National University, 501 Jinju-daero, Jinju 52828, Republic of Korea, *Corresponding author: prasanth@cusat.ac.in,*

Composite polymer electrolyte using PVdF-HFP polymer electrolyte with silica loaded filler content synthesised via non-solvent induced phase inversion technique. *In-situ* synthesised silica was added to PVdF-HFP with different filler concentration (PSI- 0,3,6,9) and its morphological studies were evaluated by FESEM image and elemental analysis (EDX) spectroscopy. The effect of crystallinity was examined by X-ray diffraction analysis (XRD) encapsulates the decreases in crystallinity with increase in the filler content. This microporous structure of PSI-6 exhibit higher porosity, electrolyte uptake (262%) and electrolyte retention (0.48). PSI-6 also exhibit high ionic conductivity (0.71651 S cm^{-1}) confirms from the higher surface area obtained from BET analysis (784.14 m^2g^{-1}). This composite polymer electrolyte exhibit electrochemical stability < 4.5V verses Na/Na^+. Na ion half-cell fabricated with Na/CPE/Hard carbon shows a specific capacity of ~120 mAh g^{-1}at 0.1 C rate in room temperature with stable cycle performance.

05-19

DEVELOPMENT OF SOLID CONTACT BIOMIMETIC POTENTIOMETRIC SENSOR FOR ATRAZINE

K R Anjana and Saumya Varghese

Department of chemistry,St. Joseph's college(autonomous), Devagiri,Calicut-673008,Kerala

Background: Atrazine is a biologically active compound used by farmers to increase the yield of crops by destroying species like pests (pesticides) which are harmful to the growing crops. Nowadays unethical usage of these class of pesticides are increasing and thereby polluting the environment, mainly water resources. Reports show that up to half of all fruits sold in market contain pesticides that have been linked to human health problems in huge numbers. Here in India also the situation is more critical. So it is highly recommended to develop sensors for detecting the trace amounts of pesticides in ground water, vegetables and fruits for controlling unethical usage of pesticides in the growing crops. A potentiometric sensor based on Molecular imprinted polymer composite film was developed for detecting Atrazine in ground water samples.

Method: A potentiometric sensor for detecting atrazine was developed using 2-Nitrophenyl octyl ether as plasticizer. Here Atrazine Molecular imprinted polymer (MIP) was used as ionophore and carbon cloth is used as solid contact in developing the biomimetic sensor. The MIP and the

reference non-imprinted polymer, NIP was characterized using FESEM and FTIR. The potentiometric response was monitored using ELICO LI 126 Ion analyser with saturated calomel electrode as the reference electrode and carbon cloth based MIP sensor as the indicator electrode.

Results: The sensor shows a linear working range of $1\times10^{-6}$to $1\times10^{-2}$with a slope of 58mV. The limit of detection observed is 1×10^{-6}M. The conditioning of the sensor leads to a stable and better response for the sensor. The potential stability and response time of the developed Atrazine sensor was studied and the equilibrium potential reaches within 1minute and 50 seconds.However the optimization studies are in progress and hope we can develop an economic, lightweight, reliable and flexible atrazine potentiometric sensor for its trace level detection in ground water.

Conclusion: The present study involves the development of Atrazine sensor based on molecular imprinting technique, MIT as the synthesised polymer (MIP) shows target specificity and can improve the sensor performance in potentiometric sensor. The completion of template removal and porous nature of ionophore, MIP are confirmed using FTIR studies and FESEM. The sensor is economic, light weight and flexible with a response profile in the concentration range of 1×10^{-6}M to 1×10^{-2} M with a slope of 58 mV and a limit of detection of 1×10^{-6}M. Here a faster response time of 1 minute and 50 seconds was observed. The high sensitivity, selectivity, stability and portability of sensor is favourable for real sample analysis and in field monitoring. The optimization studies were not complete. After completing the optimisation and selectivity studies, hope we can contribute an economic, light weight and flexible sensor for real sample analysis.

Keywords: Non-imprinted polymer, molecular imprinted polymer, Atrazine, biomimetic

05-20

ASSESSMENT OF ROAD USER'S SATISFACTION FOR MAJOR ROADS IN KERALA

Athira Menon P [1*], Archana S [2], and Shaheem S [3]

[1]Department of Civil Engineering Jyothi Engineering College Thrissur; Pin: 679531; India; athira.2471997@gmail.com, [2] Department of Civil Engineering; Jyothi Engineering College Thrissur; Pin :679531; India; archanas@jecc.ac.in*
[3] Principal Scientist; KSCSTE – NATPAC; Akkulam; Thiruvananthapuram. Pin:695011; Kerala; India; shaheems@yahoo.co.in

Background: Roads play a very important role as majority of travel trips take place through roads. The efficiency of any road network is evaluated by the condition of the road infrastructure. The trip satisfaction is considered as a type of road user satisfaction. Hence finding out the parameters influencing user satisfaction for a road facility is essential for achieving trip satisfaction.

Method: The study aims to find out road user satisfaction level depending on various parameters of road services which helps in the development of existing facilities and future road developments. Also, the priority analysis of most influencing parameters was conducted which will aid for further road developments. The study area selected for the study was 15 km MC road stretch in Thiruvananthapuram district that extends from Vetturoad near Kazhakottam to Venjaramood. Data for the study was collected using questionnaire survey from different road users of the study area. The users were asked to rate the road services in a five-point likert scale like very satisfied, satisfied, neither satisfied nor dissatisfied, dissatisfied and very dissatisfied. Exploratory factor analysis was done to reduce the observed variables and to derive latent

variables associated with it. Safety, comfort, information and guidance and physical condition were the four latent variables identified from the study. Multiple linear regression models were developed to correlate the satisfaction of users and latent constructs affecting the road user behavior. The analytical hierarchy process was done to find out the priority of latent parameters considering road user requirement based on the expert opinion survey.

Results: Safety, comfort, information and guidance, and physical condition were found to be the four latent parameters affecting road user satisfaction. Thus, in the priority analysis, it was found that safety had the highest priority followed by comfort, information and guidance, and the physical condition of the road.

Conclusion: While developing road infrastructure facilities, the concerned authorities must emphasize the highest priority for safety, comfort, information and guidance, and the physical condition of the road. The study concluded that although people have perceptions about different characteristics of the road, they are more concerned about the safety parameter of the road. This study can be used as a benchmark to develop road users' aligned policies for different categories of roads in Kerala.

Keywords: Exploratory factor analysis, Road infrastructure facilities, Multiple linear regression, Analytical hierarchy process

05-21

BIOLOGICAL WASTEWATER TREATMENT USING COIR GEOTEXTILE FILTER BED

Mohamed Suhail T [1] Fayisa .P[2] Nuhmanul Shibili P V[3]

[1] Department of Civil Engineering MES College Of Engineering Kuttippuram, Thrikanapuram South PO, Malappuram DT, Kerala,

[2, 3] MES College Of Engineering Kuttippuram, Thrikanapuram South PO, MalappuramDT,Kerala

Abstract — Geotextile materials have been used worldwide for broad range of civil engineering applications. In this study non-woven needle punched coir geotextiles were used as a filter media for the treatment of wastewater. Synthetic wastewater was prepared in lab using analytical grade glucose and starch in appropriate composition. The optimum packing density of geotextile filter bed was found out by conducting the constant head permeability test using water and synthetic wastewater on various density packings. The result shows a trend in increasing permeability value at the initial stage and later it gradually decreases and becomes a constant value. The least permeability value of raw water and wastewater was 1.90 x 10^{-2} cm/s and 1.56 x 10^{-2} cm/s respectively under 140 kg/m^3 density packing. The optimum density packing for 0.1m filter bed with the least permeability is obtained as 140 kg/m^3. The treatment of wastewater was carried out for a constant HRT of 18 hrs under different packing densities using 10cm filter depth. The results show that the maximum BOD reduction (75%) in the treatment process was obtained for a density packing of 100 kg/m^3.

Keywords- Biofiltration, coir-geotextile, Density packing.

05-22

CAPACITIVE DEIONISATION (CDI): AN ECO-FRIENDLY AND SUSTAINABLE DESALINATION TECHNOLOGY

Vajitha. G [a], Madan Kisan Pradhan [a], Soujit Sen Gupta [a, b] Shihabudheen M. Maliyekkal[a, a]

Department of Civil and Environmental Engineering, Indian Institute of Technology Tirupati, Andhra Pradesh, India, [a, b] Director and CEO, NGEN water solution, A incubated company under the Indian Institute of Technology Tirupati, Andhra Pradesh, India

Adequate access to clean water and sanitation is fundamental to a healthy life and drives economic growth. Brackish and seawater desalination methods were introduced to meet the increasing global demand for safe drinking water. Even though multiple desalination techniques are available, reverse osmosis (RO) gained significant attention due to its high efficiency and reliable performance. However, the mass deployment of the technology is limited to high operation and maintenance, high rejection and low recovery of treated water, complete demineralization, high energy consumption, and membrane fouling. Capacitive Deionization (CDI) is an emerging, promising, and sustainable desalination technology suitable for treating brackish water at lower operating costs. It is a non-membrane-based technique that works on the principle of electrosorption to remove ionic and polarisable species from water. This paper describes the development of a novel CDI working prototype with a capacity of 200 to 500 LPH. The unit is developed at IIT Tirupati in collaboration with NGEN Water Solutions PVT. LTD., a start-up incubated at IIT Tirupati. The CDI unit is fully automated with the ability to monitor the water quality characteristics and the health of the CDI system. The extended performance of the CDI system and the effects of various operational parameters on the CDI performance will be discussed. The data reveals that CDI can deliver water at an operating cost of less than 2 paise per liter with a service life of more than five years. The authors strongly believe CDI technology has potential application in brackish water desalination and is a sustainable and energy-efficient alternative to conventional RO-based membrane technology.

Keywords: Capacitive Deionization, Electrosorption capacity, Graphic materials, Multi-level categoric design, Optimization

05-23

THERMAL PRE-TREATMENT AND CO-DIGESTION TO IMPROVE ANAEROBIC DIGESTION OF STP SECONDARY SLUDGE

Haritha K [1, 2], Akhina M K [1, 2], & Krishnakumar B [1, 2]

[1]Environmental Technology Division, CSIR – NIIST, Thiruvananthapuram – 19
[2]Academy for Scientific and Innovative Research (AcSIR), Ghaziabad- 201002, India

Background: The management of secondary sludge (bio-solid) is a major practical problem during sewage treatment plant (STP) operations. Anaerobic digestion (AD) of bio-solids is regarded as an effective approach among different management practices. However, AD of secondary sludge reported less biogas yield due to the inherent properties of the sludge. The present study examines how pre-treatment (different temperatures and time intervals) and co-digestion impact the anaerobic digestion process of biogas production.

Method Secondary Sludge Collected From A Working STP Was Used For This Study. After Detailed Characterization Of The Sludge, Bench-Scale Experiments Were Conducted In A Standard Bio-Methanation Set-Up. The Sludge Was Exposed To Different Temperatures And Periods (From 60 °C To 90 °C For 30 To 90 Min). After The Heat Treatment, The Change In Soluble COD (SCOD) And The Bio-Methanation Potential (BMP) Of The Heat-Treated Sludge Were Tested. Co-Digestion Studies Of Secondary Sludge Were Also Done After Mixing It With Food Waste In Different Ratios

Result: Thermal Treatment At 70 To 90 °C Resulted In An Increase Of 1.8 To 3.9 Times Over The Untreated Sample. A Significant Increase In Soluble COD (Up To 18 Times) Was Seen During Thermal Treatment At 70, 80, And 90 °C, Which Was Reflected In A Higher Biogas Yield. Co-Digestion Studies Of Secondary Sludge Were Also Done After Mixing It With Food Waste In Different Ratios (50:50,75:25, And 85:15) SS: FW Respectively. 3.4 Times Higher Yield In Biogas Was Observed Compared With The Control. In Summary, The Present Study Indicates Thermal Pre-Treatment, As Well As Co-Digestion Approaches With Suitable Substrates, Results In A Higher Biogas Yield From STP Secondary Sludge.

Conclusions: This Study Revealed That Anaerobic Digestion Of Secondary Sludge After Pre-Treatment And Co-digestion can improve the biogas yield of secondary sludge rather than the untreated sample. Hence it appears to be an appealing technology for environmental preservation and energy savings.

Keywords: Bio-methanation potential, Anaerobic sludge, co-digestion, pre treatment

05-24

GREEN EXTRACTION OF NANOCELLULOSE AND ITS USE IN CONTROLLED DELIVERY OF ANTIMICROBIAL AGENT

Mridula Sreedharan, Arya Mangalan, Afsal Sali, Raji V, Nandakumar Kalarikkal, Sabu Thomas

International and Inter University Centre for Nanoscience and Nanotechnology, Mahatma Gandhi University, Kottayam, Kerala 686560

Background: Nanocellulose due to its unique properties like water retention, mechanical strength, biocompatibility, biodegradation, 3D structures mimicking the extracellular matrix has been a potential candidate for various biomedical applications such as drug carrier, tissue engineered scaffold material and 3D bioprinting ink. The process of extraction owes to its activity *in-vivo* because use of toxic and strong chemicals during its extraction can lead to changes in its active site groups and the residual chemicals can cause toxicity to cells. Thus, a green method and low-cost technique for extracting high quality nanocellulose is of great importance.

Methods: Pre-treatment of the plant fibers with a green chemical followed by ultrasonication is the method we have adopted for a low cost and green extraction technique. The source of nanocellulose was chosen as water hyacinth which is considered as an invasive species which causes trouble to inland water transportation system and fisheries industry. The extracted nanocellulose was used in preparing films with essential oil and the delivery pattern was studied in-vitro.

Results: The extracted nanocellulose had a yield of 57%. Various parameters like concentration of the bleaching agent and reaction time were optimised and nanocellulose fibers with dimension of

50nm were obtained with impurities removed. The delivery of the antimicrobial agent, essential oil, showed a controlled release for a study conducted for 7 days.

Conclusion: A facile, green, scalable, cost effective, non-toxic method for nanocellulose extraction was optimised and the extracted nanocellulose formed a good composite film and could deliver essential oil in a controlled fashion. Thus, the film could be used for wound healing application or as antimicrobial membranes for biomedical applications.

Keywords: Nanocellulose, Green Synthesis, Water hyacinth, Essential Oil, Antimicrobial Film

05-25

MAPPING OF TRAFFIC NOISE LEVELS IN KOTTAYAM TOWN BASED ON OBSERVATIONS USING SMARTPHONE

Athulya Venu[1], Jisa Jose[1], Neha Prakash[1], Rinu Anna Koshy[1], Sinan Nizar[2], and D. S. Pai[2]

[1]Amal Jyothi College of Engineering, Kanjirapally 686518, India. [2]Institute for Climate Change Studies, Kottayam 686 104, India

Traffic noise is probably the most rigorous and pervasive type of noise pollution. Traffic noise has become a serious problem nowadays because of inadequate urban planning of the city in the past. In this context, the present study attempts to map noise levels in the town of Kottayam using smartphone-based sensors. Sensors in the smartphones were calibrated and noise levels along various major roads in the town were measured. These observations were used to examine the diurnal variation as well as the spatial distribution of the noise levels. The accuracy of various spatial interpolation techniques in mapping noise levels were evaluated using a cross-validation approach. The results indicated that road traffic is the major source of noise in the town, and that the levels decrease as we move away from the traffic. However, the rate of decrease depends not only on the initial sound levels, but also on the type of buildings in the area. Further, based on the results, a framework for spatial mapping of noise levels using smartphone is proposed. The framework includes a new technique for spatial interpolation based on the noise level gradient with special reference to the urban canopy. The proposed framework shows improved representation of the noise level data in the Town of Kottayam. The framework can be used in other similar towns for a quick assessment of the noise pollution.

Keywords: Traffic noise, Urban planning, Sensors, Spatial distribution, Noise level gradient

05-26

MULTI-LABEL BIRD SPECIES CLASSIFICATION USING SEQUENTIAL AGGREGATION MODEL

Noumida A[1] and Rajeev Rajan[2]

[1]College of Engineering Trivandrum, [2]Government Engineering College, Barton Hill, Trivandrum, APJ Abdul Kalam Technological University, Thiruvananthapuram, India

Background: For the conservation of avian biodiversity, bird detection is vital since it allows ornithologists to quantify which species exist in a particular area. The sound production mechanism in the vocal organ (syrinx) of birds is different from speech production in humans. Moreover, we do not have sufficient knowledge regarding the structural properties of bird

vocalization. It is common to classify bird species with assumption that a single bird call is present in an audio excerpt. However, a few experiments have been focused on detecting simultaneous bird calls in long-duration recordings. Our goal is to develop a methodology to classify multiple bird species from field recordings which may be noisy or overlapping.

Methods: We proposed two schemes acoustic feature Attention-BiGRU and Mel-spectrogram Swin-Transformer, and compared them with pre-trained CNN and GRU models. We adopted a short-time sliding-aggregation approach to decide on the test data, in which probability outcomes are species-wise summed and normalized. Species with the highest probability scores are assumed to be the dominant species in the recording.

Results: The performance of the proposed models is evaluated using precision, recall, and F1-score. VGG-16, Swin-Transformer, GRU, and Attention-BiGRU had overall classification scores of 0.65, 0.67, 0.58, and 0.84, respectively. Our Attention-BiGRU classifier achieves pretty high performance in the Xeno-Canto dataset with an F1-score of 0.84.

Conclusion: We tackle the challenge of detecting the set of all species from multiple overlapping vocalizations in a given audio recording. The attention mechanism focuses on all species in contrast to models without attention. The Swin-Transformer model performs significantly better than CNN and pre-trained models. Compared to visual and acoustic frameworks, the proposed Attention-BiGRU architecture performs better.

Keywords: multi-label, bird call, sequential, augmentation, Swin-Transformer, Attention-BiGRU.

05-27

MODE CHOICE MODELLING IN URBAN AREAS

Senna Maria Saju, Nayanthara M M, Anna Rose Donson, Anjaly Tom, Dr Krishnapriya M G

Christ College of Engineering, Irinjalakkuda, Thrissur

Mode choice analysis is the process of determining the transportation mode used by the individuals or a group of individuals under a specific set of conditions. Examining commuters' mode-choice characteristics in Thrissur Corporation and to better understand how COVID19 affected mode choice behaviour in the study area before and after the pandemic are the aim of this study. Understanding the expected changes in travel behaviour during COVID-19 will help us analyse the differences in people's travel behaviour before and after lockdown. The major goal of the modelling is to use discrete choice modelling to identify the mode choice behaviour of people in urban regions. Personal interviews are done for data collection using questionnaires. Socioeconomic circumstances and travel patterns of people are analysed. Modelling is done using Multinomial Logit models. Due to its easy mathematical form, ease of estimation and interpretation, and flexibility in adding or eliminating option alternatives, the MNL model structure is widely used for both urban and international mode choice models. The method was selected because it makes it simple to analyse human behaviour, and commuters have access to a variety of alternative transportation options, such as cars, buses, two- and three-wheelers, and public transportation. SPSS (Statistical Package for Social Sciences) or NLOGIT is used for modelling.

05-28

DISASTER PREPAREDNESS OR EVACUATION PLAN FOR ATTAPPADY REGION

Arun Chandran[1], Deeptha M S[2]

[1]National Transportation Planning and Research Centre, aruncpanayil@gmail.com, [2] National Transportation Planning and Research Centre, deepthams1992@gmail.com

Kerala has witnessed recurring floods in consecutive years due to extreme rainfall events which were accompanied with landslides and landslips. Transportation network along the disaster affected region was severely crippled as a result. This in turn disrupts relief and rescue operation as well as supply chain management. A forethoughtful evacuation plan for a region will minimize the fatality count during rapid evacuation and also ensure transportation connectivity for supply chain management to rescue shelters within disaster prone zones. The scope of the study is limited to regions that are likely to get stranded and isolated during the times of natural disasters.

In this study, an evacuation plan is proposed for Attappady block in Palakkad district, where all the road links to the region were disrupted and led to total isolation. Weighted overlay analysis was carried out to prepare hazard zonation mapping of Attappady. Field visit to the study area was conducted and collected information regarding disaster history and evacuation. An evacuation plan based on relief and rescue perspective is formulated. Road network of study area was developed using GIS software. Closest rescue shelter for each evacuation zone and connecting routes were identified using Closest Facility tool of Network Analyst extension.

Keywords: Evacuation Plan; Weighted Overlay Analysis; Evacuation Route; Emergency Sheltering; Closest Facility Analysis.

05-29

EFFECT OF GEOTECHNICAL PROPERTIES ON SEDIMENT RESUSPENSION AND ITS IMPLICATION ON FLOCCULATION OF SUSPENDED SEDIMENTS DRIVEN BY Fe (II) IN A MIXED SEDIMENT ENVIRONMENT

Febina A Manaf and Priya K L

TKM College of Engineering, Kollam, Kerala, India

Background: Estuaries are mixed sediment environment where the suspended sediments are mixed within the water column. The properties of sediments along with turbulence, organic matters, inorganic matters, salinity, heavymetals contribute to the resuspension and flocculation of the sediments in estuary. Ashtamudi estuary, which is a mixed sediment estuary, is chosen as the study area. The present study aims at analysing the effect of geotechnical properties on the resuspension of sediments, and influence of Fe(II) on the collision efficiency and breakage coefficient of suspended sediments.

Method: Water samples were collected in acid washed containers and analysed for heavymetal concentration using Atomic Absorption Spectroscopy.Sediment samples were collected using fabricated samplers and analysed for geotechnical properties using IS code methods.Sorption experiments to determine the behaviour of Fe and Cr in the presence of salinity were carried out in a rotary shaker. The flocculation experiments were carried out in a jar test apparatus for different concentrations of Fe at different salinities. The images of the flocs were captured using a DSLR camera and processed using imageJ software Collision efficiency and breakage

coefficient of the flocs were determined using the equation.

Results: Results shows that the sediments of locations 2and3 with low clay content, low shear strength, low consolidation coefficient and comparatively high sand content exhibited more resuspension with considerable amount of suspended sediment concentration(SSC). The longitudinal variation of heavy metals indicated higher concentrations of Fe and Cr at locations 2 and 3. Sorption studies on Fe and Cr indicated that adsorption of Fe was observed to be more at high salinity reaches where Cr exhibited desorption behaviour at high salinities.Collision efficiency enhanced with salinity and Fe(II)concentration.Higher breakage coefficient was observed for high F(II)concentration and salinity, while its value decreased at high turbulence and sand addition.The flocculation experiments indicated that floc size and collision efficiency increased with Fe concentration and salinity.

Conclusions: The presence of Fe in a water column with resuspended sediments can undergo floc formation with the suspended sediments and produce larger and stronger flocs that can settle faster and removed easily. At higher salinities where the adsorption of Fe is more, higher removal of flocs can be expected.

Keywords: Resuspension, flocculation, collision efficiency, breakage coefficient

05-30

PREPARING A DIGITAL ELEVATION MODEL FROM GOOGLE EARTH PRO AND ITS COMPARISON WITH OTHER DEMS – A CASE STUDY FROM KERALA

Karthika Mohan and Celine George

KSCSTE-CWRDM, Sub Centre, Manimalakunnu, Koothattukulam, Ernakulam-68662.

Background: Detailed information about the earth's surface is increasingly required for performing simulations and calculations from the terrain that respond to problems such as landslides, floods etc. With increase in development activities, the earth topography is changing rapidly. As the production of Digital Elevation Model (DEM) is a costly task, it is updated at large interval of time. In addition, only urban areas are given priority rather than remote areas. This paper aims to introduce Google Earth as another source to retrieve the elevation information in terms of DEM by deploying an open source elevation converter using the online utility GPS Visualizer.

Method: A new methodology is adopted in this work for preparing the Digital Elevation Model (DEM) from Google Earth. A point path is created in the entire study area using the create path tool and saved as a kml file. To prepare DEM from this kml file the gps visualizer and GIS softwares were used. This DEM is then compared with ground surveyed values as well as different DEMs like SRTM with 30m resolution and ALOS PALSAR with 12.5m resolution and also Cartosat with 10m resolution.

Results: The statistical values obtained on comparison of the DEMs are given in table 1.

Table 1 Comparison of different DEMs with the ground data

PARAMETERS	GROUND POINTS	GOOGLE EARTH DEM	SRTM DEM	CARTOSAT DEM	ALOS PALSAR DEM
Mean Elevation	16.33	15.86	15.38	18.32	15.11
Maximum Elevation	53.87	34.51	38	47	37
Minimum Elevation	0.7	0.68	1	2	-1
Absolute Arthmetic Mean		1.08	2.56	3.91	2.48
Standard Deviation		2.63	2.83	3.53	2.7
RMSE		2.84	3.82	5.27	3.66

From the above table it is observed that the error values are very less which shows the acceptance of Google Earth DEM for research purposes.

Conclusions: DEM prepared from Google Earth is as precise as freely available as well as 10m Cartosat DEM. This methodology enables researches having difficulty in collecting elevation data for their studies to have relatively precise data without much difficulty. Google Earth generated DEM can be used as an alternative elevation data than the conventional available DEM for micro level infrastructural planning for a smaller area.

Keywords: DEM, Google Earth, SRTM, ALOSPALSAR, CARTOSAT

05-31

ENERGY HARVESTING OF NOVEL TRIBOELECTRIC NANOGENERATOR BASED ON POLYACRYLONITRILE BUTADIENE STYRENE/POLYVINYLIDENE BASED COMPOSITE MEMBRANES

Neethu T. M Balakrishnan [a], Prasanth Raghavan * [a, b]

[a] Material Science and NanoEngineering Laboratory (MSNE-Lab), Department of Polymer Science and Rubber Technology (PSRT), Cochin University of Science and Technology (CUSAT), Cochin-682022, [b] Biorefining and Advanced Materials Research Center, SRUC (Scotland's Rural College), Edinburgh EH9 3JG, UK

Abstract: The triboelectric nanogenerators (TENGs) are most important energy harvesting technology that harness the abundant mechanical energy. Polymer materials are extensively examined in TENG to generate the electrical energy and mostly piezoelectric materials exhibiting ferroelectric performance are foremost in this area.

The current research involves a comprehensive analysis of novel composite system based on silica incorporated polyacrylonitrile butadiene styrene (ABS)/polyvinylidene difluoride (PVdF)/PA6 pair as the nanogenerator. All the polymer membranes are fabricated by phase inversion method and compared to the pristine membrane. The optimal composite outperforms to yield better

electrical output owing to the enhancement of the β-phase and surface roughness caused by the incorporation of the novel dopant system. The uniform distribution of the filler is confirmed by the *in-situ* addition and the performance enhancement is confirmed from the direct filler incorporated system.

The optimized composite membrane yields a high open circuit voltage of 1000 V and a short circuit current of 11 μA under a frequency of 3.5 Hz. The output power extracted from the composite PVdF membrane is about 14 mW which is nearly 5 times higher than that of pristine membrane (3 mW). This work provides an effective route to enhance the performance of ABS/PVdF/PA6 based triboelectric pair by incorporation of novel dopant system that can power the low power electronic devices.

Key words: ABS/PVdF, composite, filler content, triboelectric performance

05-32

A CASE STUDY ON CAPACITY ESTIMATION AT UNSIGNALIZED INTERSECTIONS IN THIRUVANANTHAPURAM CITY

Praveen P S[1], Anaina S. [2], Jenifer Mary Xavier[3], Nicky Sunil[4] and Swetha Promod M. [5]

[1] KSCSTE-National Transportation Planning and Research Centre (NATPAC),K. Karunakaran Transpark, Akkulam, Thuruvikkal P O., Thiruvananthapuram-695011,[2,3,4,5] Mar Ivanios Vidyanagar, Nalanchira P.O, Thiruvananthapuram-695015

Background: Among the different types of intersections in road way networks, an unsignalized intersection is a common type which is observed in India. Unsignalized intersections are potential locations of accidents, especially in developing countries like India where heterogeneous traffic is prevailing and regulations are not strictly followed. It is formed when two roads meet at grade and intersect. In the present study, critical gap and capacity values are estimated at one 'T' intersection which is considered as base intersection and two 'Y' intersections which are considered as non-base intersections and a comparative study is also carried out. This study also estimates adjustment factor for estimating capacity at 'Y' intersections.

Methods: Data collection consist of collection of details of study stretches such as geometric characteristics like width of intersecting roads, number of intersecting streets, angle of the intersection and traffic data. Traffic data at the selected study stretches are collected by mounting video cameras on high rise buildings on a week day during morning peak hour and off peak hour. Data analysis included classified volume count, identification of different movements possible in the intersections and estimation of conflicting flows at the selected study sites. In this study, the procedure suggested by Indo HCM is used as the basis for capacity estimation at unsignalised intersections.

Results: Conflicting flows, critical gaps and capacity values are estimated and a comparative study is carried out. It is observed from the present study that the conflicting flows at base 'T' intersection for right turning movement from major to minor street during peak hour is higher than that during off-peak hour at both base 'T' intersection and non-base 'Y' unsignalized intersections. The adjustment factors for the estimation of capacity at non-base 'Y' intersection is also determined.

Conclusions: In the present study, it is observed that there is considerable variation in conflicting flows, critical gaps and capacity values estimated at these study stretches during peak and off-peak hours. The variation of capacity for non-base intersection and base intersections are due to the changes in geometry pattern, critical gap and volume of conflicting flow.

Keywords: unsignalized intersection, heterogeneous traffic, critical gap, capacity

05-33

D-RISK WEBTOOL APPLICATION TO ASSESS THE DROUGHT RISKS ASSOCIATED WITH THE CHANGING IRRIGATED CROP AREAS

Rishma Chengot[1,2], Jerry W. Knox[1],

[1]Cranfield University, Bedfordshire, MK43 0AL, UK
[2]Centre for Water Resources Development and Management, Kozhikode, 673 571, India

Drought driven agricultural and economic losses are major concerns of agricultural stakeholders not only in arid regions, but also in humid temperate regions like UK. Supplemental irrigation plays a vital role to get by the water deficit issues during droughts and hence to maintain the production of good quality high value crops. In the UK, irrigation water abstraction requires a licence (or permit) with daily and annual volumetric limits from stipulated water sources. However, extreme droughts can exert significant pressure on regional water resources resulting in mandatory abstraction constraints for irrigated agriculture with consequences for productivity and revenue. D-Risk (www.d-risk.eu) is a free and simple decision support webtool developed to support agricultural stakeholders and catchment managers to evaluate the risks of abstraction restrictions and having insufficient irrigation volumes during drought events. D-Risk uses input information (location, crop and soil types, abstraction licence details and on-farm reservoir storage), MaRIUS event set weather data derived aridity index (potential soil moisture deficit) and DECIPHeR hydrologic model derived daily river flows to run a monthly water balance model to assess the annual irrigation deficit and licenced headroom. This study focuses on the application of D-Risk webtool to assess the changing drought risks associated with the expansion of the irrigated area with wheat that could be irrigated by using the excess water available in the farmer's licence without compromising the irrigation need of the current crop mix. An example case study farm was selected and the D-Risk model was run for the wheat area expansion ranges from 20 ha to 140 ha in a given year. D-Risk analysis concludes that the business will not experience any risk of water shortage with expansion of the irrigated area up to 40 ha under current climate variability. However, if the irrigated area is expanded beyond 40 ha then there is a risk of an irrigation deficit from both utilising the whole annual licenced volume and being unable to meet peak daily irrigation needs.

Key words: agriculture, irrigation, farm management, water stress

05-34

SYNTHESIS AND HIGH FREQUENCY EQUIVALENT CIRCUIT ANALYSIS OF BARIUM STRONTIUM TITANATE BASED MIM CAPACITOR

Smitha P S[1] and V Suresh Babu[2]

Sree Chitra Thirunal College of Engineering[1], College of Engineering Trivandrum[2], APJ Abdul Kalam Technological University, Thiruvananthapuram, Kerala

Background: In high frequency circuits, passive components have very high significance. Filtering and matching are vital processes in communication circuits for attenuating noises while boosting required frequencies. Both inductors and capacitors are needed to design filters and impedance matching circuits. Hence extending traditional ac measurements from audio to several

MHz frequency range is required in many practical applications [3]. Passive components exhibit high frequency parasitics which impart loss and hence limit higher frequency range over which these components work efficiently.

Method: The $Ba_xSr_{1-x}TiO_3$ nanopowder with x = 0.1, 0.3, 0.5, 0.7 and 0.9 were prepared and made into pellets. Silver metal paste was spread over top and bottom surfaces of pellets to act as top and bottom electrodes of MIM capacitor device. The capacitance, equivalent series resistance (ESR), equivalent series inductance (ESL) and parallel leakage resistance (R_p) of Ag/ $Ba_xSr_{1-x}TiO_3$ /Ag MIM capacitors were measured using Hioki 3532-50 LCR Hi-Tester.

Results: In this work, investigation on capacitance, ESR, ESL and R_p of $Ba_xSr_{1-x}TiO_3$ ceramic based Metal-Insulator-Metal capacitor for different barium mole fractions (x) is conducted. $Ba_{0.7}Sr_{0.3}TiO_3$ ceramic based MIM capacitor possesses high capacitance, low ESL, better ESR and low R_p.

Conclusion: This study shows that at high frequencies above 1 MHz, equivalent series inductance, equivalent series resistance and leakage resistance of $Ba_xSr_{1-x}TiO_3$ ceramic based MIM capacitor can be ignored. Even then they behave as real capacitors having equivalent series inductance, equivalent series resistance and leakage resistance at low frequency range up to 10 kHz.

Keywords: Ceramic based MIM capacitor, High frequency equivalent circuit, Capacitance, Equivalent series resistance, Equivalent series inductance, Parallel leakage resistance

06 –ENVIRONMENTAL SCIENCE

ORAL PRESENTATION

06-1

WOOD COLOR CHARACTERIZATION OF 10-YEAR OLD CLONAL TEAK (*TECTONA GRANDIS* L.F.) FROM KERALA, INDIA

Ann Mary Sebastian[1], Raghu A. V.*[2] & Hrideek, T.K[3]

[1]Department of Forest Genetics and Tree Breeding, KSCSTE - Kerala Forest Research Institute, Peechi, Kerala, [2]Division of Extension and Training
KSCSTE - Kerala Forest Research Institute, Peechi, Kerala, India
*[3]State Medicinal Plants Board, Government of Kerala, (*Correspondence: dravraghu@gmail.com)*

Background: Teak (*Tectona grandis* L.f.), the most important tropical timber species valued for its durability and aesthetics. Today, due to the declining supply of natural teak, planted teak is the only resource to meet the rising demand of teakwood. Through teak clonal forestry, large scale fast growing uniform quality teak stands of superior quality can be produced. In 2000, the pioneer work undertaken by KFRI resulted in establishing a pilot-scale true-to-type teak clones of superior mother trees originated from Nilambur, Konni and Arienkavu planted in Vellikkulangara. As part of breeding programme, it is the time to check the characteristics of these clones.

Method: Wood samples were taken from the clonal teak plantation (2.0 ha) established by KSCSTE-Kerala Forest Research Institute, Peechi in the year 2011 at Vellikkulangara, Thrissur. Five clones of superior plus trees originated from Nilambur, Arienkavu and Konni. Five defect-free dominant trees were selected for wood sampling from five teak clones. The physical properties like wood color characteristics were determined by CIE L*a*b* system using colour spectrophotometer (Datacolor Check II Plus, USA). One-way ANOVA was used for the statistical analysis of wood colour parameters.

Results: The physical properties were studied and compared with mature Nilambur natural teak. The wood colour studied by CIE L*a*b* system showed significant colour difference (dE) between the clones and natural Nilambur teak. The two Nilambur clones (T1&T7) showed no significant variation, but showed significant variation with natural teak. T16 (Arienkavu) showed maximum redness and significant variation from other clones and mature teak.

Conclusion:

At the age of 10 years, the wood colour studied by CIE L*a*b* system showed no significant colour difference (dE) between the clones in terms of redness index and yellowness index. However, the redness index (a*) of clone T16 from Arienkavu was distinctly different than other clones. In general, the wood quality in terms of wood colour no clones reached the characteristics of mature teak. The differences in the obtained values with that of the standard values may be attributed to the juvenility of the clones selected.

Keywords: Teak clonal forestry, density, wood colour, CIE L*a*b*, *Tectona grandis*

06-2

EXPLORATION OF AUTOROTATION IN DISPERSAL UNITS OF *GETONIA FLORIBUNDA* ROXB. (COMBRETACEAE)

Drisya V.V.[1*], C. Pramod[1,2], A.K. Pradeep[2] & T.P. Suresh[3]

[1]Department of Botany, Government Brennen College, Dharmadam P.O., Thalassery, Kerala 670 106, [2]Department of Botany, University of Calicut, Calicut University P.O., Kerala 673 635, [3]Department of Physics, Government Brennen College, Dharmadam P.O., Thalassery, Kerala 670 106, drisyachandran96@gmail.com

Background: Generally, plants are sessile creatures that produce winged diaspores primarily to aid in successful dispersal thereby increasing their population size. They display amazing aerodynamic behaviours like gliding, rocking and spinning (autorotation) in the air to slow the rate of descent on detachment from the mother plant. Dispersal units of *Getonia floribunda* Roxb. (Combretaceae) is one such example of a winged diaspore which performs interesting specific autorotation in the air during wind dispersal for decreasing the rate of descent on detachment from the parent plant. Exploration of this autorotation in the dispersal units of *G. floribunda* is a curious task and it will provide us some clues to develop and advance our technology by serving as bioinspiration in future. In this context, the present study aims to find out the mechanism behind the autorotation in *G. floribunda* diaspores and its unique direction of rotation.

Method: Diaspores were collected from various locations of Kannur District of Kerala and detailed morphological, micromorphological and morphogenetic studies of collected specimens were done in the laboratory. Field observations of autorotation including the direction of rotation of the diaspores collected from different localities were carried out and the entire trajectory, mechanism, and effect of external factors on autorotation were studied by conducting experiments in still air and the results were analysed with the help of tracker analysis software. Wing modification and paper model experiments were conducted to resolve the specificity in the direction of rotation during falling.

Results: During dispersal, *G. floribunda* diaspores perform helicopter motion in the air *i.e.*, spin tightly around a vertical line passing through its centre of mass (autorotation). External factors in the field affect its straight vertical line path into an inclined path without changing its autorotation. Initial small falling and flipping position follows continuous autorotation. Distribution of the centre of mass in the vertical axis of rotation and diaspore geometry and wing configuration leads to the initial flipping of position and steady autorotation with the help of lift, drag and gravity forces. Unique inclined curvature in the wings is the reason for its specific anticlockwise direction of rotation.

Conclusions: The spatial configuration and distribution of weight on the wings of diaspores have a significant effect on the type of motion during descent. Studying more about these structures will have profound implications for practical aerodynamics in future.

Keywords: Aerodynamics, Anemophily, Dispersal, Geometry, Winged diaspore.

06-3

CHITIN: A VERSATILE NANOCARRIER FOR CONTROLLED NUTRIENT RELEASE IN SUSTAINABLE AGRICULTURE

Jaiby Cyriac[a] and Bejoy Thomas[b]

[a] Department of Botany Newman College Thodupuzha, Idukki district, [b]Department of Chemistry, Newman College Thodupuzha, Idukki district

Background: The increasing use of fertilizers with low uptake and utilization efficiency may cause serious environmental pollution and soil alkalization, threatening people's health. One alternative is to adopt Enhanced Efficiency Fertilizers (EEFs). The emergence of nanotechnology in agricultural science puts forward a new concept of slow-release and researchers have started the encapsulation of various macro and micro-nutrients into the nanomaterials. We focus our research work on the synthesis of environmentally safe nanoparticles carrying zinc as the crop nutrient that can be released in a controlled manner for use as a nano micronutrient. In this study, zinc is loaded into biopolymer chitin which is a waste material in the marine industry. It is selected due to its excellent biocompatibility, biodegradability, and non-toxic nature.

Methods: Chitin is extracted from seashell waste using green methodology avoiding toxic organic solvents and then it is made into its nanoparticles by acid hydrolysis. A particular molar concentration of Zinc acetate is then added dropwise to the solution separately which is kept under constant stirring. After adding NaOH to form ZnO the solution was autoclaved for 12 hours and washed using deionized water three times using a high-speed centrifuge. The slow-release profile of zinc in the soil is done through percolation studies and confirmed the data from Atomic Absorption Spectroscopy (AAS).

Results: The high surface area to volume ratio offered by nanoparticles allows the binding of a large amount of zinc oxide molecules. The formulation of zinc-based nanocomposite is proved with the results of SEM with EDAX, TEM, and XRD. The slow release of zinc ions in agricultural soil is confirmed by the results of the Atomic Absorption Spectrophotometer in the percolation experiment.

Conclusion: The present results indicate that the nano chitin extracted from marine waste may act as a superior substrate or carrier for the zinc nutrients to be loaded. It has the properties of a slow-release source of Zn nutrients to plants assuring crop growth and increased higher yield.

Keywords: Nano micronutrient, slow release of nutrients, Enhanced Efficiency Fertilizers.

06-4

CHROMATE REMEDIATION FROM INDUSTRIAL WASTEWATERS USING CALCINED FRIEDEL SALT - A STEP TOWARDS CIRCULAR ECONOMY IN WASTE MANAGEMENT

Jiffin Sam[1,2], Vaishna V R[1], Rothish R Nair[1,2], K.P Prathish*

[1]Environmental Technology Division, CSIR – NIIST, Thiruvananthapuram – 19
[2]Academy for Scientific and Innovative Research (AcSIR), Ghaziabad- 201002

Background: The TiO_2 pigment production sector uses the chloride process generates hazardous iron oxide waste byproducts that are high in chloride concentration. The precipitation of chloride

as Friedel Salt, is one way to mitigate the issue, although the generation of huge quantity of FS pose yet another challenge while enabling iron oxide end-use applications. Layered double hydroxides are prospective candidates for cationic and anionic pollutant adsorption in wastewater treatment, and FS is one such low cost LDH material. The demand for a cost effective adsorbent for Cr(VI), from water resources has long been a hot research topic. The study assessed the adsorptive characteristics of calcined FS for removal of chromate ions from aqueous environments.

Method: FS obtained as a by-product from titanium industries was characterised and utilised as the sorbent for Cr (VI). The expected chemical reaction of adsorbent synthesis is as follows;

$4Ca^{2+} + 2Al^{3+} + 2Cl^{-} + 12OH^{-} \rightarrow Ca_4Al_2Cl_2(OH)_{12}$

The following can be the expected reaction for the creation of Cr (VI) bounded Ca-Al LDH.

$Ca_4Al_2(OH)_{12}(OH)_2(H_2O)_4 \cdot xH_2O + CrO_4^{2-} \rightarrow Ca_4Al_2(OH)_{12}CrO_4(H_2O)_4 \cdot xH_2O + 2OH^{-}$

Results: The characterization demonstrated that Cr(VI) was intercalated into the CFS. The removal percentage of 150 mg CFS for 100 mgL^{-1} Cr(VI) remained above 84%.

Conclusion: The present research indicates that CFS is a potential cost-effective adsorbent for Cr(VI) removal from wastewater.

Keywords: Friedel Salt, Chromate Remediation, Wastewater treatment, Adsorption, Calcination

06-5

OBSERVATIONAL STUDY OF CHANGES IN TRACE AIR POLLUTANTS OVER KANNUR DURING LOCKDOWN AND ITS VALIDATION USING CMAQ WITH INTEGRATED PROCESS ANALYSIS.

Keerthi Lakshmi K A[1], Nishanth T[1]*, Satheesh Kumar MK[2]

[1]Department of Physics, Sree Krishna College Guruvayur, Kerala, India- 680102
[2]Department of Atomic and Molecular Physics, MAHE, Manipal, India- 576104

The Government of India imposed a lockdown to restrict the spread of the SARS-CoV-2 coronavirus pandemic, on 25 March 2020. In India, Kannur district was identified as the first "hotspot" of virus transmission and a "triple-lockdown" was implemented for a span of twenty days from 20 April 2020. This work highlights the variations of surface O_3, NO, NO_2, CO, SO_2, NH_3, VOC's, PM_{10}, $PM_{2.5}$ and meteorological parameters at the time of pre-lockdown, lockdown and triple-lockdown days at Kannur town in south India using ground-based analyzers and its validation using CMAQ model with integrated process analysis. At Kannur, from pre-lockdown days to triple-lockdown days, surface O_3 concentration was found to increase by 22% in this VOC limited environment. The concentration of NO, NO_2, CO, VOCs, SO_2, NH_3, PM_{10}, $PM_{2.5}$ were observed to decline significantly from pre-lockdown days to triple-lockdown days. The Community Multi-Scale Air Quality (CMAQ) model was applied to evaluate the changes in air quality over Kannur during the lockdown. The results revealed that the vertical transport from the upper layers dominated the surface O_3 formation, comprising 89.4%, 83.1%, and 88.9% of the O_3 sources during the pre-lockdown, Lock down and, and Triple lockdown periods. Photochemistry contributed negatively to the O_3 concentrations at the surface layer. Compared with the Pre-lock down period, the O_3 enhancement during the Lock period was primarily attributable to the lower

negative contribution of photochemistry and the lower O_3 removal rate by horizontal transport. During the Triple lockdown period, a slower consumption of O_3 by gas-phase chemistry and a stronger vertical import from the upper layers to the surface accounted for the increase in O_3.

Keywords: Lockdown, Kannur, Air pollutants, Air quality, CMAQ

06-6

A CRITICAL STUDY TO EXPLORE AFFORDABLE TOOLS TO ASSESS DIOXIN-LIKE POPs BIOACCUMULATION & HUMAN HEALTH RISK TRENDS AT POPS HOTSPOTS IN DEVELOPING COUNTRIES

P S Kirankumar[a,b], K Sanath[a], S V Ajay[a,b], Amala Varghese[a,b], K. P. Prathish[a,b]*

[a]Environmental Technology Division, CSIR-NIIST, Thiruvananthapuram, [b]Academy of Scientific and Innovative Research (AcSIR), Ghaziabad-201002

Background: Development of scientific monitoring plans and cost effective analytical methodology are absolute necessary to developing nations like India to understand current scenario of the identified POPs hot spot regions. The recent technological progress in the area of GC MS-MS made it as an affordable confirmatory tool for dioxin like POPs analysis. It is the first study on dl-POPs contamination conducted using GC MS-MS based methodology in the riverine ecosystem surrounding one of the major global POPs hotspot.

Method: The work reports on the critical validation and assessment of GC-MS/MS based confirmatory tool to quantify the levels of dioxins-like Persistent Organic Pollutants (dl-POPs) in fish and sediment samples from a historical POPs hotspot Eloor-Edayar region. The findings of the study using scientific tools such as congener finger prints, regression analysis, BSAF and daily intake estimation systematically unveil the persisting concerns of significant health risk posed by routine consumption of fishery products in the region and its bioaccumulation trends from river sediments.

Results: The observed average levels of contaminants in fish samples were many folds higher than the control samples. The statistically significant strong positive correlation of dl-POPs levels in sediment and fish samples, confirmed the root cause & bioaccumulation pathways for the observed levels in fish samples. The calculated weekly intake values were 3- 24 times higher than TWI of 2 pgTEQ kg^{-1} bw $week^{-1}$ established by EFSA in various fish species and a moderate to high health risk from regular intake of *M. cephalus* and *E. suratensis* species can be inferred.

Conclusions: The study developed and critically validated GC MS-MS based analytical protocol for monitoring dl-POPs. The results were used to estimate bioaccumulation of contaminants and health risk to fish consumers of the study region. The developed analytical methodology and work flow can be easily emulated to other POPs hot spots of developing nations. The data obtained from such studies will be highly beneficial to regulatory bodies to understand current scenario after a decade of Stockholm convention ratification and plan global strategies to further reduce dl-POPs levels.

Keywords: Dioxin & PCBs, GC-MS/MS, POPs Hotspot, BSAF, Correlation analysis, Health risk assessment.

06-7

VEGETATIVE PROPAGATION IN SELECTED MANGROVE SPECIES OF KERALA

Namitha, K., Drisya, P., Sreekumar, V.B., Sandeep S*, Sreejith, K.A.

Forest Ecology and Biodiversity Conservation Division,
** Sustainable Forest Management Division, Kerala Forest Research Institute, Peechi, 680 653, Thrissur, Kerala,*

Background: Mangroves are salt-tolerant plants that can endure high water pressure and grow in tropical and subtropical intertidal zones all over the world. Over 15 million hectares of world's tropical and subtropical coasts are covered by mangrove vegetation and is home to a variety of creatures, including bacteria, fungus, algae, insects, birds, and animals (Kathiresan & Bingham, 2001). Oneof the main issues with mangrove afforestation is year-round shortage of propagules. In this situation, a lot of species struggle with extra inborn difficulties such as irregular flowering, insufficient seed viability, insect attack, low seed viability, issues with post-dispersal growth of seeds, and low germination rates. So, prioritizing vegetative propagation is necessary to get over these constraints. This work aims to develop a procedure for the conservation of mangrove species by hormone treatment and subsequent nursery experiments to produce 'true to type progenies'.

Methodology: Collected stem cuttings were treated for the removal of phenolic compounds using 20% stock solution of sodium tungstate and sodium carbonate. After being submerged, Stem cuttings were rinsed with distilled water. From which 25% and 10% of working solutions is prepared using short- and long term treatment. Following this, hormone treatment is conducted using IAA, IBA, NAA were 1g of rooting hormone is dissolved in 1N sodium hydroxide added drop wise for dissolution and makeup to 100ml (i.e. 10,000 ppm). Later, cuttings are grown in potting media and relocated to mist chamber for observation.

The data were analyzed statistically using SPSS. The significance of differences among mean values was carried out using Duncan's multiple range at $P < 0.05$. The results are expressed as Mean ± SD.

Results: The collected juvenile cuttings of, *Bruguiera sexangula, Avicennia marina* and *Sonneratiacaseolaris* were treated using different root initials. However, among the three rooting hormone (IAA, IBA and NAA) IBA alone has resulted greater root initiation. Even though different potting media were used, Vermiculite and clay were resulted effective in terms of survival percentage. The semi hard wood cuttings of *Sonneratia caseolaris* showed positive response to lateral buds, leaf and root initiation (concentrations ranging from 2000 to 3000ppm) after 15 to 35 days. In the case of *Bruguiera sexangula* juvenile propagule cutting were treated withdifferent concentrations of IBA and the finest root primodia were developed in 1500 to3000ppm.The first leaf initiation was noticed after 20 days of observation, while root primodia growth was recorded after 25 days of observation, while root primodia growth was recorded after 1 month. In *Avicennia marina*, all the cuttings juvenile cuttings were treated with different IBA combinations from which IBA 2000ppm-3000ppm showed shoot initiation after 20 days but no root primodia was noted.

Conclusions: According to the vigor scale, juvenile and semi-hard wood showed the higherst survival percentage in IBA between the concentration ranging from 2000 to 3500ppm. Vermiculite and clay show highest growth under the mist condition. Variation in the shoot height and root primodia revealed that, the adaptability to new environmental conditions influenced the survival percentage depending on the species nature. The propagation of plants by vegetative or clonal is

considered as the most effective and cheapest technique in modern conservation to develop superior clones of the same 'true to type progenies' of the species.

Keywords: Vegetative propagation, true to type progenies, conservation, survival percentage

06-8

FIBER CHARACTERISTICS OF 19-YEAR OLD CLONAL TEAK (*TECTONA GRANDIS* L.F.) FROM KERALA, INDIA

B. Preetha[1], Hrideek[2] T. K. & P. K. Thulasidas[3]

[1&2]Department of Forest Genetics and Tree Breeding, [3]Division of Wood Science and Technology, KSCSTE - Kerala Forest Research Institute, Peechi - 680653, Kerala

Background: Teakwood supply declines year by year and utilization of fast-grown teakwood especially from planted forests increases. In early 2000, Surendran *et al.,* (2006) established pilot scale true-to –type clones of superior plus trees of teak planted in suitable locations in Kerala having their parent plus trees originated in Nilambur, Arienkavu and Konni Forest Divisions. In this study, the anatomical characters and wood density of teak clones from three different origins were investigated.

Method: Wood anatomical and physical properties were studied following standard wood anatomical protocols using interactive Image Analysis System (Leica S/w) in a compound microscope fitted with CCD camera. Wood increment core samples of ten clones were taken from the 19 year –old clonal teak plantation (1.72 ha) established by Kerala Forest Research Institute, Peechi in the year 2000 at Decent Mukku, Kulathupuzha, Kerala. Wood basic wood density was determined by the water displacement method (ratio of oven-dry weight to green volume basis). The fibre properties were analysed on the macerated tissues obtained following Franklin's method (1945).

Results: Density of all the ten clones were in the range 0.510 g/cm^3 – 0.635 g/cm^3 of which the clones from Nilambur plus trees showed significant variation from others, close to the density of a mature teak. Density of clone T11 (Nilambur) is low (0.510 g/cm^3) compared to other Nilambur clones (0.585 - 0.635 g/cm^3). This was attributed to higher amount of earlywood with thin walled fibers. The fiber length of the ten clones ranges from 1.12 – 1.29 mm in which higher fiber length obtained in T3 followed by T10. The significance of fiber wall thickness as one of the anatomical property determining the wood density were studied in the present work and confirmed that the clone T11 from Nilambur showing less wood density has the lowest double wall thickness. It is remarkable that the double wall thickness of fibers coupled with other anatomical characteristics is responsible for the variation in wood density which is a heritable trait.

Conclusion: This study set out to compare and evaluate some physical and anatomical properties of 19-year old clonal teak from Kerala. The clones originated from Nilambur plus tree (T11) shows low density compared to other Nilambur clones and this was attributed to higher amount of earlywood with thin walled fibers. The study concluded that the anatomical characteristics like fiber quality influences the wood density and the density can be considered as a good predictor of wood properties.

Keywords: Teak clonal forestry, wood density, *Tectona grandis*, Plus tree, fiber characters.

06-9

METAGENOMICS OF HEALTHY AND SPIKE INFECTED SANDALWOOD RHIZOSPHERE MICROBIOTA FOR POTENTIAL BIOINDICATORS

[1]Reshma Bhasker T, [2]Anaina KA and [1]Suma Arun Dev

[1]Kerala Forest Research Institute, Peechi, Thrissur, Kerala 680653, [2]Kerala University of Fisheries and Ocean Studies, Panangad, Kochi, Kerala 682506

Background: Susceptibility to various infestations like sandal spike that severely depletes *S. album* populations in Kerala and Karnataka forests of India, is one of the major causes for its resource shrinkage. A comparative evaluation of the sandalwood associated microbiota and its diversities in correlation with the health status of the tree can aid in developing disease management strategies in sandalwood.

Method: Amplicon metagenomics approach using 16srRNA is employed to elucidate microbial diversity in healthy, early stage infected and severely infected samples of sandalwood rhizosphere. Bacterial v3-v4 region is amplified, library prepared and sequenced in Nanopore minION mk1B and the fast5 file obtained used for downstream analysis.

Results: *Mesorhizhobium, Bradyrhizobium, Sphigomonas, Nocardioides, Rhizobacter, Candidatus solibacter, Rhodoplanes*, *Luteitalea* and *Streptomyces* were more abundant in healthy samples compared to early stage and severely infected ones. *Cornexibacter, solirubrobacter* and *Paludibaculum fermentans* had higher occurrence in infected and decreased with early stage and healthy ones. Differential abundance analysis showed an under representation of 4 species, i.e., *Metabacillus sp. B2-18, Oceanobacillus zhaokaii, Niabella soli* and *Metabacillus litoralis* in severely infected samples compared to others.

Conclusions: Organisms that are abundant in healthy soil samples, probably those PGPRs, could be used as potential biocontrol agents. Correlating physicochemical properties with microbial diversity can give insights into its influence on biogeochemical processes involved. Understanding the microbial resistance mechanism and identifying antibiotic resistance genes would help in controlling pathogen infection to a great extent.

Keywords: Amplicon metagenomics, Nanopore, Microbial diversity, Differential abundance

06-10

DETERMINATION OF RAINFALL THRESHOLD AND LANSLIDE HAZARD ZONATION FOR THRISSUR DISTRICT

N. Rohit, S. Sandeep, Alan Rose and T.J. Vishnu

Kerala Forest Research Institute, Peechi, Thrissur, Kerala.

Background: Landslides are catastrophic events impacting the economy, infrastructure, culture and heritage, and human injury that can extend to the loss of lives. Rainfall and slope can be attributed as the major factors among the multiple causes that trigger almost every landslide event. As people migrate into new areas of hilly or mountainous terrain, it is essential to understand the significance of the future susceptibility to landslide hazards. Cities and towns can plan for modern construction engineering, land use, and infrastructure that will minimize the cost of living with landslides. The physical causes of landslides cannot be checked; landslide risks can be minimized

by geological studies, by sound engineering practices, and by productive land use management laws. The triggers, movement characteristics, soil properties, geology associated with them, and where they can occur are important to consider. Furthermore, mitigation measure estimates may decrease damages due to landslide to a greater degree and strong risk avoidance strategies can be applied to decrease hazard severity. This study aims to analyse the causative factor and identify climatic thresholds that can trigger the landslide.

Methods: Empirical methods of prediction of rainfall intensity and duration were used for developing rainfall threshold of the Thrissur district. Weighed overlay method was used in the preparation of landslide hazard zonation map.

Results: Regression equation prepared by rainfall intensity and duration, show that a rainfall intensity of 5.361 mm/hr for 24hr duration could trigger landslide in the region. A landslide hazard zonation map of Thrissur was prepared by using and overlaying different thematic maps of the study area

Conclusion: The study conducted in the landslide sites of Thrissur district helped to identify different factors that have led to the occurrences of landslide. The study revealed that the major cause of the landslide was due to the high intensity of rainfall over short duration of time in these sites. The soil in these regions have become saturated under the influence of heavy rainfall thereby reducing the cohesive and binding forces triggering the slide.

Keywords: Rainfall threshold, Hazard zonation, Landslide triggering factor, cumulative rainfall, vulnerability

06-11

APPRAISAL IN DEVELOPING STANDARDISED AND FIELD-TESTED IDEAL INSECT TRAP SYSTEM WITH A PROTOCOL FOR ASSESSING INSECT DIVERSITY AND ABUNDANCE IN TROPICAL FOREST ECOSYSTEMS

Shine Raj Tholkudiyil*, Romila Devi, Thushar Naduvalloor, Jithu U. Krishnan,

T. V. Sajeev

Department of Forest Entomology
KSCSTE-Kerala Forest Research Institute, Peechi, Thrissur- 680 653, Kerala
**Corresponding and presenting author: shineraj263@gmail.com*

Background: Tropical forests most likely support a maximum of the insect diversity on the globe, but few studies have attempted to comprehensively examine whole insect communities in tropical forests. Therefore, we compared five different types of passive and active insect traps to collect insects from different forest types of Kerala part of the Southern Western Ghats.

Methods: The diversity of insects was analysed using the samples collected from malaise trap, yellow pan traps, dung pitfall traps, and light traps in five different forest habitats of Kerala.

Results: A total of 13245 specimens were collected, which comes under 13 insect orders. In our study, the light trap was generally the most effective trap in terms of capturing the majority of insect orders (84.61%), and dung pit fall ranked the top in the case of the maximum number of

specimens collected. The insect trap capture varied significantly among the different forest ranges between moist deciduous forests and evergreen forests (K = 7.82; P< 0.05).

Conclusions: Our study came in concordance with using multiple sampling protocols maximises insect diversity measures and can be used to identify as a signature for the ecology of the terrain it is represented. The present study gives a strategy for entomologists and ecologists on the quantitative sampling of tropical forest systems of the Western Ghats. Such methods of composite collection and analysis of metadata can provide valuable information on a larger perspective of insect diversity and on the ecology of the ecosystem, which is very much essential in this era of climate change effects, forest area decline due to invasion from exotic species, and from unregulated and unsustainable developmental projects.

Keywords: Insect diversity, Insect collection, Western Ghats, Tropical insects

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06-12

A CASE STUDY ON THE DIMINISHING COAST OF THIRUVANANTHAPURAM DISTRICT USING A NEW WATER INDEX

P.S. Smitha[1], K. Maya[1] , K. P. Sudheer[2], V. M. Bindhu[3], K. Sreelash[1] and D. Padmalal[1]

[1]National Centre for Earth Science Studies, Akkulam, Thiruvananthapuram
[2]Kerala State Council for Science, Technology and Environment, Thiruvananthapuram
[3]M/S Vassar Labs IT Solutions Pvt Ltd, Hyderabad

Background: Coastlines are subjected to both complex natural processes and human interventions which results in physical, chemical and biological changes in the coastal zones. The dynamic nature of the shoreline demands an effective system for the assessment of long and short term erosion occurring in the coastal zones. Commonly used methods for coastline mapping such as field surveys and aerial photography are constrained in its applicability mainly due to its limited spatio-temporal coverage. Remote sensing techniques have gained prominence with its improved spatio temporal resolution, accuracy and easiness in computation. Various coastline mapping techniques have been developed from medium resolution satellite images using single and multiple bands for the extraction of shorelines. However, most of the methods developed to extract shoreline had profound influence of tides which can affect the long term pattern of coastal changes. The main focus of this study is to formulate an index that can extract the shoreline free from tidal effects.

Method: This study proposes a new water index namely advanced multi spectral water index (AMSWI) using the visible and near infra-red band of satellite images to effectively delineate the shoreline compared to three widely used water indices namely Modified Normalized Difference Water Index (MNDWI) and Normalized Difference Water Index (NDWI). The new index was first tested in different lakes with different background features to assess the accuracy of delineation of boundary of water bodies. The index was then applied on different stretches of Kerala coast to delineate the shoreline. The accuracy assessment of proposed methodology was performed using kappa coefficient and F1 score.

Results: A higher F1 score and kappa coefficient of 0.97 and 0.98 respectively was obtained for AMSWI. The results showed that the proposed water index exhibits higher ability to extract shoreline compared to MNDWI and NDWI along the sandy beaches of Kerala coast.

Conclusion: The proposed water index can effectively delineate shoreline from sandy beaches which is a high albedo surface and major source of error in mapping with satellite images. This methodology helps in developing both short term and long term shoreline change maps for Kerala coast and aid in effective coastal zone management

Keywords: Water index, Remote sensing, Coastal erosion, Kappa coefficient, Shoreline

06-13

PRELIMINARY STUDIES ON EPIPHYTIC GROWTH IMPACT OF *EPIPREMNUM PINNATUM* CV. *AUREUM* ON HOST TREE HEALTH: A CASE STUDY ON *TECTONA GRANDIS*

M.V. Sruthi, P.A. Jose, R. Jayaraj and Shambhu Kumar

KSCSTE-Kerala Forest Research Institute, Peechi- 680 653

Background:The epiphytic growth impact of *Epipremnum pinnatum* cv. *aureum* (Money plant) on host trees, *Tectona grandis,* located in the campus of Kerala Forest Research institute, Peechi was studied where the host showed stunted growth, wilting of branches and overall unhealthy.

Method: A survey of epiphytic growth on the host tree was carried out in the campus to assess the dominance of interaction. The bark anatomy, soil analysis, allelopathic effect and endophytic fungus relationship between epiphyte and host were investigated through standard laboratory methods.

Results: Major interaction of *Epipremnum pinnatum* cv. *aureum* was noted among the reproductive individuals of the host growing in the premises of conservatory gardens. Bark structural damage of the host tree was proved. Sharing of soil moisture and nutrients were recorded. The allelopathic effect of epiphyte was detected. A latent pathogenic endophytic fungus, *Aspergillus pulvericola* from the epiphyte was isolated.

Conclusions: The scientific causes behind unhealthy teak trees was studied and proved. Cumulative effect of multiple negative factors of the epiphyte was found responsible and impacted. In-depth studies are required species-specific impact of the epiphyte.

Key words: Epiphyte, Host tree, Interaction, impact, unhealth

06-14

TEAK GENOMICS FOR CONSERVATION, PRODUCTIVITY IMPROVEMENT AND TIMBER FORENSICS

Swathi Balakrishnan[a], Remya Unnikrishnan[a], Suma Arun Dev[a], Yasodha R[b]

[a] Forest Genetics and Biotechnology Division, Kerala Forest Research Institute, Thrissur, Kerala 680653, [b] Division of Plant Biotechnology, Institute of Forest Genetics and Tree Breeding, Coimbatore 641002

Background: Genomic characterization using high throughput sequencing technologies has revolutionized the field of conservation genetics and can immensely benefit the tree improvement programs. The main impediment recently faced by the productivity improvement programs in teak

is the narrow gene pool and lack of quality planting materials. Additionally, illegal logging has also adversely affected the teak genetic resources.

Method: Whole genome sequencing of teak was done followed by identifying genome-wide SSR markers. Twenty-five genome-wide SSR markers were used for genotyping 425 individuals from 18 natural teak populations. Genotyping data was used to assess the genetic diversity parameters and to create a reference database for timber forensics. Additionally, from genome data identification, structural characterization and evolution of cellulose synthase gene superfamily were studied followed by protein-protein interaction network analysis of wood related genes.

Results: Three gene-ecological zones, genetic diversity hotspots as well as the populations/genotypes with adaptive alleles were identified from the genotyping data. A reference database of genetic profiles using 10 SSRs for timber forensics was developed and verified using Machine learning approach (MLA). We identified 39 full-length non-redundant proteins belonging to teak cellulose synthase gene families with multiple domains and domain duplications. The teak cellulose synthase genes involved in wood coloration was also identified.

Conclusion: Integrating population genomics and conservation biology would be an ideal approach to formulate appropriate strategies for sustainably managing the natural and planted teak genetic resources. DNA testing can provide strong scientific evidence and precision to the legal framework so as to curb illegal felling. Further, the study offers foundation for future research to assess the teak wood property traits especially, the provenance effect in teak wood colour.

Keywords: Teak, Genetic diversity, Gene-ecological zonation, Illegal logging, Cellulose synthase, Machine learning approach

06-15

MANGROVES AS BLUE CARBON SINKS FOR CLIMATE CHANGE MITIGATION- A CASE STUDY FROM KANNUR DISTRICT, KERALA

M Swedha Madhavan[1], K T Chandramohanan[2], P Sreeja[3]

[1]Department of Botany and Research Centre, Government Brennen College, Dharmadam P O, Thalassery, Kerala 670 106, [2] Department of Botany and Research Centre, Government Brennen College, Dharmadam P O, Thalassery, Kerala 670 106, [3] Department of Post Graduate studies and Research in Botany, Sir Syed College, Taliparamba, Kannur, Kerala 670 142, India.

Background: Mangroves are one of the world's richest storehouses of biological and genetic diversity**.** Mangroves, like other coastal wetlands, are extremely effective carbon sinks. That is, they absorb carbon dioxide from the air and store it in their roots, branches, and the sediment that accumulates around them. The preliminary aim of the study includes estimation of biomass and carbon stock assessment of mangrove species distributed in the selected study stations of Kannur district, Kerala.

Method: The selected stations of Kannur district for the study include Edatt (S_1), Cherukunnu (S_2) and Nadal (S_3). Quadrant study was carried out for the non-destructive estimation of biomass of mangrove species. Existing general allometric equations were applied for computing biomass and carbon content of mangrove species.

Results: The total biomass (AGB +BGB) and carbon content of mangrove trees estimated from the ten study plots in S_1 was found to be higher in *A. officinalis* (11247.8 Kg and 5568.42 Kg C)

and lower in *Aegiceras corniculatum* (312 Kg and 245.8 Kg C). In S_2, *Avicennia officinalis* shows highest average Carbon content/ tree (112.20 Kg C) followed by *Avicennia marina* (62.33 Kg C) and *Rhizophora mucronata* (48.34 Kg C).

The biomass of all the true mangroves distributed in S_1, S_2 and S_3 are estimated to be 1510.79 ton/ha, 382.98 ton/ha and 185.43 ton/ha. The carbon stock of mangroves was found to be higher in S_1 (783.95 ton C/ ha) followed by S_2 (203.10 ton C/ha) and S_3 (93.56 ton C/ha) which is equivalent to 2877.09 ton CO_2/ha, 745.38 ton CO_2/ha, 343.36 ton CO_2/ha respectively.

Conclusions: The co-benefit of mitigating climate change through so-called blue carbon storage in coastal ecosystems has increased interest in mangroves. The study signifies the potential of mangrove species in blue carbon sequestration by reducing atmospheric CO_2 emissions.

Keywords: Mangroves, Biomass, Carbon Stock, Climate change, CO_2

06-16

EFFECTIVE UTILIZATION OF NUTMEG FRUIT RIND WASTE FOR Cr(VI) REMOVAL FROM INDUSTRIAL WASTEWATER

V.R Vaishna[1], JiffinSam[1,2], K.P. Prathish[1,2*]

*[1]Environmental Technology Division, CSIR- National Institute for Interdisciplinary Science & Technology, Industrial Estate P.O, Thiruvananthapuram, Kerala, 695019, [2]Academy of Scientific and Innovative Research (AcSIR), Ghaziabad, 201002, *Corresponding Author, prathishkp@niist.res.in*

Background: Low-cost biosorbents are one of the most promising substances for pollutant removal in water treatment research. Biosorption has several key benefits over chemical approaches for removing metals, including cheap cost, reduced chemical use and minimizing sludge generation owing to possible regeneration of biosorbents. This study investigates the possibility of nutmeg rind powder (NMP) as a cost-effective and environmentally benign method for removing hexavalent chromium from tainted streams.

Methods: The experiment on chromium adsorption by nutmeg rind powder (NMP) was performed using the batch experiment technique by taking the requisite amount (1-100 ppm). Various amounts (0.005-0.20 g) of NMP were dispersed into the respective solutions. The solution's pH obtained by the addition of adsorbent was 3.58 and is maintained. It was observed that chromium removal was found to be maximum at 12hrs, at room temperature with a shaking speed of 150rpm. The total volume in all the cases was maintained at 100ml. The suspensions were filtered after equilibration, and the quantity of Cr(VI) in the filtrates was quantified using a UV-Visible spectrophotometer at 540 nm. The chromium uptake was calculated from the decrease in chromium concentration concerning those of initial concentration in the solution.

Results: The results demonstrated that the adsorption process is influenced by temperature, contact time, adsorbent dosage, adsorbate concentration, and pH. The kinetics and adsorption studies showed that the dynamical information functioned well with the pseudo-second-order kinetic model and sorption data followed the Sips isotherm as opposed to other isotherm models. The sorption of Cr(VI) was exothermic and spontaneous based on thermodynamic studies.

Conclusion: The work demonstrated the utilization of wastefruit shell—an accumulated source of biological solid waste—as a copious and inexpensive bio-sorbent for the removal of Cr(VI) from effluent streams.

Keywords: *Adsorption, Thermodynamics, kinetics, isotherm*

06-17

UNDERSTANDING ROLE OF LAND USE ON LAND SURFACE TEMPERATURE USING SATELLITE DATA

Asha M.S, Sachin V.M, Renjith K.R and Dawn Emil Sebastian

KSCSTE – Centre for Water Resources Development and Management, Kunnamangalam, Kozhikode, Kerala – 673571

Background: Vembanad Lake is one of the largest and richest biological hotspots in Kerala which poses huge socio-economic and ecological importance. Significant alterations in its physical characteristics like area and land use has been witnessed over the years. However, the impact of such changes on the local temperature is not yet analyzed.

Method: Landsat images during 2001 and 2021 are procured for the study region and various land surface features like land surface temperature (LST), normalized difference vegetation index (NDVI) and normalized difference in built-up index (NDBI) are extracted to understand the role played by land use changes and urbanization on the local temperature.

Results: LST has witnessed significant changes over the two decades in the study region which witnessed a decrease in NDVI values and an increase in built-up areas based on NDBI classification. Large shifts in LST are visible around the urban regions in the study area around Cochin City. By comparing the LST anomaly values, it is evident that while LST is majorly being driven by global temperature changes; the regional land use plays a significant role especially in the spatial distribution.

Conclusions: It has been found that the changes in LST are influenced by the local land use features in addition to the global changes in temperature.

Keywords: Landsat, LST, NDVI, NDBI

06-18

EFFECT OF HEAT ON THE DIOXIN CONTENT OF PACKAGED MILK AND ITS EFFECT ON H295 R CELLS

Sujith S[1], Usha PTA[2], Bibu John Kariyil[1], Sanis Juliet[3], Raji, K[4] and Shynu M[5]

[1]Department of Veterinary Pharmacology and Toxicology, College of Veterinary and Animal Sciences Mannuthy, [2] Department of Veterinary Pharmacology and Toxicology, College of Veterinary and Animal Sciences Mannuthy, [3]Department of Veterinary Pharmacology and Toxicology, College of Veterinary and Animal Sciences Pookode, Wayanad, [4]Department of Veterinary Physiology, College of Veterinary and Animal Sciences Pookode, Wayanad, [5]Associate Dean, College of Veterinary and Animal Sciences Mannuthy

Background: In Kerala, there is a habit in small to medium level tea shops to keep the packed milk on top of boilers till they are opened and used. In this context, the present study was undertaken with the objectives of determining whether heating of milk packets cause leaching of contaminant into the milk by gas chromatography mass spectrometry and the effect of detected concentration of TCDD in H 295 R cell lines.

Method: Packaged milk samples (12 brands, 10 lots) were analysed for TCDD content before and after heating for 3 hours using Gas chromatography mass spectrometry. The detected levels of TCDD was then added to H 295 R cells, incubated for 96 hours and then assayed microscopically and RNA isolated , cDNA synthesised and changes in expression of *CYP1A1, CYP11A1* and *StAR* genes were analysed by qRT PCR keeping *GAPDH* as reference.

Results: TCDD was detected in 8 out of 12 samples of milk heated where as it was detected in only two samples without heating. Heating increased the content of TCDD in those samples where it was detected without heating. TCDD was detected from concentrations of 2.097 ng/mL to 32.807 ng/mL. The cells that were exposed to 25 and 25 ng/mL could not proliferate where as from other cells, the expression of *CYP1A1, CYP11A1* and *StAR* genes were upregulated.

Conclusions: From the study, it could be concluded that heating cause leaching of TCDD into fat and it can be cytotoxic and increase the exression of genes like *CYP1A1, StAR* and *CYP11A1*.

Key words: TCDD, H295R, Gas chromatography Mass spectrometry,Milk

POSTER PRESENTATION

06-19

SYNTHESIS OF NANOCERIA AND ITS ANTIBACTERIAL ACTIVITY AGAINST *ESCHERICHIA COLI*

Aishu A, A. Ganesan, P. Periyat*

Department of Environmental Studies, Kannur University,
Mangattuparamba Campus Kannur- 670567
**pperiyat@kannuruniv.ac.in*

Background: Nanoceria (CeO_2) is a prominent semiconducting metal oxide nanomaterial. During the past years, a large number of studies were carried out on aspects such as synthesis, properties and applications of CeO_2 nanomaterials.

Method: The semiconductor CeO_2 sol is successfully synthesized by sol-gel method and powder of CeO_2 nanoparticles were made by calcinations of the sample at 100, 500 and 600°C. The as prepared CeO_2 powder samples were well characterized using XRD, FE-SEM and TEM analysis, further used for measuring the antibacterial activity. Antibacterial activity of CeO_2 against a set of bacteria from environmental water sample and E. coli bacteria from clinical sample using the Kirby Bauer disc diffusion assay method were studied.

Results: The characterization data provided an insight into the application of the nano-material for antibacterial activity. Cerium oxide nanoparticles showed growth inhibition towards set of bacteria and clinical E. coli with notable results.

Conclusion: The complete study demonstrated that synthesized CeO_2 nano powder had antibacterial properties against a group of bacteria from the environmental water sample and clinical E. coli. Out of the three calcined CeO_2 NPs, 500 and 600°C calcined powders showed maximum anti-bacterial activity.

Keywords: Nanoceria, Anti-bacterial Activity, Clinical E. coli

06-20

ISOLATION AND IDENTIFICATION OF CULTURABLE MICROBES FROM THE SEDIMENTS OF KOTTOOLI WETLANDS, KOZHIKODE

Aiswarya P. and Sebastian C. D.

Division of Molecular Biology, Department of Zoology, University of Calicut

Background: Wetland ecosystem serves various important ecological functions, such as controlling flood, serves as breeding ground for several species of fishes, supports a wide range of wildlife. They also filter nutrients, sediments and even serves as sink and detoxify harmful pollutants.

Method: The present study aims at understanding the diversity of cultivable microbes from Kottooli Wetlands, Calicut. The bacterial and yeast isolates obtained were identified based on various morphological, biochemical and molecular methods.

Results: The pH of the sediments varied between 6.5 to 7.2 and temperature ranged from 25–26°C. The CFU per milligram of the sediment (CFU/mg) of the culturable bacteria and yeasts showed considerable difference between the four sites within the wetland. The isolates obtained were grouped. 8 bacterial isolates and 3 yeast isolates were selected from each group and molecular identification was done.

Conclusion: This study clearly indicates the contamination and deterioration of water quality of the wetland owing to unscientific water influx from various sources.

Keywords: Wetland, Sediment microbes, Bacteria, Yeast, Microbial Diversity

06-21

BIO METHANATION POTENTIAL OF ANAEROBIC SLUDGE UNDER DIFFERENT STORAGE CONDITIONS

Akhina M K [1, 2], Haritha K [1, 2] & Krishnakumar B [1, 2]

[1]Environmental Technology Division, CSIR – NIIST, Thiruvananthapuram – 19
[2]Academy for Scientific and Innovative Research (AcSIR), Ghaziabad- 201002

Introduction: Anaerobic digestion (AD) is a commonly practiced method for the stabilization of organic waste and recovery of biogas and organic manure. The discharge slurry (digestate) apart from its manure value, it can be used as start-up inoculum for new biogas plants. However, scientific data on the storage condition and activity during storage are lacking Therefore, the major objective of the present study was to assess the bio-methanation potential of the digestate under different storage conditions.

Method: The discharge slurry collected from a working biogas plant after preliminary characterization, was stored under different periods (two weeks, one month and one year), and under different temperature (room temperature and 4 °C) in liquid form. The 96% moisture containing slurry converted to 30% in solid form through sun drying. One year old slurry was stored only under room temperature. The bio-methane potential (BMP)of the stored sludge was assessed through standard bio-methanation activity test using glucose as substrate. A control was run parallel with freshly collected sludge.

Results: Biogas yield using fresh slurry as inoculum was 535 ml/g VS (glucose). The slurry stored at 4 °C for two weeks produced 520.75 ml/g VS, whereas it declined to 482 ml/g VS with one month storage. At room temperature (30°C), two weeks stored slurry produced 525 ml biogas/g VS, and it reduced to 498 ml/g VS after one month of storage. However, the biogas yield using one-year stored slurry was 463 ml/g VS. The sun dried digestate produced a biogas yield of 225.178±18 ml/ g VS of amylose and it is comparable with the normal.

Conclusions: The present study indicated that storage of anaerobic slurry under room temperature and the biogas plants for long term without feeding (starved condition) having a bio-methanation potential. Therefore, storing the slurry, and its subsequent use can be adopted as a better substitute for cow dung slurry for initiating new biogas plants.

Keywords: Bio methanation potential, Anaerobic sludge, Storage conditions, Sun drying.

06-22

MANGROVE EXTENT OF THRISSUR DISTRICT OF KERALA

Ameen T, Jibin Joseph, Muhammed Afsal, K. A Sreejith, Sandeep S

Kerala Forest Research Institute, Peechi, Kerala 680653

Background: The Kerala state once had 700 sq.km of mangroves along its coast. Human interferences of various types had resulted in the shrinkage of mangrove habitats later. Mangrove patches that still survive are distributed across ten coastal districts of the state. Various studies differed on the total extent of mangrove in the state. Theses discrepancy in the assessment of the extent of mangroves reflected in the district level also, which necessitated the current study of Thrissur district.

Method: Thorough literature review was done to understand the status and extension of mangroves of the study area. Utilising data of previous studies and surveys, marked all the known and possible mangrove locations on Google earth pro. By visiting these locations, patches were verified and marked using GPS. Verified locations plotted using Google earth pro and ArcGIS software. From these maps, area and extension were calculated.

Results: The study revealed a considerable increase in total mangrove cover of Thrissur district compared to earlier investigations, recording 53.49 ha which spread across 173 patches. Patches were recorded form Thaikkad,Sreenarayanapuram, Vellangallur, Puthenchira, Kadappuram, Pavaratty, Orumanayoor, Venkidangu, and Poyya panchayaths and Kodungalloor and Chavakkad municipalities. The largest patch (5.48 ha) recorded was in Kodungallur muncipality.

Conclusions: The increase in extent of mangroves is attributed to various conservation and restoration activities carried out in Thrissur District. Disturbances observed in different regions of the district due to shrimp farming expansions and real-estate activities are a threat to this achieved progress, which needs to be addressed.

Key words: Mangrove cover, Thrissur, Kerala

06-23

STUDY ON THE DIVERSITY OF MYXOMYCETES IN A TROPICAL WET EVERGREEN FOREST ECOSYSTEM, SHOLAYAR, KERALA

K.S Arunkumar, P. Neethu and K.A Sreejith

KSCSTE- Kerala Forest Research Institute, Peechi, Thrissur

Myxomycetes are Protists that produce fruiting bodies like Fungi and are commonly found in high rainfall and humid climatic regions. They have been collected and studied for more than three and a half centuries and during this period they have been variously classified as plants, animals or fungi. As research has been progressed, they have been found to form part of a super group, the Amoebozoa. As on date, 68 genera and more than 1050 species of Myxomycetes are recorded and interestingly, more than 225 species were added during last two decades as new species.Although being a hotspot of biodiversity, the Myxomycetes of tropical forests of Kerala are totally unexplored.The primary objective of this study is to investigate the diversity and distribution of this truly fascinating but little-known group of organisms in species rich tropical wet evergreen ecosystem in Kerala.

As a first step, a long-term monitoring site (10 ha permanent plot) in the wet evergreen forest part of Sholayar reserve forest were selected. The study could record 30 different species of Myxomycetes belonging to 16 genera, 5 different orders and 7 families. Among the 5 orders the most dominant order was found to be Physarales represented 11 species. It is noteworthy that among the 30 species recorded, 10 species are new to Kerala and 14 species are rarely seen from Kerala. Each sampleswere permanently stored in boxes for further detailed study. This collection of Myxomycetes (Slimarium) will the vital information such as scientific name, substratum, place, collection date, collector's name etc. It also creates awareness among people about this less explored group of organisms. This will further act as source for culturing this organism for further studies, including its potential use in different industries such as pharmaceutical.

06-24

TIME SERIES ANALYSIS OF LAND USE/LAND COVER AND LAND SURFACE TEMPERATURE CHANGES OF KOCHI URBAN AREA USING REMOTE SENSING AND GIS

Aswathy Asok[a], A L Achu[b], Girish Gopinath[b], Sabu Joseph[a].

[a]Department of Environmental Sciences, University of Kerala, Kariavattom Campus, Thiruvananthapuram.
[b]Department of Climate Variability and Aquatic Ecosystems, Kerala University of Fisheries and Ocean Studies (KUFOS), Kochi

In order to understand how urbanisation affects the urban thermal environment, the relationship between LU/LC and patterns and thermal characteristics has to be examined. With the help of satellite remote sensing of thermal infrared radiation, the land surface temperature (LST), a highly dynamic quantity that governs numerous terrestrial physical processes, can be measured. The present study took the urban area of Kochi city as the study area for the time series analysis of LU/LC and its impact on LST variations over a period from 1988 to 2022. The LU/LC classification and change detection was done using Maximum Likelihood Classification. The LST was calculated for the period of 18 years using mono window algorithm. The results show that

from 1988 to 2022 there is a significant decrease in vegetation from 352km^2 to 289 km^2. On the other hand, built up have increased from 1988 to 2022 at a steady rate from 63 km^2 to 128 km^2. On the basis of the study, it can be explained that development involves urbanization where most of the vegetation is converted into built up. Besides the result of the study also shows that LST is inverse relation to vegetation. The results also showed that LST for urban area is high compared to other LULC classes. The findings of the study can be used by urban planners to put into practise strategies that can result in a sustainable development.

Keywords: Land Use Land Cover, Land Surface Temperature, Remote Sensing, Kochi, Kerala.

06-25

LAND-USE / LAND-COVER DYNAMICS AND ITS IMPACT ON SURFACE TEMPERATURE AND NORMALISED VEGETATION INDEX IN A RAPIDLY URBANIZING PROVINCE OF THE KOCHI CITY OF KERALA, INDIA

Athulya Tom[1*], Dr. Divya Vijayan V [2,3], Devika T. M.[3]

1. Dept. Silviculture and Agroforestry, College of Forestry, Vellanikkara, Kerala Agricultural University, 2. Dept. Geographic Information System (GIS) and Remote Sensing (RS) , College of Forestry, Vellanikkara, Kerala Agricultural University, 3. Dept. Soil Science and Agricultural Chemistry, College of Agriculture, Vellanikkara, Kerala Agricultural University
**athulyaelizabethtom@gmail.com*

Background: Kochi has undergone lots of land transformations over the years due to the various development projects in the coastal zone. Land Surface temperature (LST) is a physical index of energy exchange between the atmosphere and biosphere. The long-term change detection and monitoring in accordance with spatial and temporal changes by investigating Land use/land cover (LULC), in relation to the variation in land surface temperature (LST), and normalized difference vegetation index (NDVI) are of paramount importance for taking intervention for urban planning in a sustainable way to curtail the rising temperature and escalating declining of vegetations of mangrove and wetlands in regions of Kochi.

Method: The study is comprised of Vypin and Palluruthi block of Kochi with an area of 183.13 sq.km. The LULC of the area was extracted using LISS IV and Sentinel 2A satellite data and was classified to 15 major land use classes. The mean LST and NDVI of the area was retrieved for the periods 2005-2010 and 2017-21 using the Google Earth Engine cloud platform.

Results: The result of the study showed that out of the total study area of 183 sq.km maximum percent change (14.87 %) was noticed in mixed built up class. This class was changed to built up sparse and compact. The compact built up of the area increased from 52.73 sq.km in 2007 to 61.85sq.km in 2021, due to the expansion of the city. There is an observable loss of dense mangrove cover from 5.77 sq. km to 4.04 sq. km. The coastal sand (0.10sq.km) and scrubland (0.32 sq.km) in 2005 has decreased in 2021, due to the various constructional activities near the cost. The LULC classification of the year 2021 showed an overall accuracy of around 91% with a kappa coefficient of 0.89 for the study area. The maximum LST for the period 2005-10 shows an increasing trend when compared with the maximum LST of 2017-21. The NDVI value of the two periods of the study showed a higher value for vegetative cover during 2005-10 compared with 2017-21.

Conclusion: Mangrove vegetation and marshy land act as a buffering agent around the fragile coastline along the Kochi backwater, the loss of dense mangroves and conversion to other land use categories has resulted in low NDVI and higher LST in 2021 compared to 2007, thus LULC changes affects the variation in LST and NDVI in the province of Kochi city.

Keywords: Land Surface temperature, Land Use Land Cover, NDVI.

06-26

EVALUATION OF IN- VITRO ANTI-OXIDANT POTENTIAL OF BIO-FABRICATED ZINC OXIDE NANOPARTICLES USING RED MANGROVE LEAF EXTRACT.

Devika J[1], Anu Gopinath[*1], Aneesha K Alexander[2], Sneha T J[3]

[1]Department Of Aquatic Environment Management, KUFOS, Kochi, 682506, [2]St. Thomas College, Kozhencherry, Pathanamthitta, Kerala 689641, [3]Christ College, Irinjalakuda, Thrissur, Kerala 680125

Background: Nanoparticles, especially metal and metal oxide nanoparticles, are widely used in biomedical, pharmaceutical, environmental, electrical, and other similar technology fields. This necessitated in large-scale production of nanoparticles which can be achieved through green synthesis in an eco-friendly and economical way. Mangroves are a class of bio-entities which are less explored in such studies. As zinc is well known in its antioxidant ability, zinc oxide nanoparticles are to be evaluated for scavenging free radical ions.

Method: Biogenic reduction of metal for synthesising nanoparticle is employed. The green synthesised zinc oxide nanoparticles are done using UV-Visible Spectroscopy, High Resolution Transmission electron microscopy (HRTEM), X-ray diffraction (XRD), and Fourier transform infrared spectroscopy (FTIR) techniques. Further, the in- vitro antioxidant potential of the synthesised nanoparticles was analysed by improved ABTS radical cation decolorization assay.

Results: A UV spectrum obtained at 370 nm confirmed the presence of ZnO NPs. TEM analysis revealed the morphology of the particle as polygonal and XRD revealed the crystallinity of the particles. Capping and stabilisation activity of secondary metabolites through different functional groups in the extract was confirmed by analysis of FT-IR spectra.

In the in- vitro ABTS assay, the IC 50 value of the particle is calculated as 21.6045. When comparing to the IC 50 value of standard Ascorbic acid (IC 50 = 50 µg/ml), the bio- fabricated ZnO NPs have excellent free radical scavenging ability.

Conclusions: Mangrove extract proved as a good bio-entity for the green synthesis of ZnO nanoparticles. These bio-fabricated zinc oxide nanoparticles show great antioxidant potential when tested against ABTS free radical ions. Mangrove based zinc oxide nanoparticle are thus a future hope in medical and pharmaceutical research.

Key words: Bio-fabrication, Zinc Oxide Nanoparticles, Anti-oxidant potential, ABTS assay

06-27

DISTRIBUTION INVESTIGATION OF *Oxytenanthera bourdillonii* Gamble AND *Oxytenanthera monadelpha* (Thw.) Alst TWO LESS STUDIED ENDEMIC BAMBOOS IN KERALA

Krishnapriya K. R, Syam Viswanath, Sreekumar V. B.

Kerala Forest Research Institute, Peechi, Thrissur, Kerala, India – 680653

Background: - *Oxytenanthera bourdilloni* and *Oxytenanthera monadelpha* are the two useful yet underutilized endemic bamboos of Kerala. *O. bourdillonii* is distributed in Kerala parts of Westernghats. It locally known as arayambu and grows on steep precipitous places. *O. monadelpha* is endemic to both India and Srilanka. Locally it known as valleeta. Generally found on the ecotone of evergreen forest. As per CITES report *O. bourdillonii* comes under rare/ threatened category. Distribution and studies of these species is little known so suitable locations for the introduction of these two species need to be explored.

Method: - Identification of bamboo growing area is important for proper planning and management of resources. For identifying natural distribution of these species available clumps from the forest, non forest area in Kerala was surveyed to find the distribution. Occurrence points recorded during field survey, herbarium and from journals. Global positioning system (GPS) has been used to assess suitability of habitat distribution.

Result: - A total of six occurrence points were recorded during field survey. Four locations of *O. monadelpha* from Munnar, Kerala. GPS readings are Latitude 10° 04 ' 24.76". Longitude 077° 05 ' 54.93", elevation 1701m. N 10° 04 ' 01.77" E 077° 03 ' 58.52" (1454m). N 10° 04 ' 17.93" E 077° 03 ' 12.67"(1463m) and N 10° 05 ' 21.48" E 077° 05 ' 06.34" (1590m). Two *O. bourdilloni* locations were GPS recorded. One from chimmini wild life sanctuary N 10° 28 ' 29.62" E 076° 30 ' 24.26"(755m) and the other from Athirapilly Thrissur N 10° 07 ' 51.41" E 076° 41 ' 18.15" (146m). Other locations reported include Kurisumala Kumali Idukki, Ranimedu Nelliampathy Palakkad, Sholayar Thrissur, Vazhachal Thrissur (*O. bourdillonii*). Muthikulam Palakkad, Mundai Wayanad, Singappara palakkad, Silent valley, Pythal mala Kannur, Chembra peak Wayanad, Pakshipadalam Wayanad, Vellarimala Kozhikode, New amarambalam Malappuram, Peringalkuthu thrissur (*O. monadelpha*).

Conclusion: - Endemic species are less studied due to its distribution pattern. Bamboo provides important support to local soil and biodiversity. The gap in literature is may be due to its distribution. *O. bourdilloni* found grow on steep precipitous places and wet rocks of moist deciduous forest of an altitude up to 1300m.*O. monadelpha* found on the ecotone of evergreen forest particularly near streams at an elevation ranging from 800 – 1800m. Much exploration on local distribution and habitat suitability are essential requirement for the conservation of these two endemic species.

Keywords: - Endemic, GPS, CITES, *Oxytenanthera bourdillonii*, *Oxytenanthera monadelpha*, Ecotone.

06-28

DISTRIBUTION OF MANGROVES IN KASARAGOD DISTRICT OF KERALA

Mamatha N.A, Muhammed Afsal, K. A Sreejith, Naveen Unnimenon, Sandeep S

Kerala Forest Research Institute, Peechi, Kerala 680653

Background: Mangroves are found in 10 coastal districts of Kerala. There are previous studies on the distribution and extent of mangroves but there were methodological limitations for precise estimates. Kasaragod is the northernmost district estimated to have 315 ha of mangrove cover in 2014. Therefore, the present study is to have precise updated data on the distribution and extend of mangroves in Kasaragod District.

Method: Details of mangrove habitats in Kasaragod district were collected from Kerala Forest Department, Panchayaths, local people, NGOs and previous studies. Field visits were conducted to the identified mangrove patches. Locations of the mangrove habitats were marked using Global positioning system (GPS). Mangrove distribution maps were made with the help of softwares such as Google Earth pro and ArcGIS10.8.2.

Results: The entire extent of the mangrove cover that spread across 220 patches in the Kasaragod district was assessed to be 124.06ha, which is much smaller than the amount estimated in earlier studies. The large areas under mangrove cover has been noticed in Arikady region of Kumbala panchayath. Mangrove patches were reported from Mangeswaram, Kumbala, Mangalpady, Mogral-Puthur, Valiyaparamba panchayaths of Kasaragod district and from the Kasaragod Muncipality.

Conclusion: The study has find out that there is considerable decrease in the mangrove cover in Kasaragod district compared to earlier estimates. In depth studies are needed for identifying exact reason for this decrease in the extent of mangroves but definitely human disturbance in the form of habitat destruction, pollution could be seen in many of the patches. Hence more efforts are needed for the conservation of existing patches and for the restoration of degraded localities.

Keywords: Mangrove extent and distribution, Mangrove mapping, Kasaragod, Arc GIS

06-29

NANOLAYERED COIR FIBRE –A GREEN MATERIAL FOR THE RECYCLING OF COLOR INDUSTRY WASTE WATER

Mary Lidiya Mathew, Usha K Aravind

School of Environmental Studies, Cochin University of Science and Technology, Kochi, 682022

Background: Nanolayer assembly using Layer by layer (LbL) technique can be regarded as an emerging technology for the separation of organic micro-pollutants from water. Direct assembly of polyelectrolytes (PEs) under LbL mode on natural support material is rare.Adsorption is highly competent water purification and recycling technology that has high demand in colored effluent treatments. LbL can generate super adsorbents based on agrowaste materials.

Methods: A low-cost adsorbent is developed from chitosan (CHI) and polyacrylic acid (PAA) through LbL deposition on coir fiber (CF) by alternate exposure to their aqueous solutions. Their layer dependent formation is characterized by spectroscopic and microscopic techniques.

Results: layered coir fiber (LCF) showed high loading of cationic and anionic dyes both at acidic and alkaline loading pH. Nearly complete removal (~ 99%) is observed at the alkaline pH region. The influence of salts and surfactants in the removal are also illustrated. The coated CF is characterized and its capability in the treatment of real textile industrial effluent is discussed. The chemical stability and reusability are also included.

Conclusion: The present study showed the possibility to utilize LbL modified natural fibers for the treatment of textile dye effluent. The adsorbent we introduced is a new green composite material which has been tested for water treatment for the first time.

Keywords: Nanolayer, polyelectrolyte, textile dyes, Layer by layer, coir fiber, water treatment.

06-30

FOREST CANOPY DENSITY MONITORING AND LAND USE/LAND COVER MAPPING OF PALAPPILLY FOREST RANGE, THRISSUR, KERALA

Merin P. Menachery[1], Habeel Sahal[2], Ashline Shaji[3], Dr. Divya Vijayan V[4], Dr. Srinivasan K[1], Haffis Mohammed[1]

[1]Dept. of Forest Resource Management, College of Forestry, Kerala Agricultural University
[2]Indira Gandhi Open University, Maiden Garhi, New Delhi, [3]Dept. of Forest Products and Utilization, College of Forestry, Kerala Agricultural University, [4]Dept. of Geographic Information System and Remote sensing, College of Forestry, Kerala Agricultural University

Background: The study region of Palappilly forest range of Chalakudy division of Thrissur district, the management and conservation of forest resources are crucial. The findings obtained with the use of Geographical Information System (GIS) and Remote Sensing (RS) data are highly reliable. This study aims to find out the canopy density variations in reserve forest area, changes in density of vegetation through the entire land use system of Palappilly range and to map Land Use Land Cover (LULC) of the study area.

Methods: The study was conducted using satellite data from landsat 9 which was collected from USGS earth explorer. LULC was prepared with classes; forest, tree clad, agriculture, water body, barren land, rocky patches and settlement/ buildings. Advanced Vegetation Index (AVI) and Bare Soil Index (BI) are made using different band. Combining AVI and BI, Vegetation Density Index (VD) calculated. Scaled Shadow Index (SSI) was calculated by scaling Shadow Index (SI). Using the SSI and VD, Forest Canopy Density (FCD) is determined for reserve forest area in the range. Accuracy assessment were done using Kappa coefficient.

Results: The land use/land cover (LULC) of the area is 200.21 sq. km. The result showed that reserve forest covers an area of 56 sq. km. The VD value of forest, tree clad and cultivated agriculture land show increased rate of vegetation density compare to than that of water bodies, barren land, settlements and rocky patches have very low values in VD. Based on the percentage, the entire area was classified into four classes for FCD: very low dense forest, low dense forest, moderate dense forest, and high dense forest. Overall accuracy is 81.25% and Kappa coefficient is.75.

Conclusion: It has been highlighted that the FCD model, which assessed changes in forest canopy density throughout the area in this study utilising RS and GIS technologies, was a time and money efficient approach. This information will form baseline data for further quality assessment studies, policy making and for management plans.

Keyword: Forest Canopy Density (FCD), Geographic Information System (GIS), Vegetation Density Index (VD), Land Use Land Cover (LULC).

06-31

MANGROVE DISTRIBUTION IN ALAPPUZHA DISTRICT OF KERALA

Muhammed Afsal, K A Sreejith, Jibin Joseph

KSCSTE-Kerala Forest Research Institute, Peechi, Thrissur-680653, Kerala

Background: Mangroves are woody trees and shrubs that grow in sheltered estuaries, riverbanks, and lagoons in the tropics and subtropics. Mangrove forests cover an estimated 14.79 million hectares across 113 nations, according to the Global Forest Resource Assessment, 2020, and It is said that Asia has the greatest Mangrove area (5.55 million hectares). Where in India Mangroves occupies 4992 square kilometres, around 0.15 percent of the country's total land area. This study intended to visit each and every mangrove patches in Alappuzha districts of Kerala to understand the extent and distribution of mangroves in the District.

Method: From data which is collected from different sources, the locations with mangrove patches were identified and field visits were conducted to the mangrove sites. Locations of the mangrove habitats were marked using Global positioning system (GPS). The marked GPS data were mapped using Google Earth and ArcGIS software. From the maps, area of mangrove cover in each district were calculated using ArcGIS tools.

Results: The study team visited 658 mangrove patches distributed in the study area and estimated the total extent of Mangroves (143.01 ha) in Alappuzha District. Aroor is the region having larger area under mangrove cover (29.2 ha) in Alappuzha district followed by Chandiroor (16.08ha). Aroor has been noticed with the largest single mangrove patch occupying 3.22ha area. The smallest mangrove patch was seen in Kumajalam region with 0.0033ha.

Conclusion: This study provides an accurate and updated information on the distribution of mangroves in Alappuzha District. The increase in the total extent indicating the success of conservation and restoration effort of mangroves in Alappuzha District which need to be strengthen further.

Keywords: Mangrove cover, Extent and distribution, Global positioning system

06-32

DISTRIBUTION PATTERN AND THREAT FACTORS OF *PSUDOXYTENANTHERA RITCHIEI*, AN ENDEMIC BAMBOO SPECIES, IN KERALA PART OF WESTERN GHATS

Muhsina Moosa[1], Antony C. P[2], M. Amruth[2], and Syam Viswanath[3*]

[1]Department of Forest Genetics & Tree Breeding, [2]Department of Sociology, [3]Director-KFRI
KSCSTE-Kerala Forest Research Institute, Peechi, Thrissur-680653, Kerala

Background: *Pseudoxytenanthera ritchiei* (Munro) H. B. Naithani, is a unique and endemic bamboo species of the Western Ghats with completely solid culms and is widely used in states such as Maharashtra for a variety of localised uses from source of nutrition to utilisation as

structural material in construction. However, the potential of this species remains untapped in Kerala, primarily due to lack of information on its distribution and availability, and secondly due to lack of supply of sufficient quantity for commercial use. This study aims to identify the natural distribution range of the species in Kerala along with the documentation of threat factors.

Method: Information regarding the occurrence of the species was gathered from both primary and secondary sources. A thorough review of published literature using all synonyms of *P. ritchiei* was conducted. As the information on the species was limited to Kasaragod, Malappuram, and Palakkad, surveys were carried out to map the distribution as well as to identify the threat factors.

Results: Extensive field surveys in the districts of Kasaragod, Malappuram, and Palakkad revealed that species were distributed as scattered patches or bamboo groves in forest areas. Around 28 such unreported locations were identified, of which 23 were from forest areas and more sites were identified from the Malappuram district (19). Unsustainable harvesting, damages due to invasive species, habitat loss due to land use changes, low seed set, low germination potential of seeds, various animal interactions and pest attacks were major threats identified in the field

Conclusion: *P. ritchiei* is a rare bamboo species found in small and scattered patches in the forests of the Kasaragod, Malappuram, and Palakkad districts. The constant disturbance and restricted distribution suggest that appropriate conservation strategies, both in-situ and ex-situ, are required to prevent loss of genotypes of the species. Steps must also be taken to encourage propagation outside the forest in order to reduce pressure on the forest while also ensuring a steady supply of resources for commercial activities.

Keywords: *Pseudoxytenanthera ritchiei*, Distribution, Threat factors

06-33

PHYTOLITH DYNAMICS IN CONTRASTING FORESTED SYSTEMS OF AGASTHYAMALA LANDSCAPE IN WESTERN GHATS

Panchami Jaya.,Gayathri A.S., Tomjo C.P., Sandeep S

Sustainable Forest Management Division
Kerala Forest Research Institute, Peechi, 680 653, Thrissur, Kerala, India

Background: Carbon biogeochemically sequestrated within the silica presents an extremely stable form of carbon in terrestrial systems. Plants have an excellent capacity to occlude carbon within the silica, known as phytolith occluded carbon (PhytOC). Owing to their abundance and environmental sensitivity, the use of phytoliths as an environmental indicator has received increasing attention. Specifically, we are trying to figure out the morphotypes of phytoliths under continuous teak cultivations, forest soil and to discuss the effects of soil physicochemical indexes on phytoliths preservation in the soil, such as pH and nutrients changes.

Method: We examined soil phytolith contents and other soil physicochemical properties of soil in southern High Hills. ANOVA was employed to analyse differences in the quantitative characteristics of phytoliths. Phytolith translocation indices were used to determine the phytolith translocation rate in natural soil profiles.

Result: Southern High hills plantation had trapeziform corniculate morphotypes of phytoliths. While the forest showed trapeziform, parallelepipedal, shaped phytoliths, open lands exhibited trapeziform corniculate, shaped phytoliths. The results indicate that there are substantial

differences in translocation rate (T_r) values among the Plantation, forest and open land soils in Southern High Hills. Specifically, the Tr values of total phytoliths for the forest and plantation soils are lower and the Tr values of total phytoliths for open land soils are the largest.

Conclusion: Phytolith is an important way for long-term sequestration of soil organic carbon. Soil phytolith storage is affected by soil physicochemical properties and climate. However, the acid-base level of soil is more important for phytolith preservation. The effects of hydrothermal conditions on the yield and stability of phytoliths on a large spatial scale need to be studied in future.

Keywords : CO2 Sequestration, Phytolith, Soil carbon dynamics

06-34

HISTORICAL CHANGES ON SEDIMENTATION AND INFLUENCE OF ANTHROPOGENIC ACTIVITIES DURING THE LAST THREE DECADES

Praseetha. B.S[*1,2], Tiju I Varghese[*1], Prakash T.N[*1], Bhushan R[*3], Shankar, R[*4]

[1]Marine Geoscience Group, National Centre for Earth Science Studies, Thiruvananthapuram, [2]Cochin University of Science and Technology, Kochi, [3]Geoscience division, Physical Research Laboratory, Ahmedabad, [4]Dept.of marine Geology, Mangalore University, Karnataka

Background: Magnetic parameters in conjunction with the geochemical, textural, and geochronological (Excess Pb-210) data are utilized to demarcate historical changes in the depositional environment in the estuary. However, recent centennial-scale changes are more difficult due to increasing anthropogenic factors, for which the studies are limited. This study reports for the first time the environmental magnetic, sediment texture and major and trace metals geochemistry of the core sediments for the last three decades of the estuary to determine the change in the sediment processes and its linkage to environmental variations.

Method: 1m long sediment core were collected from the barmouth of Beypore estuary using gravity corer. The pretreated samples were analyzed for the texture, major and trace elements and environmental magnetic parameters and geochronology using the instruments PSA, ICPMS and 210Pb dating methods, respectively.

Results: Textural parameters show an increasing trend of fine sediments in the top part of the core. The magnetic parameters and their ratios show a drastic variation from 1995 to 2004 and from 2010 to recent. A 30-year sedimentary record in the Beypore Estuary was examined to elucidate natural and anthropogenic influence on the sedimentation processes in the estuary.

Conclusions: The results indicate that these proxies changed significantly during the last 32 years, with an abrupt change occurring corresponds to the industrial activities of the Beypore/Kozhikode area, in the banks of Chaliyar River. This abrupt change is likely the result of active functioning of Grasim rayon factory at Mavoor. After the closing of Rayon factory, there is an increase in other activities like steel and paint production, tile manufacturing and other small-scale industries which has increased of the terrigenous input and weathering processes may have had a significant influence on the sedimentation process.

Keywords: Environmental magnetism, geochemistry, Beypore, core sediments

06-35

GERMPLASM CONSERVATION OF PALMS (ARECACEAE) FROM THE ANDAMAN-NICOBAR ISLANDS AT JNTBGRI

Rashmi K. A., Nithyamol K. M., Abdul Jabbar M., Joemon Jacob

KSCSTE-Jawaharlal Nehru Tropical Botanic Garden and Research Institute
Palode, Thiruvananthapuram- 695 562

Background: Andaman - Nicobar Islands in the Bay of Bengal is rich and diverse with 2314 angiosperm species. The insular flora is characterized with small gene pools, strict competition, geographical isolation and reduced out breeding pushing them towards endangerment and finally into extinction. Palms are one of the ecologically important, taxonomically diverse component of the flora with 31 species belongs to14 genera of which 17 taxa are under threat category. Various ecological, climatological and anthropogenic threats are prevalent in the region. Under these threats, without effective protection much of the palm species is unlikely to survive, so strategies to promote its conservation outside the islands are needed.

Methods: Periodical exploration trips and collection 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 of the JNTBGRI. Ripened seeds of selected established plants were collected from the field, propagated and distributed to various organizations.

Results: As part of the *ex-situ* conservation, JNTBGRI is presently conserving the germplasm of 21 insular palm species under 10 genera. Of these, 8 species are endemic and 4 each are endangered, critically endangered, vulnerable and 3 are under near threatened category**.** Most of the palms utilized by the inhabitants is identified as a potential resource with economic importance.

Conclusion: The current study reveal details on *ex-situ* conservation of 21 species of insular palms under 10 genera at JNTBGRI. It is found that no serious or organized efforts were made for the conservation of insular species including palms outside the island until 1994 at JNTBGRI.

Keywords: Andaman-Nicobar Islands, Arecaceae

06-36

DEVELOPMENT OF ADSORPTION & DESTRUCT CONCEPT FOR PERCHLORATE REMEDIATION VIA IN-SITU/EX-SITU MICROBIAL REDUCTION

Rothish R Nair[a,b], Jiffin Sam [a,b] , Jasmin G Russel [a,b] , Krishnakumar B [a] and Prathish K P [a*]

*[a]Environmental Technology Division, CSIR NIIST, Thiruvananthapuram -19, [b]Academy of Scientific and Innovative Research (AcSIR), Ghaziabad 201002,*Corresponding author. Environmental Technology Division, CSIR-NIIST, Industrial Estate P.O. Pappanamcode, Thiruvananthapuram, India – 695019*
rothish93@gmail.com

The study reports the development of a functionalized clay-chitosan imprinted flexible carbon cloth material for the efficient sorption of toxic perchlorate from polluted water bodies and its in-situ/ex-site microbial reduction based decontamination process. Perchlorate, a persistent inorganic pollutant is an emerging toxicant and is particularly of concern near explosive/fire

cracker/propellant (NH_4ClO_4) manufacturing units. The modified Mt adsorbent functionalized with surfactant (HDTMA) and chitosan (CTS) was synthesized and imprinted on the flexible carbon cloth to develop the floating sorbent. Experiments were carried out as per Box–Behnken surface statistical design with four input parameters namely adsorbent dose (0.25–0.75 g), initial concentration (10–40 mgL^{-1}), time (30–60 minutes) and pH (3–12). Regression analysis showed good fit of the experimental data to the second-order polynomial model with coefficient of determination (R^2) value of 0.9958. .Applying the method of the optimization of adsorbent dose (0.5 g), initial concentration (25 mgL^{-1}), time (45 minutes) and pH (7.5) gave a maximum of 98.96 % perchlorate removal. Further studies using real contaminated pond water collected from nearest to ammonium perchlorate manufacturing plant could prove its excellent (>99%) perchlorate removal/decontamination potential and fast kinetics (>98 % removal within 45 minutes from 25 mg/L aqueous media). A comparison of in-situ and ex-situ biorgeneration revealed that the ex-situ process is more effective and convenient in terms of regeneration/reusability for the developed floating sorbent system. The developed scavenge & destruct process is an innovative technology for the decontamination of perchlorate and similar endocrine disrupters in pond, reservoirs and ground water sources etc.

Keywords: clay, adsorbent, floating sorbent, Box–Behnken model Bio-regeneration, perchlorate

06-37

GENOMICS AND TRANSCRIPTOMICS FOR CONSERVATION AND MANAGEMENT OF FOREST GENETIC RESOURCES

Paremmal Sarath, Swathi Balakrishnan, Remya Unnikrishnan, Reshma Bhasker T and *Suma Arun Dev

*Forest Genetics and Biotechnology Division, Kerala Forest Research Institute, Thrissur, Kerala 680653, *correspondence: sumadev@kfri.res.in*

Background: Genomics and transcriptomics based research in forest trees has uncovered the genetic composition of many tree species leading to a major breakthrough in forest genetic research. Population genomics has helped in designing proper genetic conservation strategies, resource utilization and climatic resilience while metagenomic investigations of tree associated microbiome have been looked upon for improving the general health and immunity status of forest tree species.

Methods: Draft genome of forest tree species such as *Tectona grandis, Santalum album,* and *Korthalsia laciniosa* were constructed using next generation sequencing (NGS) approach. Further, wood related genes and genome-wide molecular markers were excavated from the genomic database. Transcriptome sequencing of medicinally exploited woody liana, *Coscinium fenestratum,* was performed followed by variant SNP calling to identify gender specific molecular markers. Metagenomic approach was carried out to evaluate the microbiome associated with healthy and infected sandalwood tress to correlate with the general health and immunity status of the trees.

Results: The wood related genes identified from the teak genome provided an insight into the evolutionary history of the cellulose synthase gene family and its role in wood colouration. Genome-wide molecular markers were used to identify the genetic diversity hotspots, gene-ecological zonation, adaptive genetic potential and demographic history with application in timber

forensics. Sex specific SNPs could be identified from comparative transcriptome data of male and female *C. fenestratum,* which was used in early sexing of seedlings for effective restoration programs. Metagenomics of microbiome associated with healthy and diseased *S. album* identified core microbial communities for further research to improve the resistance of trees.

Conclusion: Integrating genomics and transcriptomics with population genetics of forest trees can be used as effective tools in conservation, population restoration and genetic improvement programs. Early sexing can ensure viable population sex ratio for successful reproduction leading to long term survival of endangered dioecious species like *C. fenestratum*. Furthermore, metagenomics can provide an insight into the indicator species, microbial interactions and its influence in general health and immunity of associated tree species.

Keywords: Population genomics, transcriptomics, metagenomics, conservation biology, early sex determination

06-38

DIVERSITY OF ALGAL FLORA ON SPECIAL ROOTS OF TRUE MANGROVES- A CASE STUDY

P Silshalakshmanan and P Sreeja

[1]*Department of Post Graduate Studies and Research in Botany, Sir Syed College, Taliparamba, Kerala*

Background: Mangrove forests are an ecosystem of incredible biological diversity which are tropical and subtropical in distribution. They have specialized aerial root systems to survive in high salinity and anerobic soil. Mangrove roots support diversity of algae as epiphytes on them. These algae are significant as principal primary producer in the mangrove ecosystem, because they are substantial contributors to marine ecosystems. Algae in mangrove wetlands belong to various classes such as Bacillariophyceae, Cyanophyceae, Chlorophyceae, Rhodophyceae, and Xanthophyceae etc.

Method: The selected mangrove wetlands are Nadal, Pattuvam, and Kunhimangalam of Kannur District. Special roots such as pneumatophores, stilt roots, and Knee roots were collected, which were brought to the laboratory, and epiphytic algae separated from them. Microscopic slides were prepared and photographs were taken. Algal identification was done by using standard literatures.

Results: The comparison of epiphytic algal flora from special roots of true mangroves revealed a total of 19 algal genera which belong to Bacillariophyceae (10), Cyanophyceae (4), Cholophyceae (2), Rhodophyceae (2) and Xanthophyceae (1). Pneumatophores support richest growth and diversity of epiphytic algae on them as compared to other special roots. Kunhimangalam study station shows more number of epiphytic algae followed by Nadal, then the Pattuvam.

Conclusion: The present study reports the epiphytic algae from special roots of true mangroves and also observed that the pneumatophores serve as favourable substrata for the rich growth of epiphytic algae**.** Out of the nineteen algal genera identified, eighteen were found in association with pneumatophores. The algal diversity is found to be affected by pollution.

Keywords: Mangrove special roots, Pneumatophores, epiphytic algae.

06-39

BIOSYNTHESIS, CHARACTERIZATION AND MOSQUITO LARVICIDAL EFFICACY OF SILVER AND IRON NANOPARTICLES FROM AQUEOUS EXTRACTS OF *EUPATORIUM ADENOPHORUM* AND *ARTOCARPUS HIRSUTUS*

SUNILA C.T[1] AND **SYLAS V.P.**[1, 2]*

[1]*School of Environmental Sciences, Mahatma Gandhi University, Kottayam, Kerala- 686 560,* [2]*Advanced Centre of Environmental Studies and Sustainable Development, Mahatma Gandhi University, Kottayam, Kerala – 686 560, sylas@mgu.ac.in*

Background: Nowadays bionanoscience has emerged as a favourable research field and making incredible changes in the biomedical as well as agricultural sector. The use of plant species for the synthesis of nanoparticles (NPs) can serve as a substitute to replacing the wide use of toxic chemicals used during synthesis of NPs thereby reducing toxicological impacts caused by discharge of these chemicals into the environment. Climate change, population growth, deforestation and insecticide resistance have contributed to resurgences in mosquito populations leading to a significant outbreak of vector-borne diseases, including malaria, filariasis, chikungunya and dengue across the world. Hence controlling of mosquitoes like vectors are very urgent action of the need. Here, the incorporation of bio-nanoscience as effective tool for the control of vectors like mosquitoes.

Method: The present study focused on evaluating the possibilities of producing and characterizing the biocompatible silver and iron (AgNP and FeNP) nanoparticles using aqueous extract of two local plants, *Eupatorium adenophorum* (EA) and *Artocarpus hirsutus*(AH). And also assessed their potential larvicidal activity against larvae of *Culexquinquefasciatus*. The result demonstrated that both plant aqueous extracts had the metal reducing ability to produce nanoparticles from $AgNO_3$ and $FeCl_3$. The presence of silver and iron nanoparticles were first established bycolour shifts and then characterized by UV-Vis spectroscopy, XRD, HR-TEM, DLS and AFM analysis. The existence of secondary metabolites containing hydroxyl, amine, and carbonyl group as reducing / capping agents was confirmed by preliminary phytochemical tests and FTIR analysis. The larvicidal activity of both biosynthesized AgNP and FeNP and their respective aqueous extracts at different concentrations against mosquito larvae were assessedas per the protocol by World Health Organization.

Results: The result of the studyindicated that the plant mediated and fabricated particles were nanoscale (12-35nm) in size and had a high crystalline nature. The synthesized silver and iron nanoparticles (AgNPs- EA, and AH, FeNPs- EA and AH) displayed considerable anti-larvicidal activity against*Cx. quinquefasciatus*, with LC_{50} values of 2.76 and 2.36 mg/L for AgNPs- EA and AH, and 3.29 and 3.31 mg/L for FeNPs- EA and AH respectively. Furthermore, the result of the study revealed that both types of AgNPs and FeNPs have a distinct concentrationdependent larval mortality. Here,green synthesized silver and iron nanoparticles (EA and AH) were lethal at higher concentrations (20mg/L for AgNPs and 35mg/L for FeNPs) for mosquito larvae.

Conclusions: The overall result concluded that *E.adenophorum* and *A.hirsutus* mediated silver and iron nanoparticles have excellent mosquito larvicidal activity and hence, might be used as an efficient mosquito control tool. Further research including ecotoxicological studies are essential for further improvement and commercial applications.

Key words:*Artocarpus hirsutus*, *Eupatorium adenophorum*, Larvicidal activity, Iron nanoparticle, Silver nanoparticle, *Culex quinquefasciatus*

06-40

DISTRIBUTION OF *LANTANA CAMARA* L., *CHROMOLAENA ODORATA* (L.) R. M. KING AND H. ROBINSON *AND SENNA SPECTABILIS* IN WAYANAD WILDLIFE SANCTUARY, KERALA, INDIA

M. Vishnu Chandran[1], S. Gopakumar[2], K. Harilal[3]

[1,2,3] Department of Forest Resource Management, College of Forestry, Kerala Agricultural University, N.H. 47, Vellanikkara, Thrissur, Kerala 680656, [1]vchandran187@gmail.com,

Background: Invasive species becomes a serious barrier for conservation and sustainable use of biodiversity, with significant undesirable impacts on the goods and services provided by ecosystems. Increase in the number of IAS and their wide extent across the world is homogenizing the world's fauna and flora. The distribution characteristics of selected invasive alien species (IAPS) viz. *Lantana camara*, *Senna spectabilis* and *Chromolaena odorata* in three vegetation types (Plantation, Natural forest and Vayal) of Wayanad Wildlife Sanctuary (WS I and WS II) was studied.

Method: Through reconnaissance survey, five hundred 10 m × 10 m sample plots were randomly selected in each of the three vegetation types. In these 10 m × 10 m sample plots, the crown area was measured to determine the percentage of ground covered by invasive alien plant species (IAPS). This information was then used to illustrate the distribution of the IAPS in question.

Results: In disturbed natural forests, *L. camara* became the dominant understory vegetation (16.83% of the total sampled area was invaded by *L. camara).* Wayanad's degraded fields, pastures, outskirts, and woods that are recovering from logging or fire could serve as a foundation for the growth of *Lantana*. *Senna spectabilis* was mainly distributed along the boundaries of Sulthan bathery-Muthanga ranges and Kaimaram section nearer to Thirunelli RF in WS II and WSII parts respectively. *Senna spectabilis* has invaded about 10.9% of total sampled natural forest in the sanctuary. *Chromolaena* has the highest rate of invasion in Plantation and Wayal. 16.34% of plantations and 30.34 % of Wayals in the Wayamad WLS have been invaded by *Chromolaena*. Mavinahalla and Kurichiat RF were discovered to have high levels of *Chromolaena* invasion.

Conclusion: *Lantana* and *Chromolaena* were distributed all over the sanctuary and it is also creating impacts on the regeneration of native species. Out of the three major IAPS studied in Wayanad WLS, *S. spectabilis* had shown maximum impact on the native species even with less percentage cover it had on the plots than other IAPS. It is now a major management challenge for forest managers all over the globe.

06-41

STUDIES ON THE ENDEMIC AND THREATENED FLOWERING PLANTS OF URUMBIKKARA HILLS, WESTERN GHATS, INDIA

Anoop P. Balan* and Robi A.J.

Bishop Abraham Memorial College, Thuruthicad, Pathanamthitta, Kerala, Pin. 689 597
** Email: anooppb01@gmail.com*

Background: Urumbikkara is an emerging tourist destination near Vagamon in Idukki district of Kerala. These high-altitude hills are located outside protected forest areas and are not been subjected to any detailed floristic studies. The biodiversity-rich hills are under serious threat especially due to illegal encroachments for resort tourism, rock mining and natural calamities. In these scenario, detailed taxonomic studies has been conducted during the period 2019-2022 on the floristic diversity and endemism in Urumbikkkara hills.

Method: Authors conducted repeated seasonal collections of plant specimens from the study area during the year 2019–2022 and the specimens were processed and studied as per standard practices. Herbarium sheets were prepared and are housed at the herbarium in BAM College, Thuruthicad, Pathanamthitta, Kerala (BAM). Identification of each taxon was done with pertinent literature and consultation with experts.

Results: About 124 rare and threatened endemic plants restricted to the Western Ghats-Sri Lankan biodiversity hotspot could be identified during the study from Urumbikkara hills. Out of which about 67% of the plants are confined to the Western Ghats, of which 23 are endemic to Kerala. Among the families Orchidaceae dominates with highest number of endemic plants (15) followed by Lauraceae (13), Leguminosae (11), Balsaminaceae (10) and Melastomataceae (10). Two species, namely, *Aglaia keralana* and *Ixora abrahamia* are described as new species from the study area. *Impatiens megamalayana* is added as a new record to Kerala. Extended distribution of eight recently described taxa including *Goniothlamus keralensis*, *Gymnanthemum sahyadricum* and *Litsea manilaliana* is reported. Seven Vulnerable trees are also documented from the study area.

Conclusion: Urumbikkara hills are very rich in floristic diversity and endemism and are facing severe threat due to anthropogenic activities and natural calamities like flood and landslides. Urgent conservation measures are needed to preserve the remaining floristic diversity of these verdant hills.

Key words: Urumbikkara, Western Ghats, endemism, threatened plants, conservation, new species

06-42

BIOCLIMATOLOGY AND CLASSIFICATION FOR THE RIPARIAN FOREST ECOSYSTEMS OF THE WESTERN GHATS AND ITS IUCN ECOSYSTEM THREAT STATUS ASSESSMENT

Amitha Bachan K.H.

Research Department of Botany, MES Asmabi College, P. Vemballur, Thrissur, Kerala-680671, India, Email: amithabmes@gmail.com

The riparian forests are considered one of the most biodiverse, unique and threatened ecosystems having great extent of human interaction. This has been hardly documented from Indian region

until a comprehensive study initiated in the Chalakudy river basin of the Anamalai part of Western Ghats (Bachan, 2005 & 2010). Champion and Seth (1968) mention it as represented with riparian vegetation of the drier part of India in his revised classification of forest types of India. Our studies on bioclimatology, floristics, phytosociology, biodiversity significance and threats of this unique ecosystem since 2001 brought out a comprehensive understanding of riparian vegetation of the Western Ghats. This paper brings out classification of various riparian vegetation types and subtypes of the Western Ghats along with its bioclimatology defining the niches and threatened status of the ecosystem based on IUCN ecosystem red list criteria for the first time. This has been classified as six major vegetation types under tropical and subtropical forest types based on IUCN global ecosystem typology and again sub divided into 24 subtypes of primary and secondary vegetation adding to the Champion and Seth revised classification of Indian forest types. Bioclimatic parameters of these were elucidated through World clim data base using Species Distribution modelling and standardized with proper ground truthing and field level climatic data. The potential sites across the Ghats are identified and the tropical moist riparian forest assessed as Endangered (EN) ecosystem for the first time based on IUCN criteria.

Keywords: Niche modelling, Wetland, Ecotone, Vegetation

06-43

ANTIMICROBIAL ACTIVITY OF BIOACTIVE COMPOUNDS OF *GANODERMA LUCIDUM IN VITRO*

Mallikarjunaswamy, G. E. *, Princy P. K and Sruthimol Prakash

Department of Forest Pathology, KFRI Sub Centre Nilambur, Malappuram, Kerala-679329
Email: gemswamy@kfri.res.in

Background: Mushrooms are rich sources of bioactive substances with a wide range of chemical configurations. In this regard, isolated chemicals from mushrooms may be helpful in the hunt for novel, highly effective antimicrobial substances. *Ganoderma lucidum*, belongs to the family Ganodermataceae, having an activity of anti-inflammation, anti- oxidation, anti-liver disorder, anti-tumour growth and metastasis.

Method: Fruiting bodies of *Ganoderma lucidum* were collected from KFRI Sub Centre, Nilambur and were identified and extracted by successive solvent extraction method using chloroform and methanol. The antimicrobial activity of *G. lucidum* extract (50µg/ml) against chloroform and methanol were tested against each four species of bacteria and fungi by agar well diffusion method. Bioactive compounds in *G. lucidum*. Bioactive compounds were identified by GC-MS analysis.

Result: The major bioactive compounds present in chloroform extract of *G. lucidum* were 2, 4-Ditert-butylphenoland 1, 4-Dimethoxytetrachlorobenzene whereas the major bioactive compounds present in methanol extract were Tetrachlorohydroquinone dimethyl ether and nonacosane. The inhibition zone diameter of methanolic extracts against different test organisms were ranging from 2mm – 4mm. Where, antimicrobial activity of chloroform extract of fruiting body of *G. lucidum* shows the inhibition zone diameter ranging from 2mm - 7mm.

Conclusions: Among the 4 bacterial strains selected for antibacterial activity *Pseudomonas aerugenosa* shows maximum inhibitory activity against chloroform extract and *Klebsiella pnuemoniane* shows maximum inhibitory activity against methanol extract and among the fungal

strains selected *Penicillium chrysogenum* shows lowest growth in chloroformand methanol extract. This study reveals the pharmaceutical importance of the *Ganoderma* species.

Keywords: *Ganoderma lucidium*, Bioactive compounds, antimicrobial activity & GC-MC

06-44

IMPLICATIONS ON SURFACE WATER - GROUND WATER INTERACTIONS IN VELLAYANI LAKE – A HYDROCHEMICAL AND STABLE ISOTOPIC ASSESSMENT

Jayasooryan K.K[1], Anamika S[1], Smitha V.S[2], Resmi T.R[2]

[1]Training and Outreach Research Group, KSCSTE-Centre for Water Resources Development and Management, Kozhikode, [2]Ecology and Environment Research Group, KSCSTE-Centre for Water Resources Development and Management, Kozhikode

Background: Vellayani lake has great importance for the local community and industrial development (Vizhinjam port) due to the high dependency of its resources. In the present study, we analyzed the physico-chemical parameters along with its stable isotopic characteristics of lake water and ground water from the catchment area of Vellayani lake to understand the impacts of anthropogenic interventions and influence of surface water on ground water and vice versa on the hydrology of the lake.

Methods: Surface water and ground water samples were collected from different locations of the lake and its catchment area and analysed for hydrochemical parameters and stable isotopic composition of H and O.

Results and conclusion: The study indicates the influence of anthropogenic interventions on the quality of water. Hydrochemical and isotopic data of water samples collected from the lake and catchment area indicates the regions of SW and GW interactions, which is mainly confined to the south western regions of the lake. The study is helpful for sustainable use of water from the lake, which is over exploited through domestic and industrial purposes.

Key words: *Vellayani Lake, hydrochemistry, Stable isotopes, SW-GW interactions.*

07 –FISHERIES AND VETERINARY

ORAL PRESENTATION

Student Category

07-1

ASSESSMENT OF LIPID MOBILISATION AND LIVER ENZYME LEVELS DURING EARLY LACTATION IN CROSSBRED COWS

Aleesha[1], **V. Beena.**[2], **Athulya Swaminathan**[3], **Sreekumar T.R** [4], **Uma R**[5].

[1]Department of Veterinary Biochemistry, College of Veterinary and Animal Sciences, Mannuthy, [2] Department of Veterinary Physiology, College of Veterinary and Animal Sciences, Mannuthy

Background: Metabolic parameters of lipolysis and ketogenesis are useful indicators for measuring early lactation stress in cows. The present study focusing on metabolic profiling of early lactating dairy cows which would be of great use in adopting the feeding strategies.

Method: The study was conducted on seven pregnant crossbreed dairy cows in third parity maintained at the College of Veterinary and Animal Sciences, Mannuthy. The study period started from 0-74 days after calving. Biochemical parameters such as β-hydroxyl butyrate (BHB), glucose, Triacylglycerol (TAG), Calcium (Ca), Phosphorous (P), γ-glutamyl transferase (GGT) and Aspartate transaminase (AST) estimated at monthly intervals from 0-5 days, 25-30 days and 45-60 days after calving. Animals were given standard ration and provided with ad libitum water. Milk yield data were collected and lactation curves were plotted.

Results: The overall mean concentration of BHB (0.610 ± 0.026 m*M*/dL), glucose (44.238 ± 0.769 mg/dL), AST (103.733 ± 4.483 mg/dL) and phosphorous (5.876 ± 0.183 mg/dL) did not differ significantly from zero to five days, 25-30 days and 45-60 days respectively in early postpartum period of dairy cows whereas the mean concentration of TAG, Ca and GGT shows significant difference, this may be indicating the nutrient insufficiency, increased Ca demand for milk production and oxidative stress respectively during early lactation. The values of BHB and glucose shown that animals were in positive energy balance during early lactation.

Conclusions: From this study it could be concluded that metabolic profiling would be of great use in ascertaining the feeding strategies already adopted or going for newer interventions. Early detection of metabolic profile will help to identify metabolic and infectious diseases in early lactation.

Keywords: β-hydroxyl butyrate, Calcium, Phosphorous, Triacylglycerol, γ-glutamyl transferees, Aspartate transferase.

07-2

ANTIBACTERIAL EFFICACY OF GREEN SYNTHESISED SILVER-ZINC OXIDE NANOCOMPOSITES AGAINST MULTI-DRUG RESISTANT NON-TYPHOIDAL *SALMONELLA* SPP.

P. R. Arya[a], P. M. Abishad[a], L. John[c], Asha K[a], Prejit[a], S. Juliet[d], V. K. Vinod[a], J. Vergis[a]*, N. V. Kurkure[e], S. B. Barbuddhe[b], K. Byrappa[f], and D. B. Rawool[b]

[a]Department of Veterinary Public Health, College of Veterinary and Animal Sciences, Pookode, KVASU, Wayanad- 673 576,[b]ICAR- National Research Centre on Meat, Hyderabad- 500 092, [c]Department of Veterinary Biochemistry, College of Veterinary and Animal Sciences, Pookode, KVASU, Wayanad- 673 576, [d]Department of Veterinary Pharmacology and Toxicology, College of Veterinary and Animal Sciences, Pookode, KVASU, Wayanad- 673 576, [e]Department of Veterinary Pathology, Nagpur Veterinary College, Nagpur- 440 006[f]Centre for Research and Innovations, BGSIT, Adichunchanagiri University, B.G. Nagara, Mandya, Karnataka itzjessvergis@gmail.com

Background: Non-typhoidal *Salmonella* spp. (NTS) constitutes one of the most versatile and resilient enteric pathogens known to have evolved a variety of survival mechanisms within the host system. Recently, multi-drug resistant (MDR) strains of NTS have emerged as a significant public health concern due to the diminishing antibiotic discovery pipeline, which demands novel alternative therapeutics.

Materials & methods: The present study attempted the biosynthesis and characterization of silver-zinc oxide nanocomposites (Ag/ZnO NCs) using methanolic extract of stem and leaves of *Curcuma longa*. The *in vitro* antibacterial efficacy of Ag/ZnO NCs was evaluated against MDR-NTS strains using micro-broth dilution technique. Later, Ag/ZnO NCs were assessed for their stability (high-end temperatures, physiological concentration of cationic salts, proteases, and pH); safety (chicken RBCs), and effect on gut beneficial microflora (*Lactobacillus acidophilus, L. plantarum,* and *Paediococcus acidilactis*).

Results: The UV-Vis spectroscopy suggested the green synthesis of Ag/ZnO NCs, which was further confirmed by FTIR analysis. The TGA/DTA revealed thermal stability of Ag/ZnO NCs, while PXRD analysis confirmed the face-centered cubic and hexagonal wurtzite structures of Ag and ZnO nanoparticles, respectively. Further, FE-SEM analysis confirmed the agglomerated polycrystalline morphology of Ag/ZnO NCs with a characteristic spherical shape (31.34±1.27 nm) in TEM analysis. The green synthesised Ag/ZnO NCs exhibited a minimum inhibitory concentration and minimum bactericidal concentration of 31.25 µg/mL and 62.50 µg/mL, respectively against the test strains. In addition, the Ag/ZnO NCs was tested stable at MIC concentration; however, a two-fold rise in the MBC value was detected. Besides, Ag/ZnO NCs tested safe with chicken RBCs; moreover, the beneficial gut microflora was not inhibited.

Conclusion: Overall, this study revealed the antibacterial potential of green synthesized Ag/ZnO NCs, which might be employed as an alternative therapeutic candidate.

Keywords: Ag/ZnO NCs; Antimicrobial resistance; *Curcuma longa*; green synthesis

07-3

ANTIBACTERIAL AND ANTIBIOFILM POTENTIAL OF A RECOMBINANTLY EXPRESSED ANTIMICROBIAL PEPTIDE BETA-DEFENSIN FROM SNAKEHEAD MURREL *CHANNA STRIATA* (BLOCH, 1793) AGAINST AQUATIC PATHOGENS

Athira P P[1], Anooja V V[1], Anju M V, Archana K[1], Neelima S[1] & Rosamma Philip[1*]

[1]Dept. of Marine Biology, Microbiology & Biochemistry, Cochin University of Science and Technology, Cochin- 16.

Background: Antimicrobial peptides (AMPs) are considered as a vital element of innate immunity providing the first line of defense against wide range of pathogens. Fishes are always exposed to microorganisms and are susceptible to infections in case of water quality deterioration. Indiscriminate use of antibiotics would lead to the development of drug resistance in microorganisms. Present study deals with the characterization of a potential antimicrobial peptide, Beta-defensin from snakehead murrel *Channa striata.*

Method: Live and healthy *Channa striata* was collected from Prakriti fish farm, Kerala and transported to laboratory in live condition. Total RNA was extracted and converted to single stranded cDNA by reverse transcription. Amplification of beta-defensin antimicrobial peptide from cDNA of *Channa striata* was done using beta-defensin primers and cloned in *E. coli* DH5 α using pGEM-T Easy cloning vector. Recombinant plasmid was isolated and sequenced at Agrigenome Kochi. The novel beta-defensin was recombinantly expressed in *E. coli* Rosetta-gami™ B (DE3) pLysS using pET 32a+. Broth microdilution assay was performed to analyze the antibacterial activity of recombinant peptide against aquatic pathogens viz., *Aeromonas hydrophila*, *Pseudomonas aeruginosa*, *Edwardsiella tarda*, *Vibrio harveyi*, *Vibrio parahaemolyticus* and *Vibrio proteolyticus.* Bacterial viability was tested by Syto9/ Propidium iodide staining. Reactive oxygen species production potential and bacterial membrane depolarization ability was analyzed. Biofilm inhibition potential was identified by quantification of biofilm biomass, exopolysaccharide production and inhibition of quorum-sensing genes by real-time PCR analysis.

Results: A 189 base pair fragment encoding 63 amino acid residues was amplified from the complementary DNA and was termed as *Cs*Def. Homologous sequence analysis showed that *Cs*Def belongs to beta-defensin family and shares sequence identity with other fish defensins. The recombinant peptide, *Cs*Def showed notable inhibition against all the tested pathogens. Mode of action of *Cs*Def was identified as membrane disruption, membrane depolarization and reactive oxygen species production. Inhibition of exopolysaccharide production. anti- quorum sensing activity and disintegration of mature biofilm confirmed the antibiofilm potential of *Cs*Def.

Conclusions: Beta-defensin antimicrobial peptide *Cs*Def identified from *Channa striata* could be recombinantly expressed in a prokaryotic host *E. coli* Rosetta-gami. The recombinant peptide exhibited significant activity against aquatic pathogens and also inhibited biofilm formation. This molecule provides a new avenue for the development of future therapeutic agents against aquaculture pathogens.

Keywords: - Innate immunity; Antimicrobial peptide; Beta-defensin; *Channa striata*; Aquatic pathogens

07-4

PROTECTIVE EFFICIENCY AND IMMUNE RESPONSE OF A FORMALIN-INACTIVATED VACCINE AGAINST *VIBRIO ALGINOLYTICUS* INFECTION IN ASIAN SEABASS (*LATES CALCARIFER (BLOCH, 1790)*)

Azhar Shahansha T. S[a]*, Pradeep M. A[a], P Ramesh Kumar[b], Sanil N. K[a].

[a]Central Marine Fisheries Research Institute, Ernakulam North P.O, Kochi 682018, [b]Mandapam Regional Centre, Central Marine Fisheries Research Institute, Mandapam Camp, Tamil Nadu, azharshahansha@gmail.com: 9846927822.

Background: Asian sea bass (*Lates calcarifer*) one of the most commercially important fish species for cage aquaculture in Southeast Asia. Several microbial pathogens infect Asian seabass at different stages of its lifecycle resulting in different bacterial and viral diseases. *Vibrio alginolyticus*, a Gram-negative motile rod bacterium, causes vibriosis, a devastating fish disease prevailing in worldwide aquaculture. However use of antibiotic to prevent such diseases has led to increasing public health concerns. In this context, prophylactic methods like vaccination is a power tool for preventing fish diseases. Vaccines based on inactivated bacterial pathogens are proven to be quite efficacious in fish.

Methods: In this study formalin-killed vaccines (FKVs) based on adjuvants and FKVs generated from *V. alginolyticus* alone were administered as the primary intra-peritoneal vaccines. We investigated the antibody response kinetics, anti-bacterial activity and lysozyme activity of the Asian seabass blood serum at 7, 14, 21 Days of Post vaccination (DPV). The efficacy of vaccines was subsequently evaluated by an experimental challenge with *V. alginolyticus*.

Results: A pivotal observation was that the FKV vaccine highly protected the seabass from a *V. alginolyticus* strain challenge after 21 DPV with relative percentage survival values of 90% and 80% for FKV with adjuvant and FKV without adjuvant respectively. At 14 DPV, antibody titers were markedly increased in the fish that had received the vaccine, and after that they began to decline. Additionally, fish exhibits robust lysozyme activity at 14 DPV and significantly decreases by 21 DPV. The mean bacterial count in the initial groups not significantly different from the mean bacterial counts in the non-vaccinated group at different sampling points. The immunological mechanism underlying this has to be clarified by additional research.

Conclusion: The current results conclude that, formalin killed Vibrio vaccines provoked a promising protection against vibriosis in Asian seabass. Furthermore, a reduction of antibody level & lysozyme activity that occurred at 21 DPV after the vaccination, suggested that booster immunisation is necessary to obtain a strong antibody response in fish.

Keywords: Asian seabass, *Vibrio alginolyticus*, formalin inactivated vaccines, adjuvant, RPS, Immune response.

07-5

SEAWEED-MICROBE SYMBIOSIS: A POTENTIAL ORIGIN OF BIOACTIVE LEADS

Chesvin Varghese[1,2,*], Kajal Chakraborty[1]

[1]Central Marine Fisheries Research Institute, Ernakulam North, Cochin-682018, Kerala,[2]Amrita Vishwa Vidyapeetham, Kollam-690525, Kerala State, India.
E-mail address: chesvinvarghese1998@gmail.com (Chesvin Varghese).

Background: Researchers are looking for new conditions to produce prospective anti-infective drugs due to the emergence of drug-resistant microorganisms and the necessity for novel potential agents. The extreme marine conditions drove the bacteria associated with marine macroalga to adapt and biosynthesize potential bioactive compounds.

Methods: Seaweed-associated heterotrophic bacteria were isolated, and their potential as antibacterial and pharmacological agents were examined. Furthermore, morphological, biochemical, and molecular approaches were used to characterize the chosen bioactive isolate *Bacillus atrophaeus* SHB2097. PCR amplification was used to analyze specific *nrps* and *pks*-I genes in addition to antibacterial and hemolytic profiles. Using an in vitro hemolytic assay, the pathogenicity of the isolate was determined, and the presence of pore-forming non-hemolytic enterotoxins and hemolysin genes was evaluated. The ability to produce siderophores, antibacterial activity as well as pharmacological properties of the organic extract *B. atrophaeus* SHB2097 were assessed. Pharmacological activities of crude extract, such as anti-inflammatory, antioxidant, antihypertensive, anti-hyper cholesterolemia, and antidiabetic activities, were monitored. Spectroscopic features of the solvent extract of *B. atrophaeus* SHB2097 were evaluated by a proton nuclear resonance spectroscopic (1H NMR) study.

Result: *B. atrophaeus* MW82179, exhibiting a zone of inhibition of 30 mm on the spot over lawn assay and antioxidant activity, was chosen for bioprospecting studies (GenBank accession number MW82179). Significant anti-infective activity was observed with bacterial organic extract against clinically important multidrug-resistant pathogens with MIC 6.25 µg/mL and comparable to the antibiotic agents' chloramphenicol and ampicillin. Genes of type-1 *pks* (MZ222383, 700 bp) and hybrid *nrps/pks* (MZ222389, 1000-1400 bp) of *B. atrophaeus* MW821482 could be amplified. The bacterium possessed genes (1000-1400 bp) involved in biosynthesizing siderophore-class molecules (MZ222387 and MZ222388). The bacterium displayed susceptibility to the commercially available antibiotic agents and was negative for the pore-forming non-hemolytic hemolysin BL (*hbl*) and enterotoxin (*nhe*) toxins; therefore, it was not pathogenic. Organic extract of *B. atrophaeus* SHB2097 revealed promising inhibition potential against cyclooxygenase-2 (IC_{90} 53.26 µg/mL) and 5-lipoxygenase (IC_{90} 9.74 µg/mL). The carbolytic enzyme α-glucosidase inhibition potential of the organic extract of the studied heterotrophic bacterium was significantly greater than (IC_{90} 118 µg/mL) than that displayed by acarbose (IC_{90} 645 µg/mL, $p < 0.05$). The implementation of nuclear magnetic resonance-based fingerprinting emphasized the assessment of the distinctive signals in the solvent extracts and their correlation of them with the pharmacological properties.

Conclusion: The heterotrophic *B. atrophaeus* SHB2097 could be used to develop possible therapeutic and biomedical agents.

Keywords: Seaweed-associated heterotroph, *Bacillus atrophaeus* MW821482, antimicrobial, drug-resistant pathogens, polyketide synthetase, pharmacological properties, anti-inflammatory

07-6

ANTIPROLIFERATIVE EFFECT OF METHANOLIC EXTRACT OF *SARACA ASOCA* BARK AND ITS POSSIBLE TARGETS OF ACTION

Devu B Nair[1*], Sujith S[2], Roshni S.S[3]., Sneha, G[3]. and Nisha A R[4]

[1]Department of Veterinary Pharmacology and Toxicology, College of Veterinary and Animal Sciences, Mannuthy, Thrissur- 680651, [2]Department of Veterinary Pharmacology and Toxicology, College of Veterinary and Animal Sciences, Mannuthy, Thrissur- 680651, [3]Department of veterinary Biochemistry, College of Veterinary and Animal Sciences, Mannuthy, Thrissur- 680651, [4]Department of Veterinary Pharmacology and Toxicology, College of Veterinary and Animal Sciences, Mannuthy, Thrissur- 680651

Background: Use of phytochemicals as anticancer drugs have gained attention in scientific and industrial approaches. In this context, the present study was undertaken with the objective of determining the antiproliferative effect of methanolic extract of *Saraca asoca* bark in C127I cell line and its possible targets of action by *In silico* analysis.

Method: Methanolic extracts of *S. asoca* bark was assessed for their cytotoxicity in C127I cell line by 3-(4,5-dimethyl thazol-2-yl)-2, 5-diphenyl tetrazolium bromide (MTT) assay at concentrations of 320, 160, 80, 40 20 and 10 µg/mL and the half maximal inhibitory concentration (IC50) was calculated using Graph Pad Prism 5.0. The cells were seeded in 6 well plates at a concentration were treated for 24 hours with extract of *S. asoca* bark at IC50 concentration. The cells were trypsinised and subjected to Acridine orange - Ethidium bromide staining (AOEB) staining for morphological evaluation of apoptosis. Fourier transform infrared (FTIR) spectroscopic analysis was performed to identify the chemical nature of the extract. Insilico analysis was done for the affinity of various phytochemicals in the extract towards Caspase and BCl_2 proteins.

Results: Dose dependent reduction in cell viability was noticed when the cells were subjected to different concentrations of the extract and IC50 value of *S. asoca* was found to be 16.55 µg/mL. AO/EB staining detected proliferating cells with green fluorescence in the control cells whereas the cells with *S.asoca* extract showed dose dependent shift from orange to red fluorescence indicating apoptosis in treated cells. Ellagic acid present in the extract was found to be have maximum affinity towards BCL_2 and Capsase proteins

Conclusions: From the study, it could be concluded that methanolic extract of *Saraca asoca* was found to possess antiproliferative effect.

Key words: *S. asoca*, C127I, FTIR

07-7

DIETARY INCORPORATION OF SARASWATHA GRITHAM RESIDUE ON GROWTH PERFORMANCE OF MALABARI KIDS

G. Seshidhar, Biju Chacko, S. Senthil Murugan, Deepa Ananth, Ajay P. Kuriakose, Ambili K

Kerala Veterinary and Animal Sciences University, College of Veterinary and Animal Sciences, Pookode, Wayanad

A study was conducted to assess the effect of dietary incorporation of Saraswatha gritham residue on growth performance, nutrient utilisation and techno economics of production in Malabari kids. A feeding trial of 90 days duration was conducted in fifteen Malabari kids, divided into three

groups of five each, as uniformly as possible with regard to body weight, sex and age and randomly allotted to three groups and fed on isonitrogenous and isocaloric rations, T1, T2 and T3, without and with 10 and 20 per cent Saraswatha gritham residue, respectively. The average daily gain and total average weight gain of kids were 41.02, 43.67, 36.91 g per day and 3.69, 3.93, 3.32 kg, respectively in groups T1, T2 and T3 were similar (P>0.05) statistical analysis of the data showed that the FCE was similar (P>0.05).

The results of digestibility coefficients of nutrients obtained in the present experiment reveal that T2 had a significantly higher (P<0.01) digestibility coefficient of CP than T1 and T3, with the latter two being similar among themselves (P>0.05); while the NFE digestibility of T2 was significantly higher (P<0.01) than T1 and T3, with T3 being significantly higher (P<0.01) than T1. The CF, EE and NDF digestibility of T2 was significantly higher (P<0.01) than T1 and T3, with T1 being significantly higher (P<0.01) than T3. The digestibility coefficients of DM and ADF of T2 was significantly higher (P<0.01) than T3, even though T2 and T3 were lower (P<0.01) than T1. . The cost per kg body weight gain was Rs. 244.50, 202.38 and 214.04 for kids in groups, T1, T2 and T3, respectively. It can be seen that better results could be achieved at 10 percent level of incorporation

07-8

COMPARISON OF WHOLE BLOOD TRANSCRIPTOME PROFILES OF HIGH AND LOW MILK PRODUCING CROSSBRED CATTLE OF KERALA

Haritha B. Pillai*, Naicy Thomas, T.V. Aravindakshan, Elizabeth Kurian

Department of Animal Genetics and Breeding, College of Veterinary and Animal Sciences, Mannuthy-680651, Kerala Veterinary and Animal Sciences University, Pookode, Wayanad

Background: Milk production is the most important economic trait in dairy cattle. Whole blood transcriptome profiling and comparison in high and low milk producing crossbred cattle, would unravel the biological differences in the pathways and functions related to differences in milk production.

Method: High throughput RNA sequencing (RNA-seq) was used to generate the bovine blood transcriptome of three high and low milk producing crossbred cattle and to investigate the variation of gene expression in the blood transcriptome profile associated to the milk production traits.

Results: A total of 295 genes were differentially expressed significantly between high and low milk producing crossbred cattle ($p \leq 0.05$), of which 82 transcripts were upregulated and 213 were downregulated in high milk producing crossbred cattle compared to low milk producing crossbred cattle. Gene ontology (GO) analysis demonstrated that the differentially expressed genes (DEGs) were enriched in specific biological processes with regard to inflammatory process, cell adhesion, positive regulation of cytosolic calcium ion concentration and immune response. The KEGG pathway analysis with 295 DEGs revealed that the most statistically significant metabolic pathways were related to toll-like receptor pathway, cytokine-cytokine receptor interaction and phosphatidyl inositol signalling system. The enrichment analysis also revealed that specific metabolic and immunological pathways are related to cattle milk yield traits. The result was validated using ten selected DEGs by qPCR, and the expression patterns were consistent with the deep sequencing results obtained by RNA-Seq.

Conclusion: Thus, the study provided a non-invasive method to identify the DEGs in cattle blood using RNA-seq for milk production. The results will provide valuable resources for biological research in cattle milk production, also helps to understand the relationship between milk production and immune function.

Keywords: Differentially expressed genes, milk yield, RNA-seq, whole blood

07-9

IDENTIFICATION OF BIOACTIVE ISOLATE FROM MARINE MACROALGAE

Shanoona K[1,2,*], Kajal Chakraborty[1]

[1]Central Marine Fisheries Research Institute, Ernakulam North, Cochin-682018, Kerala, [2]College of Agriculture, Vellayani, *Corresponding author. she18shanu@gmail.com

Background: Microbial communities associated with seaweeds are exceptionally diverse and abundant source of bioactive substance with remarkable molecular structure, which could be a potential candidate for biotechnological and medicinal applications.

Methods: Samples of marine seaweed-associated bacillus were collected at low tide from Mandapam and Vizhinjam. Heterotrophic bacteria associated with seaweeds were isolated using culture dependent method, and their antibacterial and antioxidant activity were primarily assessed by spot over lawn assay and the DPPH- Filter Paper assay. The bacterial isolates with remarkable antibacterial potential had been characterized via microbiological and biochemical experiments. The strains were identified using 16S rRNA gene sequencing. Antibiotic sensitivity of the selected bacterium chosen via spot-over-lawn assay and performed with commercially obtainable antibiotic-infused octadiscs. The bacterial growth kinetics of the selected isolates was carried out. Pathogenicity was assessed by *in vitro* haemolytic assay and presence of pore-forming non-haemolytic enterotoxin and haemolysin genes were analysed.

Results: The two most active strains, *B. siamensis* SUB12205505 and *B. velezensis* SUB12205577 (GenBank accession number OP715894 and OP715891 respectively), isolated from the seaweed *Turbinaria conoides* and *Dictyota cervicornis*, exhibited an inhibition zone of more than 25 mm on spot-over-lawn assay, was chosen for further bioprospecting research. The 16S rRNA gene sequencing led to species identification as *B. siamensis* and *B. velezensis,* exhibiting 99% similarity with other GenBank sequences in BLAST search. The selected isolates were found to be susceptible to the commercially available antibiotic agents. These isolates were negative for the presence of pore-forming non-haemolytic haemolysin BL (hbl) and enterotoxin (nhe) genes, and haemolysis on blood agar. Therefore, was not pathogenic. Consequently, the active seaweed associated heterotrophic isolates could be used as a potential source of bioactives.

Conclusion: The marine symbiotic bacteria *B. siamensis* (SUB12205505) and *B. velezensis* (SUB12205577) serve as a potential therapeutic candidate to develop microbial products with wide pharmaceutical and biotechnological application.

Keywords: Seaweed associated heterotrophic bacteria, Polyketide, Pore-forming non-haemolytic haemolysin, Enterotoxin.

07-10

ANTIPROLIFERATIVE EFFECT OF METHANOLIC AND AQUEOUS EXTRACTS OF *DURANTA ERECTA* IN C127I CELL LINE

Sherin Thomas[1], Rohit Mohanan[1], Sujith S[2], Roshni S.S.,[3] Sneha G[3] and Nisha A. R[4]

[1] Department of Veterinary Pharmacology and Toxicology, College of Veterinary and Animal Sciences Mannuthy, [2]Department of Veterinary Pharmacology and Toxicology, College of Veterinary and Animal Sciences Mannuthy, [3] Department of Veterinary Biochemistry, College of Veterinary and Animal Sciences Mannuthy, [4]Department of Veterinary Pharmacology and Toxicology, College of Veterinary and Animal Sciences Mannuthy- 680651

Background: Plants are good source of new drug development and use of phytochemicals in the therapy of cancer is a growing field in drug development. In this context, the fruits of *Duranta erecta* were assessed for its cytotoxic potential in C127I cell lines.

Method: The shade dried fruits of *D. erecta* was extracted using methanol and water and used for qualitative phytochemical analysis. The extract was assessed for its cytotoxicity by MTT dye reduction assay in C127 I cells maintained using DMEM and 10 per cent foetal bovine serum at concentrations of 320, 160, 80, 40, 20, 20 and 5 µg/mL and the percent cell inhibition and IC_{50} were calculated. The cells were subjected to Acridine Orange/Ethidium bromide staining to find out the possible mechanism of toxicity.

Results: There was a dose dependent inhibition of cell proliferation when the C127I cells were subjected to different concentration of the extracts. The IC_{50} value of the methanolic and aqueous extracts was found to be 44.66 and 41.58 µg/mL respectively. The effect was comparable to doxorubicin. Acrdine Orange/ Ethidium bromide staining revealed cells with orange to red fluorescence in the extract and doxorubicin treated cells indicating apoptosis. whereas there was greenish fluorescence in the control cells.

Conclusions: From the study, it could be concluded that aqueous and methanolic extracts of *D. erecta* indued apoptosis at their IC_{50} concentrations

Key words: D. *erecta*, C127I, MTT assay, Apoptosis

07-11

SEAWEED-ASSOCIATED HETEROTROPHIC BACTERIA AS NOVEL SOURCES OF PHARMACOLOGICAL AGENTS

Sumayya Asharaf[1, 2], Kajal Chakraborty[1]

[1]Marine Biotechnology Division, Central Marine Fisheries Research Institute, Ernakulam North P.O., P.B. No. 1603, Cochin-682018, Kerala, [2]Faculty of Marine Sciences, Lakeside Campus, Cochin University of Science and Technology, Cochin, Kerala, Corresponding author.sumayyaasharaf95@gmail.com*

Background: Marine microorganisms are exposed to the harsh oceanic environment, letting them develop an extraordinary capacity to biosynthesize bioactive constituents with unique properties. The coexistence of various microbes on top of the same surface, such as seaweed-associated heterotrophic bacteria, led them to produce promising bioactive compounds possessing anticancer, anti-inflammatory, antibacterial, antidiabetic, and antihypertensive properties, pointing them as superior pharmacological candidates.

Method: This work envisaged isolating the bacterial inhabitants allied with the intertidal seaweed and assessing their bioactive properties against selected pathogens, and various in vitro assays were performed. Seaweed-associated heterotrophic bacteria were isolated, characterized, and analyzed for the functional *pks-I* genes. The pharmacological activity of heterotrophic bacteria coupled with its ability to produce a siderophore, spectroscopic fingerprinting analysis of the organic extract of heterotrophic bacteria, and anti-cancer properties of heterotrophic *B. altitudinis* were performed.

Results: A total of 127 bacteria associated with various seaweeds belonging to Chlorophyceae, Rhodophyceae, and Phaeophyceae were isolated, and preliminary screening showed that 57 of those (~45%) were endowed with significant antibacterial properties. 23 of the isolates could tolerate consequent laboratory sub-culturing and maintain their bioactivity. Seven of the total twenty-three isolates displayed potentially higher antimicrobial potential than others. Among them, the strains *B. tequilensis* and *B. altitudinis* (deposited as MTCC 13043 and 13046, respectively) belong to the family *Firmicutes* and are isolated from the brown algae *Sargassum wightii*, showed significant antagonistic properties against pathogens including MRSA, with an inhibition zone of ≥ 30 mm. The *pks* gene amplified from *B. tequilensis and B. altitudinis* (Genbank accession number; (MW027664 and MW027660) showed similarity to type-I *pks*. *B. altituidnis* with Fe^{2+} ion chelating potential (IC_{50} 112 µg/mL), and biosynthetic gene was amplified for bacillibactin (MW481324) and enterobactin (MW481325). MIC of organic extract of *B. altitudinis* and *B. tequilensis* was 6.25- 12.5 µg/mL against *Vibrio parahemolyticus*. The organic extract of *B. altitudinis* MTCC13046 displayed significantly greater radical quenching ability (IC_{90}133 µg/mL) other than attenuating hydroxymethyl glutaryl coenzyme A reductase (hMGCR, IC_{90} 10.21 µg/mL) and relative to other studied heterotrophs. The organic extract of *B. tequilensis* MTCC13043 displayed significantly greater attenuation potential against pro-inflammatory 5-lipooxygenase (IC_{90} 5.94 µg/mL). Nuclear magnetic resonance spectroscopic fingerprint analysis was used to correlate the distinctive signals in the crude extracts with pharmacological activities. The bacterial extract of *B. altitudinis* showed anticancer properties in a dose-reactive form against HepG2 (IC_{50}, half maximal inhibitory concentration ~ 29.5μg/ml) on tetrazolium bromide analysis with less significant cytotoxicity on common fibroblast (HDF) cells (IC_{50}~ 77μg/ml). The results of the apoptosis assay showed that the crude extracts of *B. altitudinis* maintained 68% viability in normal cells compared to 11% in the cancer cells (IC_{50} 76.9μg/ml). According to the findings, *B. altitudinis* MTCC13046 could be used to develop prospective anticancer agents. Thus, the seaweed-associated *B. altitudinis* MTCC13046 and *B. tequilensis* MTCC13043 could be used to develop promising pharmacological leads.

Conclusion: The present study reported the pharmaceutical potential of the organic extracts of seaweed-associated heterotrophic bacteria belonging to the phylum *Firmicutes*.

Keywords: Seaweed-associated heterotrophic bacteria, *antimicrobial,* pharmacological properties, anticancer property, human hepatocellular adenoma-carcinoma, nuclear magnetic resonance spectroscopy.

07-12

INTEGRATION OF MUSSEL, *PERNA VIRIDIS*, WITH CAGE AQUACULTURE AIMING DOUBLING THE INCOME: A CASE STUDY AT MOOTHAKUNNAM

Sunithakumari.K[1,2]*, Shoji Joseph[1], Priya N.P[1,2], Smina M.S[1,2] ,Ajithkumar P.B[1,2]

*[1]ICAR Central Marine Fisheries Research Institute, Post BoxNo.1603, Ernakulam North P.O., Kochi-682018, Kerala, [2]CUSAT, Cochin, Kerala, *sunithasreevilasam@gmail.com*

Background: The new cage design and efforts of CMFRI during last decade considerably boomed the cage fish farming throughout Kerala. In cage farming fishes are growing in the natural water resources while being enclosed in net cages with *ad-libitum* feeding. Therefore, the nutrients and organic loads from feed waste, fish excreta etc. from the cages increases the organic loads in surrounding water. Green mussel, *Perna viridis*, farmed in India since 1970s onwards. *P. viridis* can be cultivated without any additional costs except the seed costs in cages providing more benefits to farmers. *P. viridis* is a filter feeder and they can feed on the excess organic matter coming from the feed waste and excreta of the fishes if they could associate with the cages apart from the planktonic food. Considering these aspects, the present study is planned to integrate cage fish farming with mussels aiming to increase the profit of the farmer while managing water quality parameters by feeding the organic matter. Investigations are made on the growth performance of green mussels while integrating with the cage aquaculture, its economic profit and the water quality parameters during its culture.

Method: The GI cages deployed along Moothakunnam (N10^{0}11.478' E076^{0}11.901'+ 4m) area of Ernakulam in which culture of Asian Seabass (*Lates calcarifer*) was progressing was used for studies. Fishes were stocked in October 2020 and mussels were stocked in December 2020 after 2 months when salinity of the water improved. Growth of the mussels and water quality parameters were monitored for 5.5 months (December 2020 – May 2021) till the harvest. 100 Nos of seeded strings weighing about 1.5 kg – 2.1kg were tied to the frames of cages; raft culture method was applied for the mussel culture and another 50 strings at 5 m away from the cage site on a raft as control.

Results: Weight ranging from 12.309 to 19.988 kg (average 16.8843kg) and12.464 to 17.513 kg (average 14.62767kg) harvested from the cage site and monoculture site respectively after 5.5 months. Mussels integrated with the cage showed 14.916 gm Absolute Weight Gain and 9.36 mm Absolute Length Gain. In integrated mussels Specific Weight Growth Rate (SGR (W)) was 2.7785%/day and Specific Length Growth Rate (SGR (L)) was 2.355%/day. In monoculture Absolute Weight Gain was12.65707 gm and Absolute Length Gain was 9.001mm. Here SGR (W) was 2.635%/day and SGR (L) was 2.349%/day. The survival rate of mussels in both cases was high (97 %). The total production was around 963 kg and the benefit ratio was 1: 4.28.

The water quality parameters such as temperature, salinity, transparency, nitrite and dissolved oxygen levels in both cage and monoculture sites were found almost similar throughout the culture period and observed only seasonal fluctuations in these parameters. The parameters such as pH, nitrate, ammonia, orthophosphate and TSS level were slightly high in integrated site than monoculture site.

Conclusion: Mussels can be cultivated without any additional feeding or management in the cage sites; however, it can provide additional income to the cage farmers along with the fishes. Green mussel culture can create a new export market and contribute a lot to our economy. Mussel cultivation can also enrich our blue economy and can increase our total fisheries production.

Apart from the usual phytoplankton, the uneaten feed and faecal matters of fishes in the cages form feed for the mussels growing in that area. This becomes a low input system as it requires only seed and infrastructure. Culture of green mussels can make our coastal saline water resources more productive and it can reduce environmental contamination to some extent.

Keywords: *Perna viridis*, Cage Aquaculture, Monoculture, Cost benefit ratio.

07-13

FIRST RECORD OF *PYCNOCRASPEDUM SQUAMIPINNE* ALCOCK, 1889 (OPHIDIIFORMES, OPHIDIIDAE) FROM THE ARABIAN SEA WITH AN OVERVIEW OF SYSTEMATICS, PHYLOGENETICS AND BIOLOGY

Treasa Augustina A.X.[1,2,3,4], Miriam Paul Sreeram[3,7], Sandhya Sukumaran[3,5] and Sreekumar K.M.[3,6]

[1]Cochin University of Science and Technology, Kochi, [2]Kerala State Council for Science, Technology, and Environment, Thiruvananthapuram, [3]ICAR—Central Marine Fisheries Research Institute, Kochi 682018.[4]treasaaugustina28@gmail.com

Background: *Pycnocraspedum squamipinne* is a rare species with hitherto limited records from the Indian Ocean. The present paper reports the first record of *P. squamipinne* from the Arabian Sea with a detailed study and additional information on systematics, phylogenetics, and biology of this species.

Method: Forty specimens of *P. squamipinne* was collected from deep-sea trawler by-catch between a depth range of ~290–450m from Sakthikulangara Fisheries Harbour, Kollam, Kerala, India, every month from October to May of 2021 and 2022, which is the season of deep-sea fishery season here. The meristic counts and morphometric measurements were made according to Hubbs and Lagler (1947) and Cohen & Nielsen (1978). To estimate the length-weight relationship, all the species total length and weight were recorded in the fresh condition to an accuracy of 0.1 cm and 0.1 g, respectively. Maturity stages and fecundity were examined following Qasim (1973), Bagenal (1978) and Kurup & Samuel (1991). The sex ratio was estimated following Rao and Yoon (1983). The extraction of purified DNA was carried out according to Sambrook *et al.* (1989). All the sequences were aligned using the Clustal W algorithm in MEGA 10 (Kumar *et al*. 2018). A Bayesian phylogenetic investigation with 1,000,000 generations was performed through MrBayes 3.2.7 software (Ronquist *et al*. 2012).

Results: The distinguishing characteristic of *P. squamipinne* from other congeners is the presence of two median basibranchial tooth patches, a single opercular spine, and three short spines in the preopercle region. Unlike the other species, pseudobranchial filaments are absent in *P. squamipinne*, with the origin of the dorsal fin above the preopercle region. The pectoral and pelvic fins are short. The body cavity is black and the stomach has 13 long finger-like pyloric caeca.

The species exhibited 100% genetic similarity with retrieved sequences of *P. squamipinne* in NCBI blast results and clustered in the same clade. *Sirembo jerdoni* belonging to the family Ophidiidae formed the closest clade with *P. squamipinne.* The other species of the family Ophidiidae branched separately with high posterior probability values.

The length-weight relationship of the *P. squamipinne* was worked out with the results obtained as $W=0.00062\times L^{3.610918}$ ($r^2=0.95$, n=40, unsexed). The sex ratio was observed to be 1:1.4, and the P value was statistically insignificant (P>0.05). From the twenty female specimens observed, five

stages of maturity were identified based on macroscopic and microscopic examinations. About 35% of the individuals were in the F3 stage (Ripening), followed by 25% F2 stage (Maturing virgin), 20% in the F4 stage (Ripe), and 15% were at the F1 stage (Immature). The results of the gut content analysis indicated the presence of fishes (16%), shrimps (20%), and semi-digested matter (40%). Some of the fish have empty stomachs (24%). Out of the 40 samples, eight individuals had busted stomachs, and about 32 guts with intact stomachs were examined. Full stomachs were observed in 38% of fishes, followed by 28% of ½ full stomach, 19% of an empty stomach, 9% of ¾ full stomach, and 6% of ¼ full stomach.

Conclusion: Knowledge of species belonging to the genus *Pycnocraspedum* is hitherto minimal since these species are considered by-catch discards and are mainly used for the production of fish meal and manure. More comprehensive studies on the molecular data of other species included under the *Pycnocraspedum* genus are required for further phylogenetic analysis.

Keywords: Arabian Sea, *Pycnocraspedum squamipinne*, Ophidiiformes, Systematics, Mitochondrial DNA, Biology

07-14

FIRST SUCCESSFUL REPORT ON INDUCED BREEDING, EMBRYONIC DEVELOPMENT, LARVAL REARING AND SEED PRODUCTION OF SHORT NECK CLAM *PAPHIA MALABARICA* THROUGH HORMONE INDUCTION

A. Mariyam Fazula, M.K. Anil, P. Gomathi, Summayya Rahuman, Ponni J. Mohan and R. Siju

ICAR-Central Marine Fisheries Research Institute, Vizhinjam Regional Centre, Vizhinjam, Thiruvanthapuram -695 521, Kerala, India. Email:mariyamfasula@gmail.com

Background: Oysters, mussels, clams, and scallops are examples of bivalve molluscs that make up a significant portion of the fisheries and are a major component of the diets of many people throughout the globe. As the world's population rises, these nations will need to produce more seafood. Clams are the most prevalent and plentiful species among the exploited bivalve resources of India. Clams form a subsistence fishery in the Indian coastal regions, particularly along the southern states. *Paphia malabarica,* the short neck clam locally known as 'Poovankakka', is one of the nutritious and inexpensive food sources. The present study forms the first report on the successful breeding and seed production of short neck clam *Paphia malabarica* through hormone induction and features the detailed description of the embryonic and larval development of *P. malabarica*. The study also forms the first reports on *P. malabarica* spat production using a downweller system. Recent reports show that there is a drastic decline in the short neck clam fishery in Ashtamudi Lake, Kerala, even though this is India's first Marine Stewardship Council (MSC) certified fishery. The depleted resources can be replenished by successful hatchery production and ranching.

Methods: For the broodstock development, wild clams of average weight 17.5±0.26gm and total length 34±0.5mm were collected from the Ashtamudi and Muthalapozhi estuaries in Kerala. The brooders were conditioned and fed with a mixture of microalgae for 60 days till the ripe gonads were obtained at a temperature range of 24-25 °C. Gonadal conditions were observed microscopically before induced breeding and the hormone was carefully administered; serotonin 2.5 M intramuscularly. The fertilized eggs were collected gently by opening the egg collecting valve of spawning induction tray. Mild aeration was given to the collected fertilized

egg and transfer to the incubation tank for the embryonic development and hatching. Fertilization and embryonic development stages were observed with the help of Axiocam 105 color ZIESS microscope. Measurements and photographs were taken with ZEISS Efficient Navigation (ZEN) 2.3 software. After the successful completion of incubation period of 18.04 hours, the larvae were collected and transfer carefully to1.5 ton capacity pre prepared larval rearing tank for further development. The spat of *P. malabarica* were reared in the downweller system. Water exchange and cleaning of wells were done in 2 times per week. Physico-chemical parameters such as atmospheric temperature, water temperature, salinity; dissolved oxygen, total ammonia and pH were monitored regularly (APHA, 1998).

Results: After the administration of hormone, spermatozoa were successfully released within 5–10 minutes, followed by the eggs. Fertilized eggs are spherical and measure 54.527±1.2 µm. The first polar lobe, measuring 68.802±0.6 µm, emerged 0.15 hours after fertilization (hpf). After 0.32 hours of post-embryonic development, the egg had its first mitotic division. After 11.45 hpf larvae reached trochophore stage measures 55.1±1.1 µm. Through the lashing of the terminal flagellum, larvae start free swimming linearly. Straight-hinged larvae measure 69.580 ± 0.9 µm. Due to rapid shell growth, early umbo larvae emerged 4 days after fertilization (dpf) and advanced to the umbo veliger stage on the fifth dpf and beyond. The hinge has decreased, and the larvae measure 287.684±1.9 µm. At 6 days following fertilization, the umbo veliger larvae's shell valves reveal a growing pedo. At 7 dpf, the larva was moving slowly with one foot, the pedos were visible, and the velum had lost function. *Paphia malabarica* larvae settle in the pediveliger stage (6 -7 dpf). The larvae had no eyespot stage noticed during rearing. Most larvae have gills by 15 dpf. Growth lines appeared on larval shell valve margins at 18 dpf. The foot thickened by 20 dpf, on the 25th day after fertilization, fully formed exhalant and inhalant syphons were observed, and the settled spat measured on average 1.3±0.26 mm in size. At this point, the spat were moved to a down welling system for further rearing. They were seen to gather in groups near the tank's bottom and release mucus during filter feeding. Polymorphism in shell colouration of spat was also noted. A standard feeding regimen was developed, which could be used for the hatchery production of this species. The findings showed that the serotonin-induced breeding approach is straightforward and can be used to produce the clam larvae and the final survival percentage value was 6-8%.

Conclusion: Information on breeding and seed production technology of clams is limited; the food sector depends heavily on wild collections to meet rising demand. During the present study, serotonin-induced cultural techniques yielded good results; this knowledge is essential for propagating *P. malabarica,* especially in the present situation where climate change is impacting maturation and spawning of many species. The foregoing findings might aid with induced breeding, larval rearing, seed production, and ranching of this cultivable species.

Keywords: Induced breeding, Embryonic development, Growth, Survival, Larval rearing, *P.* malabarica, Ashtamudi Lake.

07-15

PROTECTIVE EFFICACY OF RECOMBINANT STAPHYLOCOCCAL ENTEROTOXIN TYPE C AGAINST EXPERIMENTAL MURINE INFECTION BY A STRAIN OF MULTIDRUG RESISTANT *STAPHYLOCOCCUS AUREUS* ISOLATED FROM BOVINE SUBCLINICAL MASTITIS

P. Preena[1], Desh Deepak[2], Syed Atif Ali[3], Nongthombam Boby[4] and Reena Mukherjee[2]

[1]Department of Veterinary Epidemiology and Preventive Medicine, College of Veterinary and Animal Sciences, Kerala Veterinary and Animal Sciences University, Mannuthy, Thrissur, [2]ICAR-Indian Veterinary Research Institute, Izatnagar, Bareilly, Uttar Pradesh
[3]Institute of Chemistry, Academia Sinica, Taipei 115024, Taiwan, [4]Division of Comparative Pathology, Tulane National Primate Research Center, Covington, LA, United States

Background: Bovine mastitis has greatest impact in diary industry and *S. aureus* is the most prevalent and critical pathogen in subclinical and chronic mastitis. Currently, there is no effective vaccine for the prevention of bovine mastitis and the treatment is becoming increasingly difficult owing to their virulence, contagiousness, zoonotic impact andthe emergence of antibiotic resistance. Staphylococcal enterotoxin type C (SEC) is a bacterial superantigen expressed by invasive strains of *S. aureus* and one of the immunogenic determinants. An intramammary-intraductal inoculation of *S. aureus* in the mouse model was created to complement or mimicbovine staphylococcal mastitis and to understand the immunogenicity and protective efficacy of SEC protein microencapsulated in a PLGA polymer.

Method: The recombinant SEC (rSEC) protein was expressed, purified, concentrated and was further encapsulated into PLGA microparticles (MPs) by the double emulsion method. Immunization of female adult Swiss albino mice was performed with the characterized rSEC MPs. An intramammary-intraductal inoculation of lactating immunized mice with multidrug resistant *S. aureus*isolated from subclinical mastitis indairy cattle was performed. The protective potential of rSEC-MPs immunization in challenged mice were compared with healthy mice, challenged mice of non-immunized and bacterin immunized groups. The efficacy of immunization was assessed by estimation of humoral & cell mediated immunity.

Results: Clinical scores, animal survival rates, bacterial load and histopathological parameters showed better response by rSEC-MPs immunized animals. The immune response generated by the rSEC-MPs was characterized by a good humoral response marked by high IgG titres including a rise in IgG1, IgG2a & IgG2b titers. The cellular response in lymphocyte proliferation and cytokine assays revealed a mixed profile of Th1/Th2 response in rSEC immunized.

Conclusions: PLGA microformulation delivering the entrapped rSEC vaccine candidate in mice elicited specific humoral as well as cellular responses. It showed better protection against mastitis in comparison to autogenous bacterin with the additional advantage of having no adverse effect on administration.Therefore, it can be concluded that recombinant staphylococcus enterotoxin C is a promising candidate for developing a bovine *S. aureus* subunit vaccine against the corresponding type of mastitis.

Keywords: Bacterin**,** Mammary gland, IgG, Cell mediated immunity, PLGA, Microparticles

POSTER PRESENTATION

07-16

IMMUNOCYTOCHEMICAL DESCRIPTION OF CHEMOTHERAPEUTIC RESPONSE IN CANINE TRANSMISSIBLE VENEREAL TUMOUR

Aja Taj Nazer, B. Bibin Becha, C. Jayakumar, M.P. Unnikrishnan and S.S. Devi

Department of Animal Reproduction, Gynaecology and Obstetrics,
College of Veterinary and Animal Sciences, Mannuthy, Thrissur – 680651
Kerala Veterinary and Animal Sciences University, Pookode, Wayanad, Kerala

Background: Canine transmissible venereal tumour (CTVT) is a globally distributed contagious neoplasm transmitted through allograft transplantation and occurs mainly in genital organs of sexually active dogs. Cytology is the method of choice for diagnosing CTVT, as it is less invasive and preserves cell morphology compared to biopsy samples. Immunoreactivity to vimentin, a mesenchymal marker was found to be intense in CTVT cells, whose usefulness for diagnosis and prognosis of the condition has to be evaluated.

Methods: Thirty-one CTVT confirmed dogs were randomly allocated to three treatment groups. The group I dogs were treated with vincristine sulphate at weekly intervals till tumour regression. The group II dogs were treated with ivermectin, followed by vincristine sulphate after 24 hour and repeated at weekly intervals till tumour regression. The group III dogs were treated with cyclophosphamide orally for 10 days, followed by vincristine injection at weekly intervals till tumour regression. Rapid immunocytochemistry (ICC) was used for confirming the lineage of cells in tumour impression smears. The ICC index was calculated by combining the quantitative and qualitative immunostaining scores of vimentin expression. The analysis of ICC scores on different days of treatment within group and between groups was performed using non-parametric Kruskal-Wallis test and Friedman test.

Results: The ICC scoring with vimentin showed strong immunoreactivity (+++) on day of presentation in all dogs, and it was scored absent in group I by day 21, in group II by day 14 and in group III by day 28 of treatment. The duration of treatment in vincristine, vincristine-ivermectin combination and vincristine-cyclophosphamide combination were 23.10 ± 1.49, 22.00 ± 1.00 and 30.00 ± 2.00 days, respectively.

Conclusion: Duration of treatment was found to be less in vincristine-ivermectin combination therapy. Rapid ICC signalling with vimentin could be used to predict the proliferation and regression of tumour mass and thus response to chemotherapy in CTVT.

Keywords: Canine transmissible venereal tumour, immunocytochemistry, vimentin

07-17

EVALUATION OF ACUTE TOXICITY OF SCOPOLAMINE IN *DAPHNIA MAGNA* – *AN IN SILICO AND IN VIVO APPROACH*

Alfin Mariya [1], AparnaP[2], Suresh N Nair[2], and Nisha A R[3]
[1]Department of Veterinary Pharmacology and Toxicology, College of Veterinary and Animal Science Mannuthy, [2]Department of Veterinary Pharmacology and Toxicology, College of Veterinary and Animal Science Mannuthy, [3]Department of Veterinary Pharmacology and Toxicology, College of Veterinary and Animal Science Mannuthy- 680651

Background: Scopolamine is a toxic but pharmacologically significant alkaloid present in many plants of Solanaceae family. In current investigation, *in silico* and *in vivo* assessment of acute toxicity of scopolamine was done in *Daphnia magna*.

Method: *In silico* assessment of toxicity: was done using the QSAR Modeling software, T.E.S.T. and predicted the acute LC50 in *Daphnia magna*. 1 µg/ml, 5 µg/ml, 10 mg/ml, 50 µg/ml, 100 µg/ml, 200 µg/ml, 1500 µg/ml concentrations of scopolamine were prepared by serial dilution using distilled water. The experiment was conducted under uniform conditions as the stock culture was kept in the lab. The experimental group consisted of six replicates with each replicate contain ten *D. magna* neonates from healthy stocks. In the current study 10 *D. magna* were treated with various concentration of scopolamine at 24 hours after exposure the number of live mobile and dead daphnids were recorded

Result: *In silico* toxicity of *D. magna,* the LC50 were found to be 4.57µg/mL and in *in vivo* toxicity of *D. magna* the LC50 were found to be 6.591µg/mL.

Conclusion: From the result, it is clear that that scopolamine possesses significant ecotoxic potential. This is especially important when it is used for mass medication due to leaching of these secondary metabolites to the aquatic ecosystems. Here, the comparison of *in silico* LC 50 (4.57 µg/mL) and *in vivo* LC50 (6.951 µg/mL) were in good correlation, indicating the fidelity of *in silico* method

Key words: *D. magna*, *in vivo* toxicity, Scopolamine, ecotoxicity, *in silico* toxicity, T.E.S.T

07-18

THE EFFECT OF DIFFERENT MICROALGAL DIETS ON THE POPULATION DEVELOPMENT OF *PSUEUDODIAPTOMUS MALAYALUS*

Anju Soma S[1,2], Shoji Joseph[1]

[1]ICAR- Central Marine Fisheries Research Institute ,Post Box No.1603,Ernakulam North P.O., Kochi-682018, Kerala, [2] Cochin University of Science and Technology, South Kalamassery, Kochi, Kerala 682022

Background: Of the ten orders of copepods, calanoids are mostly used for larval diets of tropical marine fin fishes as it is rich in essential poly unsaturated fatty acids. In this study a calanoid copepod *Psuedodiaptomus malayalus*, a potential larval live feed for marine fin fishes, was cultured on a range of 6 different microalgal diets. The experiment was carried out to evaluate the effect of different microalgal diets on the population development of *P. malayalus*.

Method: The copepod *P. malayalus* was fed with 6 microalgal diets with different combinations. The microalgal diets studied are in 1:1 combinations of *Dicrataria inornata* + *Chlorella marina,*

Chaetoceros calcitrans + *C. marina, Isochrysis galbana* + *C. marina, D. inornata* + *Nannochloropsis salina, I. galbana* + *N. salina*, *C. calcitrans* + *N. salina* at the rate of 2×10^5 cells/ml. The population growth, number of nauplii and survivability of copepods are observed to find out the most suitable algal diet.

Results: The results of this study demonstrated that the major parameters, such as survival rate and naupliar production that are crucial to culture productivityare affected by the microalgal diet fed to *P.malayalus*. But some parameters, such as sex ratio appear to be less affected. The experiment shows that 1:1 combination of *D. inornata* + *N. salina* worked as an excellent algal diet for *P.malayalus* (nauplii production 1720.66 ± 10.066) followed by *I. galbana* + *N. salina*. (1055.66 ± 6.027) and lowest rate with the diet *C. calcitrans* + *C. marina*. (229.33 ± 17.785).

Conclusions: This work establishes a simple microalgal combinational diet for higher naupliar production of a calanoid copepod *P. malayalus*, a potential live feed for marine fish larvae.

Key words : Calanoid, Copepod, Live feed, Psuedodiaptomus , microalgae, Larval feed,

07-19

IN SILICO AND *IN VIVO* ASSESSMENT OF ACUTE TOXICITY OF HESPERIDIN IN *Daphnia magna*

Aparna P[1], Alfin Mariya[1], Suresh N Nair[2], and Nisha A R[3]

[1] Department of Veterinary Pharmacology and Toxicology, College of Veterinary and Animal Science Mannuthy, [2]Department of Veterinary Pharmacology and Toxicology, College of Veterinary and Animal Science Mannuthy, [3]Department of Veterinary Pharmacology and Toxicology, College of Veterinary and Animal Science Mannuthy- 680651

Background: Hesperidin is a flavone-glycoside present in many plants and have multiple pharmacological uses. In this context, *in silico* and *in vivo* assessment of acute toxicity of hesperidin is done in *Daphnia magna.*

Method: The concentration of 1000 µg/mL, 500 µg/mL, 100 µg/mL, 50 µg/mL, 25µg/mL, 10µg/mL, 5 µg/mL, 1 µg/mL, 0.5µg/mL and selected 10 healthy *D. magna* were introduced into each well of six well plate. Observations were made after 24 hrs of exposure and number of mobile or dead were noted at each point. The *in silico* LC50 were predicted using T.E.S.T Tool.

Result: *In silico* toxicity of *D. magna,* the LC50 were found to be 93.87µg/mL and in *in vivo* toxicity of D. magna the LC50 were found to be 93.87µg/mL

Conclusion: From the study, it could be concluded that hesperidin induces cytotoxicity in *D. magna* in both *in silico* and *in vivo* tests.

Key words: *D. magna*, hesperidin, ecotoxicity, *in silico* toxicity, T.E.S.T

07-20

A RETROSPECTIVE SURVEY BASED ANALYSIS OF AWARENESS ABOUT RABIES AMONG DOG OWNERS IN NORTHERN KERALA

Athira R Krishnan, Fathima Nourin, Sindhu.O.K, Bipin K. C. and Vinu David.P.

College of Veterinary and Animal Sciences, Pookode, Wayanad.

Rabies is a neurological disease of mammals that is almost invariably fatal once the clinical signs develop. Rabies is one of the oldest recognized zoonosis and defined as an acute progressive encephalomyelitis. Lack of knowledge among the pet owners and also in general public about the nature of rabies disease and prophylaxis has contributed to increase of rabies related deaths. There is a global upsurge in people owning dogs after the covid pandemic and Kerala has reported a consistent increase in the incidence of animal bites, mostly by dogs, and subsequent deaths due to rabies. Under this background, a retrospective survey was conducted, aimed to assess the extent of knowledge about the disease among the dog owners who visited Teaching veterinary Clinical Complex, Pookode during the period from January 1st to January 15th 2022. This community based survey covered a representative population of dog owners across Northern Kerala. We distributed questionnaire consisting of 21 questions related to dog keeping, Rabies disease awareness and prophylactic vaccination. Responses of the owners were recorded, tabulated and percentages of each response were calculated and presented.

Based on the survey conducted, 95.8% of the dog owners replied that they have heard about the rabies disease. Majority of the dog owners are under the impression that dogs are the only susceptible hosts for rabies (95%) and only a very few are aware of the fact that other animals such as cows, goats, pigs are also susceptible hosts (5%). 93% of the dog owners replied that rabies can be transmitted among dogs and to other animals or humans through bite. Only few are aware about that, simple scratches, licking of the wound etc.. can also transmit rabies among animals or humans. People doesn't consider it as a potent mode of transmission and they ignore it. Majority of the owners are having the impression that aggressive behavior is the chief sign of rabies (71.8% of dog owners). 67.6% of dog owners are aware that profuse salivation is a sign. A very few are aware of other signs such as difficulty in swallowing, change in sound, wandering, paralysis of muscles of neck and cheek, dropping of jaw are also clinical signs of rabies. 63.4% of the dog owners are unaware of the outcome of rabies and 36.6% of dog owners aware that rabies is not curable after the appearance of clinical signs. Majority of the owners know about the rabies control strategies going on in the society since they replied that castration and there by controlling the stray dog population can control the rabies. Only 28% of dog owners know that routine regular vaccination is a control measure, even though 70.4% of dog owners know the importance of rabies vaccination in dogs for preventing the spread of rabies to animals and humans. So many people are still unaware of the importance of proper and regular rabies vaccination. Even though majority of dog owners replied that they take their dogs for vaccination, many of them don't know the proper time for vaccination. 84.5% of dog owners take their dogs to veterinary clinic for vaccination and some to the nearby vaccination campaign spots. Due to financial constraints such vaccination campaigns are not being done on regular basis in Kerala. This could be one of the reasons for reduced vaccination status among pets. Majority (71.8% of dog owners) replied that due to lack of information about rabies, they hesitate to vaccinate their pets. Only few are aware of the importance of maintaining the cold chain during the vaccine transport. The potency of the vaccine will be lost if it is not stored and transported under proper temperature. This is the major factor for vaccination failures in our country. To fill the void of loneliness there have been a global upsurge in people owning dogs during corona varies due to lockdown. 42.25% of the pet owners were

keeping dogs for Less than 2 years. From this we can understand that there was a hike in dog population and dog ownerships after COVID pandemic. Kerala has reported a consistent increase in the incidence of animal bites, mostly by dogs, and subsequent deaths due to rabies over the past six years. In 2022, the number of deaths reached almost two times to date compared with the deaths in 2021.Survey results induces the importance of continuous and strategic community awareness programs while formulating the state action plan for rabies elimination along with provision of vaccines and serums at all health facilities, strengthening of laboratories, use of standard protocols and strengthening of intersectoral coordination.

07-21

MYXOBOLUS VYPINII N. SP. INFECTING THE SCALES OF *PLANILIZA MACROLEPIS* FROM COCHIN BACKWATERS, KERALA

Mary Soniya Correya, N. K. Sanil, P. Vijayagopal

Marine Biotechnology Fish Nutrition and Health Division, ICAR - Central Marine Fisheries Research Institute, Ernakulam North P.O., P.B. No. 1603, Cochin - 18

Background: Myxozoans are a diverse group of metazoans having a complex life cycle, comprising both vertebrate (fish) and invertebrate (annelid) host. *M. vypinii* n. sp. is described from the scales of largescale mullet, *Planiliza macrolepis* inhabiting Cochin backwaters, Kerala, India.

Methods: Host fishes inhabiting Cochin backwaters were collected using Chinese nets/gill nets. The morphometry and morphological studies were carried out using Nomarski differential interference contrast (DIC) optics, followed by molecular and phylogenetic analyses of the small subunit ribosomal DNA gene (SSU rDNA).

Results: Almost round, black, plasmodia occupied the central portion of the scales, measured 0.92-2.4 (1.56 ± 0.4) mm in diameter. Mature myxospores were ellipsoidal in valvular and sutural views, with edge markings, measured 5.86-7.21 (6.75 ± 0.3) X 4.83-6.24 (5.51±0.3) µm in size. Two equal polar capsules, elongate-oval with pointed anterior ends occupied the anterior half of the spore; measured 3.15–3.78 (3.4 ± 0.16) X 1.8–2.52 (2.23 ± 0.18) µm in size. Polar filaments formed 4 coils, measured 23.22–36.22 (29.61 ± 4.75) µm in length, when extruded. 1959bp 18SSU rDNA revealed the highest identity of 89.55% with related species, while in phylogenetic analysis, the present species was positioned within the Myxobolus clade infecting mullets.

Conclusions: Based on morphology, morphometry, molecular and phylogenetic analyses, along with tissue/host specificities and geographic location, the present parasite is treated as new and named as *M. vypinii* n. sp.

Keywords: Myxobolus, *Planiliza macrolepis*, Plasmodia, 18SSU rDNA, Phylogeny

07-22

HISTOPATHOLOGICAL, MOLECULAR AND PHYLOGENETIC ANALYSIS OF *PERKINSUS OLSENI* FROM ASIAN GREEN MUSSEL, *PERNA VIRIDIS* (LINNAEUS, 1758) (BIVALVIA)

Nisha E A, Pradeep M A, Sanil N K, Nidhiya Kottayi, Suja Gangadharan, Aswathy Joshy, Nivya A, Azhar shahansha T S

Marine Biotechnology Fish Nutrition and Health Division, ICAR- Central Marine Fisheries Research Institute, Ernakulam North P.O, P.B No. 1603, Cochin-18

Background: The Asian green mussel, *Perna viridis* (Linnaeus,1758) (Bivalvia, Mytilidae) is a commercially important edible mussel species in Indian aquaculture. *Perkinsus olseni*, which is OIE listed protozoan parasites of the genus *Perkinsus* which causes potential disease outbreaks and summer mortalities in bivalve population. This study provides information regarding the host-parasite interactions, histopathology, molecular and phylogeny of *Perkinsus olseni*.

Method: *Perkinsus* sp. diagnosis were performed using RFTM assay, histology, molecular and phylogenetic analysis. PCR assays were performed following the OIE recommended protocols using *Perkinsus* genus specific primers -ITS primers ITS-85: CCG CTT TGT TTG GGA/C TCC C and ITS-750: ACA TCA GGC CTT CTA ATG ATG. The best fit model for phylogenetic analysis was calculated using MEGA 11 software.

Results: Hypnospores were observed as, blue-black spheres in infected tissue in RFTM assay. Pathological changes included; histological lesions, host cell disintegration, ceroid bodies, tissue necrosis, hemocytic infiltration, vacuolation, spongy tissue and muscle tissue dissolution in mantle, gonads and foot. Parasitic stages of *Perkinsus* - trophozoite and schizonts were observed in large numbers. Genus-specific PCR assays produced 700 bp amplicon, Sequencing of ITS shows 98.81% identity to *Perkinsus olseni*. The pairwise genetic distance among the *P. olseni* isolates varied from 0.000 to 0.16. Phylogenetic trees constructed by sequences generated in the present study clustered along with of *P. olseni* with high bootstrap value of 99.

Conclusions: *Perkinsus* prevalence and infection intensity were determined from histological preparations of bivalves. The outcomes of RFTM and histology were supported by PCR experiments with genus-specific *Perkinsus* primers, which also verified *Perkinsus* infections in *P. viridis* tissues.

Keywords: Ray's Fluid Thioglycollate medium, *Perkinsus olseni*, *Perna viridis,* Histology, phylogeny.

07-23

PELLET FEEDS AND TRASH FISH FOR ASIAN SEABASS: IN CAGE AQUACULTURE

Priya, NP.[1,2*], Shoji J.[1], Sunithakumari, K.[1,2] Ajithkumar, P.B. and Smina, M.S.[1,2]

[1]ICAR- Central Marine Fisheries Research Institute, Post Box No. 1603, Ernakulam North P.O,Kochi-682018, Kerala, [2]Cochin University of Science and Technology, South Kalamassery, Kochi, Kerala 682022, priyanvnraj@gmail.com

Asian seabass (*Lates Calcarifer*) is a carnivorous fish and they were cultured in brackish and marine net cage systems from fingerlings to marketable sizes. Trash fish/low valued fishes were used as the main feed for Seabass cage aquaculture in the initial phases as there was no

compounded feed. Even though trash fish are frequently used as a feed for fish culture in many regions at present, pellet feed is highly suggested for sustainable aquaculture for many reasons. It has become the need of the hour to find out an apt floating extruded pellet feed for Seabass, mainly due to the rapid growth of cage aquaculture, then growing issues with trash fish supply, both in terms of quality and quantity, and the concern over the availability of low value fishes for long term and on the sustainable aquaculture when trash fish was utilized as a feed. Recently a few companies in India have introduced feed for Seabass culture as alternative to trash fish. Therefore the study was conducted to understand the efficiency of the commercially available pellet feeds (Feed A&B) and trash fish (Feed C) on growth performance, survival, production and water quality in cage aquaculture of Seabass at Moothakunnam (N10011.478' E76011.901'+4m), Kochi. The method used in the experiment was designed with three treatments (T1,T2,T3) triplicates. Seabass seeds (9.1±0.939g fish) were stocked in cages at a stocking density of 2000/cage for a period of 10 months and each set was fed with Feed A, Feed B and Feed C. The study revealed a significant difference ($p<0.05$) in overall growth performances and survival rates (86 to 87.7%) and production between the treatments. Statistically significant differences were observed among the proximate composition of fishes fed with various diets. Whereas water quality parameters and sediment characteristics, did not show significant differences ($p>0.05$) between cages using trash fish and pellet feeds. On the basis of results from growth performance, survival rate and production, it is suggested that among the three diets, the formulated feed (Feed B) is good for the Asian Seabass cage farming.

Keywords: Commercial pellet feed, Trash fish/low valued fish, Growth performance, water quality, Seabass, Cage aquaculture.

07-24

SCREENING AND CHARACTERIZATION OF PROTEASE-PRODUCING BACTERIA FROM KOCHI, SOUTH WEST COAST OF INDIA AND ITS POTENTIAL USE IN THE FRY DIET OF SNUB NOSE POMPANO *TRACHINOTUS BLOCHII*

Rasiya Sultana [1,2]*, **Imelda Joseph**[1]

[1] *ICAR-Central Marine Fisheries Research Institute , Post Box No. 1603, Ernakulam North P.O, Kochi-682018, Kerala,* [2] *Mangalore University, Mangalagangotri, Karnataka - 574 199*
**Email: rasiyas92@gmail.com*

Background: Microbes are a promising source of enzyme isolation and the enzymes extracted are employed in wide variety of fields. The major sources of marine bacterial strains are sediments and sea water. The oceans covering 71% of the planet is a huge resource for microorganisms. Hitherto unknown microbial populations of protease producing capabilities are expected to be identified from such sites and could be effectively used in fish diet preparation for promoting growth and survivability.

Method: Bacterial strains showing protease production capability are screened and characterized via biochemical and molecular methods. Ideal strains are incorporated to form a probiotic consortium to be supplemented to *Trachinotus blochii* and growth performance is recorded and evaluated.

Results: Bacterial strains having proteolytic activity was screened out from marine environment samples. The inclusion of these strains in the diet was found to have positive effect in growth parameters of experimental fish compared to control group.

Conclusions: Marine environment offers wide variety of microbial strains which if screened out and characterized could be used efficiently in enhancing the profitability of fish culture.

Keywords:

Probiotics, Bacillus, Enzymatic bacteria, Snub nose pompano, fisheries, phylogeny

07-25

EFFECT OF FOLLICULAR FLUID DERIVED NANOPARTICLES ON *IN VITRO* OOCYTE DEVELOPMENTAL COMPETENCE

Revathy M Murali[1], M. P Unnikrishnan[2], Abhilash R. S[3], C. Jayakumar[4] and Arya Theres[5]

[1]Dept. of ARGO, CVAS, KVASU, Mannuthy, [2] CPPR, KVASU Mannuthy, [3] Dept. of ARGO, CVAS, KVASU Mannuthy, [4] Dept. of ARGO, CVAS, KVASU Mannuthy, [5]Dept. of ARGO, CVAS, KVASU Mannuthy

Background: Exosomes are 30–200 nm sized extracellular vesicles (EVs) generated by release of intraluminal vesicles, following fusion of multi-vesicular bodies (MVBs) with the plasmamembrane.Follicular fluid is one of the sources used to investigate exosomes in reproductive studies. Exosomes derived from ovarian follicles have beneficial effects on *in vitro* oocyte maturation (IVM), fertilisation (IVF) and developmental competence of bovine embryos.

Method: Present investigation is envisaged to study the (IVM), (IVF) and developmental competence of bovine embryos, after supplementing oocyte maturation medium with follicular fluid exosomes isolated from follicles of diameter greater than 8mm. The study is also envisaged to characterise these exosomes based on cytomorphological findings by electron microscopy.

Results: Addition of follicular fluid exosomes to the oocyte maturation medium resulted in a significant increase in IVM rate and morula development compared to the control group in which no exosome supplementation was done.

Conclusions: This work develops an in vitro culture system by the addition of follicular fluid exosomes to the oocyte maturation medium to obtain better *in vitro* embryo harvest.

Key words: exosomes, follicular fluid, *in vitro* maturation, *in vitro* fertilisation, extra cellular vesicle

07-26

ANTIPROLIFERATIVE EFFECT OF METHANOLIC AND AQUEOUS EXTRACT OF *ALLOPHYLUS COBBE* IN C127I CELL LINE

Rohit Mohanan[1], Sherin Thomas[1], Sujith S[2], Roshni S.S.,[3] Sneha G[3] and Nisha A R[4]

[1]Department of Veterinary Pharmacology and Toxicology, College of Veterinary and Animal Sciences Pookode, Wayanad, [2]Department of Veterinary Pharmacology and Toxicology, College of Veterinary and Animal Sciences Mannuthy, [3]Department of Veterinary Biochemistry, College of Veterinary and Animal Sciences Mannuthy, [4]Department of Veterinary Pharmacology and Toxicology, College of Veterinary and Animal Sciences Mannuthy- 680651

Background: Scientific world is in search of newer and effective therapies against cancer and natureform a good source of drugs. The present study was undertaken to assess the antiproliferative potential of methanolic extract of *a. cobbe* in C127I cell lines.

Method: The leaves of *A. cobbe* were shade dried and was extracted using methanol and qualitative phytochemical analysis was performed. The extract was assessed for its cytotoxicity by MTT dye reduction assay in C127 I cells maintained using DMEM and 10 per cent foetal bovine serum at concentrations of 320, 160, 80, 40, 20, 20 and 5 µg/mL and the percent cell inhibition and IC_{50} were calculated. Acridine Orange/Ethidium bromide staining was used to detect the possible mechanism of cytotoxicity.

Results: From the results of MTT assay, it could be seen that there was a dose dependent inhibition of cell proliferation of C127I which was maximum at a concentration of 320 µg/mL. The IC_{50} value of the methanolic extracts was found to be 64.63 µg/mL respectively. The effect was comparable to doxorubicin. The extract and positive control treated cells showed orange to red fluorescence when stained with Acrdine Orange/ Ethidium bromide compared to greenish fluorescence in the control cells indicating apoptosis in the treated cells.

Conclusions: From the study, it could be concluded that methanolic extract of *A. cobbe* indued cytotoxicity bu inducing apoptosis

Key words: *A.cobbe,* C127I, cytotoxicity, Apoptosis

07-27

COMPARISON OF MINIMUM INHIBITORY CONCENTRATION OF CHLORHEXIDINE, QUATERNARY AMMONIUM COMPOUND AND POVIDONE IODINE AGAINST STAPHYLOCOCCI OBTAINED FROM UDDER SURFACE AND MASTITIS MILK

Vignesh S, Rathish R L, Anjaly Krishnan, Athulya E C, Rita Grace Sacharia, Archana Chandran, Lijo john, Bipin K C and Deepa P M

Department of Veterinary Epidemiology and Preventive Medicine,
College of Veterinary and Animal Sciences, Pookode, Wayanad - 673 576.

Staphylococci has been incriminated as an important group of bacteria that is responsible for contagious bovine mastitis. Although teat dipping with povidone iodine has been recommended as standard method to control contagious bovine mastitis, scarcely any data exist regarding the propensity of these organism to develop resisitance to nonspecific biocides like povidone iodine. A total of twenty-two *Staphylococcus aureus* (SA) and eleven Coagulase negative staphylococci (CNS) were obtained from milk and udder surface from 20 organized dairy farms of Wayanad district. The Minimum Inhibitory Concentration (MIC) of Chlorhexidine, Cetyl Trimethyl Ammonium Bromide (CTAB) and Povidone iodine were assessed using broth microdilution assay as per CLSI guidelines. It was observed that the average MIC of SA and CNS against chlorhexidine was 0.88±0.29 µg/ml (Mean ±SE) and 0.09 ±0.03 µg/ml respectively, which was found to be statistically significant. Average MIC of and CNS isolates against povidone iodine was 13.84±7.17 µg/ml and 19.15±5.80 µg/ml. However, there was no significant difference between MIC of povidone iodine to SA and CNS isolates. Average MIC of CTAB against SA and CNS isolates were found to be 0.58±0.24 µg/ml and 0.27±0.11 µg/ml. On comparison between the three biocides, CTAB was found to be having lowest MIC. A total of two isolates were found to be resistant to chlorhexidine and seven were resistant to povidone iodine, while none were resistant to CTAB. The study suggests that rotation of biocides need to be practiced for ensuring sustainable control of contagious bovine mastitis.

Keywords: Contagious mastitis, Biocide resistance, *Staphylococcus*

07-28

SOY MILK: A NOVEL AND ECONOMIC MILK REPLACER FOR CALVES

Biju Chacko and Fahmida V

Dept. of Animal Nutrition, College of Veterinary and Animal Sciences, Pookode, Wayanad

Background: The most critical period of a calf's life are the first, second and third months of age, wherein it should be fed with whole milk at the rate of 1/10th, 1/15th and 1/20th of its body weight, respectively. However, such a scientific feeding schedule is seldom practiced by the farmers in India, resulting in decreased growth rate of calves and other related adverse effects, which in turn has necessitated the use of cheaper substitutes for whole milk, as milk replacers.

Method: A novel milk replacer of great practical significance is soy milk, which is made by soaking soyabeans in water, followed by grinding and sieving. The fluid which results after straining is called soy milk. One litre of soy milk can be prepared from 125g of whole soya beans, ie., we get soy milk from beans, in the ratio 1:8. A study was conducted to evaluate the efficiency of soy milk as milk replacer in pre-ruminant calves on the basis of their growth performance. Eighteen healthy crossbred calves of one to two weeks of age were selected and were grouped in to three groups of six animals each. A feeding trial of 90 days was conducted by feeding them with three different dietary treatments, T1, T2 and T3, on DM basis, viz., whole milk alone, 75 per cent whole milk and 25 per cent soy milk, 50 per cent whole milk and 50 per cent soy milk, respectively.

Results: The average daily dry matter intake (DMI) of T2 and T3 were significantly higher ($P<0.05$) than those in T1, with T2 and T3 being similar ($P>0.05$). The final body weight, increase in body weight (cumulative weight gain), average daily body weight gain and feed conversion efficiency (FCE) of calves in groups T1, T2 and T3 were 57.91, 65.66, 66.20 kg; 19.41, 26.83, 27.70 kg; 0.21, 0.29, 0.27 kg and 4.62, 3.44, 3.25, respectively. The cost per kg gain of calves in three groups was Rs. 553.06, 412.43 and 366.45, respectively, with the lowest in group T3, followed by T2 and T1, in ascending order of cost.

Conclusions: Calves fed on soy milk had a higher final body weight, increase in body weight, average daily gain, DMI ($P<0.05$), better FCE and lower cost per kg gain than those of group T1 fed on whole milk alone, indicating that soy milk can be used as a partial replacement of whole milk at 25 and 50 per cent levels; the latter, with a better FCE and more economical being the most effective level of replacement.

Keywords: Calves, milk replacer, soy milk, body weight, average daily gain, cost per kg gain

07-29

SURVIVABILITY STUDY OF *CAMPYLOBACTER JEJUNI* NCTC 11168 IN RIVER-WATERS OF KERALA

Deepa Jolly, Sunil B., Latha C., Vrinda K.M. and Nithya K.R.

Department of Veterinary Public Health, College of Veterinary and Animal Sciences, Mannuthy.

Background: Campylobacter outbreaks have been a cause for concern, due to it's contamination of untreated water. The mechanisms underlying the survivability of this ubiquitous organism in

water is underestimated. This study was undertaken to evaluate the survivability of a reference human strain *Campylobacter jejuni* NCTC 11168 in riverwater.

Methods: River water samples were procured from seven rivers *viz.,* Bharathapuzha, Chalakudy, Choondal, Karuvannur, Kurumali, Manali and Puzhakkal, were used for the survivability study of *C. jejuni* NCTC 11168 at incubation temperatures, 4°C and 25°C in autoclaved and nonautoclaved water for 60 days. Culturable bacterial counts were taken on days 0, 3, 7, 15, 30 and 60, on Blood-free Campylobacter Selectivity (modified Charcoal Cefoperazone Deoxycholate,) agar media in a carbondioxide incubator at 42ºC for 48h.

Results: On the zeroth day, highly significant difference was observed between the counts of the organism in autoclaved and nonautoclaved samples, between the different months and between rivers and months. On the 7th day of storage, statistically higher significant difference in counts was observed between the four groups and between the months of collection. The mean highest counts were observed in autoclaved water at 25°C from Karuvannur and Kurumali. A significantly higher count was noticed in the autoclaved waters from Chalakudy, Puzhakkal, Bharathapuzha and Manali at 25°C. The maximum period of survival of the *C. jejuni* NCTC 11168 strain in river-waters at 4°C was 60 days under autoclaved conditions and at 25°C, it was 90 days in nonautoclaved water (Bharathapuzha).

Conclusion: Results suggested that the organism exhibited better survivability in riverwaters at higher temperatures, ie., 25°C, compared to 4°C.

Keywords: *Campylobacter jejuni NCTC 11168,* survivability, riverwater

07-30

A SIMPLE METHOD OF CONCENTRATING PYOCYANIN FROM BROTH CULTURE OF *PSEUDOMONAS AERUGINOSA* FOR THE MANAGEMENT OF VIBRIOSIS IN AQUACULTURE

Jini Jimmy& I. S. Bright Singh

National Centre for Aquatic Animal Health, Cochin University of Science and Technology, Cochin-16

Background: Pyocyanin produced by *Pseudomonas aeruginosa,* one of the phenazine derivatives has broad sprectum activity against bacteriaand fungi (Kavitha et al;2005, Arunkumar et al,1997).It has been identified as the keymolecule produced by *P. aeruginosa* and inhibits growth of pathogenic Vibrios in aquaculture systems (Preetha et al;2010, Priyaja et al ;2014).Pyocyanin has been found to be biodegradable by organisms leaving less or no residue (Yang et al; 2007).These facts imply that Pyocyanin can be used as therapeutic agent in lieu of antibiotics for sustainableaquaculture.

Methodology: Drop inoculation methodwas performed to standardize the Number of cells/absorbance (CFU/OD) of *P. aeruginosa*broth culture.Pyocyanin containing crude extract from *P. aeruginosa* culture in ZoBell's marine broth wasextracted. Amberlite extraction was carried out to separate the blue-green fraction from the culture medium. Coloured crude extract adsorbed onto amberlite was eluted using chloroform followed by filtration to remove amberlite. Chloroform was removed from the crude using rotatory evaporator and following which eluted in distilled water to get a final volume of 10ml crude extract for aquaculture applications.

Pyocyanin in the crude extract was assayed by extracting 5ml extract with 3ml chloroform. This was then re-extracted in 1ml 0.2N HCl, which gave a red coloured solution due to the basic property of one of the N atom present in pyocyanin.Absorbance of this solution was measured at 520nm and the concentration in micrograms of the compound produced per millilitre of the extract was determined by multiplying the absorbance by the factor 17.072(Essar et al.1990).Finally,Pyocyanin containing extract was stored at -20°Cprotected from light.

Results: Pyocyanin containing crude extract was prepared from marine isolate of *P. aeruginosa* broth culture for aquaculture applications.Concentration of pure pyocyanin in the crude was determined and anti-microbial activity and quorum quenching property studied.

Key words: Pyocyanin,*Pseudomonas aeruginosa,* Amberlite,Zobell marine media

07-31

MOLECULAR DETECTION OF CANID ALPHAHERPESVIRUS 1 IN PUPPIES FROM KERALA

Pradeep M., Hamza Palekkodan, Anagha A. M., Magnus Paul, Ajith Jacob George

College of Veterinary and Animal Sciences, Pookode, Wayanad

Background : Canid alphherpesvirus 1 (CaHV-1) previously known as canine herpes virus is a pathogenic virus of both the domestic and wild Canidae family. Even though the virus was first identified in the 1960s in the USA and later in different countries, molecular detection was reported from India. in this study, we report the detection of fatal CaHV-1 infection in puppies of Kerala by molecular method

Method: Unusual puppy mortalities in four litters of different breeds (Beagle, Doberman, Rottweiler, and St. Burnard) were investigated. Postmortem of dead puppies was conducted at the Department of Veterinary Pathology, College of Veterinary and Animal Sciences, Pookode, Wayanad. Lesions were recorded and collected samples for Deoxyribonucleic acid (DNA) extraction and detection of canine herpes virus using polymerized chain reaction (PCR) using specific primers targeting gB gene of the virus. The amplified product was sequenced and compared with sequences from different countries available in the NCBI database.

Results: High mortality of puppies were noticed in litters of Rottweiler and St Burnard breeds while other two had mortality of one puppy each. The affected puppies were found to be weaker and emaciated compared to the others of the same litter. Haemorrhagic lesions were observed in visceral organs. The PCR products showed amplification at 450 bp. The sequence had a hundred per cent identity with sequences from other countries such as Australia, USA, and Taiwan except for one sequence each from Brazil and UK with an identity of 99.73 and 99.74 per cent respectively.

Conclusions: The study confirmed the presence of the fatal canine herpes virus in the Indian dog population for the first time and demands further investigation in wider areas and development of effective prevention strategies aginst the fatal disease of puppies.

Keywords: Canine herpes virus, Canid alphherpesvirus 1. Kerala, molecular detection, puppies

08-HEALTH SCIENCES

ORAL PRESENTATION

08-1

ROLE OF CYTOGENETICS, WILM'S TUMOR 1 AND CYTIDINE DEAMINASE IN PREDICTING THERAPEUTIC RESPONSE OF ACUTE MYELOID LEUKEMIA PATIENTS

Akhila Raj TV[1], Geetha Raj JA[1], Geetha N[2], Mahitha MS[1], Amritha P Kumar[1], Devipriya P[1], Hariharan S[1].

[1]Division of Cancer Research, [2]Division of Medical Oncology, Regional Cancer Centre, Thiruvananthapuram, Kerala- 695011, Email: drshariharan@gmail.com, akhilaagnus@gmail.com

Background: Development of drug resistance and resulting relapse is the primary roadblock in the management of acute myeloid leukemia (AML) patients and hence dismal outcome. Therefore, we investigated the role of chromosomal and molecular abnormalities in predicting treatment response of *de novo* AML patients.

Materials and Methods: Cytogenetic profiling of 310 *de novo* non-M3 AML patients were carried to delineate chromosomal abnormalities. Further, mutation status of the hot spot regions of *FLT3*, *NPM1* and *WT1* genes were examined. Apart from this, pre-treatment *CDA* mRNA levels were also evaluated. Association of cytogenetic and molecular characteristics with treatment response, overall- survival (OS) and relapse-free survival (RFS) were analysed.

Results: Among the study subjects, systematic follow-up of patients who underwent conventional chemotherapy (n=184) identified 130 patients as non- responders. Higher frequency of intermediate risk cytogenetics (p=0.0399), *FLT3-ITD* (p=0.4032) and *WT1* mutations (p=0.0032) were identified in the non- responders and influenced the 3-year OS as well (p= 0.0062, 0.0176 and 0.0032). Moreover, *WT1* mutation showed combinatorial impact with cytogenetics, which shifts the prognosis of patients from favourable or intermediate to poor (p=0.0171 and 0.0086). Studies on mRNA level of *CDA* gene showed, higher *CDA* expression was significantly associated with a poor treatment response (p= 0.0003) and reduces the OS and RFS (p= 0.0203). Pre-treatment *CDA* expression level of patients who became non- responsive to the treatment was found to be comparable with those who presented at relapse (p=0.0243).

Conclusion: Our data suggests that risk of drug resistance and the therapeutic response can be predicted through detecting mutations in *WT1* and level of *CDA* gene at the time of diagnosis, hence can refine the pre- treatment risk stratification.

08-2

SYNTHESIS OF KAPPA CARRAGEENAN GRAFTED SILVER NANOPARTICLES FOR WOUND DRESSING APPLICATIONS

Amruth P.[1, 2], Jean Mary Joy [1, 2], Rosemol Jacob M.[1, 2], R. Anandan [1], Suseela Mathew[1*]

[1]Biochemistry and Nutrition Division, ICAR-Central Institute of Fisheries Technology, Cochin-682029, [2]Faculty of Marine Sciences, Cochin University of Science and Technology, Cochin-682022

Background: Reinforcement of effective nanoparticles in Film forming solution (FFS) is found to improve the physical, physico-mechanical, thermal and biological properties of the wound

dressing materials. Silver nanoparticles are known to possess pronounced anti-microbial properties, which remain ideal for wound dressing materials.

Method: Chemical reduction method was used for the synthesis of carrageenan–silver nanoparticles (Car-Ag-NPs) using carrageenan as reducing and stabilizing agent. The synthesis of carrageenan- silver nanoparticles (Car-Ag-NPs) was performed according to the method as described by Kalaivani et al. with slight modifications. 0.5% of carrageenan was prepared and the solution was then filtered to obtain homogenous solution. An aliquot of 5 mL of 0.1 M of $AgNO_3$ and 200 µl of 1 M NaOH were added to homogenous carrageenan solution. AgNO3 and NaOH were freshly prepared. The carrageenan solution was stirred for 3.5 h at 90 °C. The colourless carrageenan solution was changed to light yellow and then to yellowish brown which indicates the synthesis of Chi-Ag-NPs.

Result: The synthesis of Car-Ag-NPs was characterized by UV–visible spectroscopy. The UV–Vis absorption spectra of the synthesized Car-Ag-NPs composite solution, carrageenan solution and silver nanoparticles. The phenomenon of change in colour of solution into yellow, pale yellow and brown indicate the formation of the particles. The particle size of carrageenan and synthesized Car-Ag-NPs had a Z-average diameter of 3803 ± 76.03 and 224.9 ±10.11 according to the size distributions in number in percentage with PDI of 0.396 ± 0.078 and 0.426 ± 0.066.

Conclusion: The carrageenan act as an effective stabilizing and reducing agent to convert metallic silver to nanosize. Therefore, the carrageenan grafted silver nanoparticles is found promising for optimizing polymer-based dressing materials for wound healing applications.

Keywords: Carrageenan, Silver nanoparticles, Wound dressings.

08-3

A CROSS-SECTIONAL STUDY ON PROPORTION OF MASK ASSOCIATED DRY EYE (MADE) AMONG HEALTH CARE WORKERS

Dr. Anjali R, Dr. Remya R, Dr. K Mahadevan

Department Of Ophthalmology, Sree Gokulam Medical College And Research Foundation, Venjaramoodu, Trivandrum, Kerala 695607

Background - During the COVID-19 pandemic, the widespread use of face masks was recommended as a key measure against the spread of SARS-CoV-2. This has led to some concerns. The most important side effect is, it lead to the development of a new medical entity – The Mask Associated Dry Eye (MADE). This study was done to estimate the proportion of mask associated dry eyes among health workers, and to estimate the change in frequency and severity of dry eye symptoms depending on type and duration of mask wear

Method - A cross-sectional study was conducted using google forms in the month of April 2021 in the Department of Ophthalmology, Sree Gokulam Medical College, Venjaramoodu. The study included 203 health workers. Data collection was done using google forms regarding self reported symptoms related to dry eye, the type and duration of mask use. Data regarding other confounding factors were also collected.

Results - Proportion of dry eye among health care workers was 72.9% based on symptoms. The most common symptom among the study population was watering (26.6%) followed by grittiness and foreign body sensation (23.6%). The symptoms were experienced sometimes by 57.1%,

frequently by 13.3 % and constantly by 1%. 23.2 % were previously diagnosed with dry eyes. Among them 28.1 % had increase in severity of symptoms after mask use,11.8% have improved the symptoms and for 31 % stayed the same. 47.8% used a combination of N95 and surgical masks and 31% used N95 mask alone.

Conclusions – The study concluded that a significant number of health care workers had dry eyes symptoms after mask use. Health care workers should be made aware of this entity and should be educated to wear mask properly .The major limitation was lack of clinical conformation of case of dry eye.

Keywords – Dry eye, Mask Associated Dry Eye, Health care workers, COVID-19, N95 Mask

08-4

WHEY PROTEIN SUPPLEMENTATION REDUCES HYPERCHOLESTEROLEMIA AND PRO-INFLAMMATORY CYTOKINES IN HYPOTHYROIDISM

Ann Liya Sajan, Jenat P. Jerom, Ajmal J, Reshma Soman and Dr. R.Harikumaran Nair*

Physiology Research Laboratory, School of Biosciences, Mahatma Gandhi University, Kottayam-686560, Kerala, India

Background: Thyroid disorders are among the most common pathologies worldwide. Hypothyroidism can disrupt metabolism and impair the normal functioning of the liver. Hypercholesterolemia and non-alcoholic fatty liver disease (NAFLD) are prevalent in hypothyroid patients. A short-term in-vivo study was used to determine an effective dosage for whey protein supplement.

Methods: The study was designed for 90 days. Three groups of Wistar albino rats were given 0.05% propylthiouracil (PTU) through drinking water to induce hypothyroidism. Among these, one group served as the induced control group, one received whey protein (500 mg/kg b.wt.), and the last group received L-thyroxine as a positive control. A normal control group was also maintained with a normal whey protein-treated group. The alterations were studied using biochemical tests, radioimmunoassay (RIA), and ELISA.

Result: Significant variations in ALT, AST, total cholesterol, triglycerides, LDL, and inflammatory cytokines like IL6 and TNF-α were seen in the group treated with 500 mg/kg b.wt. of whey protein. Either normal or diseased, protein-treated groups showed an improvement in physiological markers compared to their corresponding control groups. PTU administration alone in rats resulted in hypothyroid pathophysiology.

Conclusion: Overall, the chances for developing hypercholesterolemia were less prevalent in animals receiving whey protein at a dose of 500 mg/kg b.wt. The lower lipid levels and reduction in hepatic and inflammatory markers demonstrate the importance of whey protein supplementation as a dietary intervention.

Keywords: Hypothyroidism, Whey protein, Lipid level, Inflammation.

08-5

VARIATION IN CHOROIDAL PARAMETERS IN RELATION TO SEVERITY OF DIABETIC RETINOPATHY AND ITS SIGNIFICANCE AS AN EARLY PROGNOSTIC MARKER.

Dr Sreelakshmi Prasanth & Dr. Remya Raghavan

Department of Ophthalmology, Sree Gokulam Medical College and Research Foundation, Trivandrum; Email: sreeluprasanth@gmail.com

Background: Diabetic retinopathy is a leading cause of vision loss in the world today. In a country like India, the Diabetic capital of the world with 1.4 billion population and nearly only 25000 Ophthalmologists, we need to introduce newer modalities of diagnosis and management to reduce the burden of this disease. There comes the role of information technology and artificial intelligence in diagnosing the early changes in Diabetic Retinopathy. Diabetic changes are observed in choroidal vasculature, which is an important source of blood supply to outer retina. Studies have shown that decreased choroidal blood flow may occur before the development of clinical manifestations of DR. This study aims to estimate the variation in choroidal parameters and to detect them with not much expertise techniques.

Method: A cross sectional prospective study, with 72 eyes of 72 patients between 35-75 years of age (mean age 56), with type 2 Diabetes Mellitus >5 years of duration attending Ophthalmology OPD at SGMC. After applying inclusion exclusion criteria, patients underwent detailed ophthalmologic evaluation and Extended Depth Optical Coherence Tomography (ED-OCT) for Subfoveal Choroidal Thickness (SFChT) and Parafoveal Choroidal Thickness (PFChT). Choroidal Vascularity Index (CVI) was calculated using binarized OCT images. Patients were divided into two groups; Group I - patients with Diabetic Retinopathy (DR) and Group II – patients without Diabetic Retinopathy (No DR). Group I was further subdivided according to the severity of Diabetes Retinopathy as mild NPDR, moderate NPDR, severe NPDR and treatment naïve PDR. Both SFChT and PFChT was calculated as distance from the lower border of the retinal pigment epithelium (RPE) to the lower border of choroid at respective positions. CVI is the ratio of the choroidal luminal area to the total choroidal area, which was calculated using python programming.

Results: Mean SFChT, mean PFChT, mean CVI is found to be significantly reduced in patients with diabetic retinopathy compared to patients with no DR. Also, these parameters show significantly reducing trends with increase severity of DR.

Conclusion: Study concludes that in patients with Diabetes Mellitus, choroidal parameters are altered and it may be related to the severity of retinopathy. Choroidal blood flow deficit can be an early pathologic change in DR. Therefore, these markers may be able to predict the prognosis of DR in patients with DM at the earliest and help in the active management of DR and DM preventing further vision loss.

Keywords: Diabetic Retinopathy, Choroidal Thickness, Choroidal Vascularity Index, Image binarization, ED-OCT, Choroidal hypoxia,

08-6

"VIRULENCE PROFILE OF STRONG BIOFILM FORMING MULTI DRUG RESISTANT KLEBSIELLA SPP. FROM CATHETER ASSOCIATED URINARY TRACT INFECTION"

[a]Honey Gopinathan, [a]Athira A S, * [a,b] Sarita Ganapathy Bhat

[a]Department of Biotechnology, Cochin University of Science and Technology, Kochi-682022, [b]Inter University Centre for Nanomaterials and Devices (IUCND), Cochin University of Science and Technology, Kerala 682022, saritagbhat@gmail.com

Background: *Klebsiella pneumoniae* is a clinically relevant oppurtunistic pathogen that usually causes nosocomial infections such as pneumonia, urinary tract infections, invasive infections, bacteremia and surgical site infections.

Method: This study explores the biofilm formation, antibiotic susceptibility profiling and virulence profiling of Klebsiella spp. (n = 23) isolated from indwelling urinary catheters. All the Klebsiella spp. were evaluated for their ability to form biofilm on both polystyrene and Natural Rubber Latex surface by crystal violet quantification method. All strains were evaluated for their antibiotic susceptibility by modified Kirby- Bauer method. Multiple Antibiotic Resistance (MAR) index of all Klebsiella spp. were also calculated. Klebsiella spp. were also screened for their β – lactamase production. The detection of virulence genes (*bla_{SHV}, $bla_{TEM,}$, fimH-1, entB, ybtS, mrkD ,uge,iutA,and kfu*) were performed by Polymerase Chain Reaction. All the strong biofilm forming Multi Drug Resistance (MDR) isolates were screened for genes encoding for the multidrug efflux pump system *AcrAB-TolC* and *MdtK*, porin coding genes such as *OmpK35* and *OmpK36*.

Results: All the 23 Klebsiella strains in the study formed biofilms on both polystyrene and natural rubber latex surfaces, but the biofilm formation on the latex material is stronger when compared to the polystyrene material. In this study, among the Catheter Associated Urinary Tract Infection associated Klebsiella spp., 95.6 % were resistant to multiple antibiotics with high-level resistance to third-generation cephalosporin antibiotic Ceftazidime and β-lactam antibiotic Cefotaxime. All Catheter Associated Urinary Tract Infection (CAUTI) isolates except *Klebsiella pneumoniae* strain BTPCE1 showed high MAR indices implying high antibiotic resistance. 73.91% Klebsiella spp. were Extended Spectrum β-Lactamase producers and 4.34 % Klebsiella spp. were Metallo β-Lactamase producers. 23 isolates presented extended-spectrum beta-lactamase-producing *bla_{TEM}* (n=17,73.91%), *bla_{SHV}* (n = 22, 95%) variants genes. The virulence-associated genes found among the 23 Klebsiella spp. were *mrkD* (n = 22, 95%), *fimH-1* (n =16, 69.5%), *uge* (n= 22,95%) *entB (n= 21,91%)*, *iutA* (n=4,17.3%), *Kfu* (n=4,17.3%, ybtS (n = 3, 13%), *OmpK35*(n=23,100% and *TolC* (n=22,95%).

Conclusions: The extensive diversity of strong biofilm forming MDR Klebsiella spp. harboring β-lactams and virulence genes strongly suggest a necessity for the implementation of effective strategies to prevent and control the spread of antibiotic resistant infections.

Key words: *Klebsiella pneumoniae*; multidrug resistance; virulence genes; Biofilm; Catheter Associated Urinary Tract Infections.

08-7

IMPAIRED WNT SIGNALING IN DEVELOPMENTAL LANGUAGE DISORDER

Jesmy James[1], Nisha M L[2], Ayyappan Anitha[1]

[1]Dept. of Neurogenetics, [2]Dept. of Audiology and Speech Language Pathology ICCONS Shoranur 679 523, Kerala

Introduction: Developmental language disorder (DLD) is a common language disorder prevalent in about 7% of school-age children. This neurodevelopmental condition is defined as the failure to develop normal speech and language skills in the absence of environmental/medical/genetic impairment. Alterations in DNA methylation could provide cues to the pathogenesis of neurodevelopmental disorders including DLD. In this study, we examined any differential DNA methylation of genes in individuals with DLD compared with healthy controls.

Methods: Twelve individuals with DLD and 12 age- and gender-matched healthy controls were recruited for the study. Genome-wide DNA methylation (GWMA) was examined using Infinium Methylation EPIC BeadChip. Any differential methylation between the DLD and control samples was examined. The results were validated in an independent set of samples (75 DLD, 75 control) through methylation-specific PCR.

Results: In GWMA, we observed differential methylation of genes that serve as modulators of the WNT signaling pathway. During validation study, significant hypomethylation of *APCDD1* (0.036), *LRP5* (0.003) and *WNT2B* (0.035) was observed in the DLD group, compared to healthy controls.

Conclusion: WNT signaling is fundamental for various neurodevelopmental and post-neurodevelopmental processes. Alterations in WNT signaling pathways have been reported in neurodevelopmental disorders such as autism. This is the first study that indicates the impairment of WNT signaling pathway in DLD, which is also a neurodevelopmental disorder.

Keywords: development language disorder, methylation ,Neurodevelopment

08-8

INVESTIGATION OF ANTI-DIABETIC POTENTIAL OF RESVERATROL DIMER ISOLATED FROM *Vatica Chinensis* IN STIMULATING GLUCOSE UPTAKE IN SKELETAL MUSCLE CELL LINES

Lekshmy Krishnan S [a], Prabha Bernard[b], K.V Radhakrishnan[b], P. Jayamurthy[a]*

*[a] Agroprocessing and Technology Division, CSIR-National Institute for Interdisciplinary Science and Technology, Thiruvananthapuram-695019, [b] Chemical Sciences and Technology Division, CSIR-National Institute for Interdisciplinary Science and Technology, Thiruvananthapuram-695019, *email: pjayamurthy@niist.res.in*

Background: Diabetes is a chronic disease, which is characterized by sustained hyperglycemia. According to the International Diabetes Federation's (IDF) report there are approximately 381 million diabetic patients worldwide, a figure that expects to rise to 592 million by 2035. Even though the currently accessible drugs seem effectual to the patients, numerous drugs have critical side effects. Hence, safer and more effective anti-diabetic drugs are still being explored.

Method: In traditional Ayurveda, numerous plants were used for treating various ailments. Dipterocarpaceae is one such kind of family in which *Vatica chinensis* belongs to. NIIST A1, a resveratrol dimer, isolated from the stem bark of *Vatica chinensis* was assessed for its antidiabetic potential in terms of glucose uptake potential and its associated molecular mechanism in skeletal muscle cell lines.

Results: The concentration of compound was fixed at at 50 µM, which was found to be less than 20% cytotoxic in skeletal muscle lines. The resveratrol oligomer was screened for the anti-diabetic potential in L6 myoblasts via glucose uptake studies using a fluorescent tagged glucose moiety 2-NBDG on a fluorescence microscope and flow cytometry. The results demonstrated that the resveratrol based compound showed remarkable glucose uptake potential, which is the uttermost downstream event in the insulin dependent and insulin independent pathway. To investigate, the signaling pathway circumspect for the resulted glucose uptake, inhibitory studies using PI3-K inhibitor and AMPK inhibitor were performed and found to be activated both insulin signaling and AMPK signaling pathway in skeletal muscle cell lines.

Conclusion: This study demonstrated the anti-diabetic potential of the resveratrol dimer in stimulating glucose uptake and the molecular mechanism of action in skeletal muscle cell lines.

Key words: Resveratrol, Diabetes, L6

08-9

SURVEY AND DNA BARCODING OF MAJOR SECONDARY DENGUE VECTORS *AEDES ALBOPICTUS* AND *AEDES VITTATUS*, WAYANAD, KERALA

Maiby Thankachan and Sebastian C. D.

Division of Molecular Biology, Department of Zoology,
University of Calicut, Kerala 673 635

Background: According to the World Health Organization (WHO), mosquito-borne diseases account for about 17% of the total burden of all infectious diseases. *Aedes* (*Stegomyia*) *albopictus* (Skuse) and *Aedes vittatus* (Bigot) have been gaining prominence in the history of global public health as a fierce invasive species and vectors of several arbo-viral diseases such as dengue fever, chikungunya and yellow fever. These diseases are increasingly becoming a global health concern due to their rapid geographical spread and high disease burden.

Method: The area selected for the present study was Mananthavady Taluk of Wayanad district, Kerala. Mosquitoes were collected from randomly selected sites throughout the study area for a period of one year (October 2019 to September 2020) during the pre-monsoon, monsoon and post-monsoon seasons and identified based on taxonomic keys and expert consultation. Molecular identification was done by mitochondrial CO I gene sequencing and phylogenetic analyses were done using MEGA X software.

Results: Among 3567 *Aedes* mosquitoes collected during the study period, 2309 were *Ae. albopictus* and 105 were *Ae. vittatus.* The mosquito diversity was abundant during monsoon period where intermitted rain favoured their multiplication. The mitochondrial COI gene sequences generated for molecular identification of these species were submitted to NCBI GenBank with the accession numbers MW542315 and MW931755.

Conclusion: Temperature, rainfall, diverse breeding habitats and varieties of plantations causes the abundance of these mosquitoe vectors in the study area. Abundance and vectoral status of these species proved it as a serious threat to public health. Molecular barcodes developed in the study would serve as an effective tool for identification and thereby helps in the control vectors. The study findings will be helpful for researchers and health authorities to design appropriate vector control measures and to mitigate future outbreaks of diseases in the area.

Keywords: *Aedes albopictus, Aedes vittatus,* mosquito vectors, dengue fever, chikungunya, Wayanad

08-10

LECTIN A BIOACTIVE PLANT PROTEIN - REVERSAL MECHANISM OF MULTIDRUG-RESISTANT NON-SMALL CELL LUNG CANCER CELLS

Puja Ghosh [1]*, Dr. Duraiswamy Basavan [1] and Dr. Justin Antony [2]

*[1]Department of Pharmacognosy, JSS College of Pharmacy, Ooty, Tamilnadu, India.[2] Department of Pharmacology, JSS College of Pharmacy, Ooty, Tamilnadu, India. *ghoshpuja392@gamil.com*

Introduction: One of the leading causes of death around the globe is cancer. Despite major advancements in cancer healing approaches over the last few decades, chemotherapy remains the predominant cancer treatment. Multidrug resistance (MDR) in cancer cells is a primary driver of chemotherapy failure in cancer patients with non small cell lung cancer (NSCLC). As a result, innovative, more clinically targeted techniques to treat this condition are desperately needed.

Our focus is to enlighten the underlying reversal mechanism of MDR NSCLC by lectin and to explore and unlock new treatment possibilities.

Methods: This systematic review and meta-analysis (PRISMA) were conducted using various scientific sources including Google Scholar, Medline (PubMed), Scholarly publications (Journals), Professional/Trade sources, Books, Database, Encyclopedias, and Government Documents.

Results: In the preclinical study it is reported that NeuNAcα (2-3) Galβ (1-4) GlcNAc/Glc specific carbohydrate binding protein lectin induce apoptosis to Paclitaxel-resistant NSCLC namely A549/PTX100 and NCI-H460/PTX100 cells, by suppressing Bcl-XL expression, Bax upregulation and enhancing the release of cytochrome C into the cytosol via mitochondrial-mediated signaling pathway**(1)**. Even the combination of lectin with paclitaxel in chemotherapy exhibits significant synergistic activity in NSCLC and induces apoptosis by activating expression of caspase-3,8&9, Bax, Bcl-XL, Bid, and βactin expression via targeting mitochondrial-mediated signaling pathway and inhibit cell proliferation by arresting cell cycle at G2 and M phase**(2)**.

Conclusions: A detailed insight into the mechanisms that seem to be clinically active in combating MDR-NSCLC, the further investigation in the clinical trial is necessary and this helps to understand the reversal mechanism and the newer treatment possibilities in MDR-NSCLC cancer.

Keywords: *Multidrug resistant non small cell lung cancer cells, Carbohydrate binding protein lectin, Synergistic activity, Chemotherapy, Cell apoptosis.*

08-11

PROTECTION OF NORMAL CELLS FROM As_2O_3 BY EUGENOL-AN NMR STUDY

Reshma Soman[1], Binu Prakash[1], Omar Zakhariah Hisham[2], Sunilkumar Puthenpurackal Narayanan[2] and Raveendran Harikumaran Nair[1]

[1]Physiology Research Laboratory, School of Biosciences, Mahatma Gandhi University, Kottayam, Kerala, India-686560

[2]NMR Facility, Institute for Integrated Programmes and Research in Basic Sciences, Mahatma Gandhi University, Kottayam, Kerala, India-686560

Background: Vital organ toxicities are a common side effect on treating leukemic patients with arsenic trioxide. Therefore, the need for co-supplementation with an antioxidant is required to hamper them. This study tries to elucidate the cellular and molecular protective mechanism of the antioxidant eugenol on normal cells while maintaining the therapeutic efficacy of arsenic trioxide on cancer cells.

Methods: Two different types of cells – leukemia (HL – 60) cells and cardiac (H9c2) cells were studied to understand the cell morphology, cell viability, generation of ROS, mitochondrial membrane potential, detection of lipid peroxidation and apoptosis of the cells. To understand the molecular mechanism of action, varying concentrations of arsenic- eugenol mixtures were studied at different pHs, acidic (4-5) and physiological (7-8), and temperatures, 20ºC and 37ºC, with the help of NMR spectroscopy. The normal cells have a pH of 7-8 and the cancer cells have an acidic pH, 4-5.

Results: Cellular studies showed that arsenic trioxide co-supplementation with eugenol helps to restore the cell morphology, cell viability, ROS level and mitochondrial membrane potential. Lipid peroxidation and apoptosis was also alleviated on eugenol cotreatment in the presence of arsenic trioxide. NMR studies showed that eugenol interacts with arsenic at physiological pH forming an inert product, while does not interact with arsenic trioxide at acidic pH.

Conclusion: Eugenol protected the normal cells from the destructive action of As_2O_3 while the therapeutic action of arsenic trioxide on cancer cells was not hindered.

Keywords: Eugenol, Arsenic trioxide, Acute promyelocytic leukemia, H9c2, HL – 60, NMR

08-12

DNA BARCODE IDENTIFIES THIPPALI ADULTERANTS FROM MARKET SAMPLES: AN IMPORTANT AYURVEDIC PLANT

Sandhra Saji, Rahul PR*, Geetha SP, Sadheeshnakumari S and Indira B

*Crop Improvement & Biotechnology Division, Centre for Medicinal Plants Research, Arya Vaidya Sala, Kottakkal, Malappuram-676503, Kerala, India. *Corresponding author Email-rahulpsvj@gmail.com*

Background: Thippali or Pippali in Ayurveda is identified with the fruits (pippali) and roots (pippalimula) of the plant *Piper longum* (Piperaceae) which is widely traded in its dried or powdered forms. The supply of this raw material is mainly through collection from wild sources. Counterfeits and drugs of poor quality reduce the clinical efficiency of ayurvedic drugs. Thus, authentication is a critical measure for successful and reliable clinical application.

Method: (I) In the present study, DNA barcode locus *matk, rbcL,* ITS and trnH-psbA were evaluated for (a) Primer universality & amplification, (b) Sequencing success and (c) Sequence variability; using DNA isolated from plant *P. longum* conserved in the AVS-CMPR herb garden. (II) ITS locus was utilized for identification of three market samples.

Results: The results indicate that primers of *matK, rbcL* and *trnH-psbA* loci are least suited for amplification in *P. longum*, while the primer ITS-P5/ITS-U4 of the ITS locus is the most ideal for amplification and sequencing in *P. longum.* Two market samples (Fruits) were identified as belonging to *P. retrofractum* while the third sample (root) was identified as *P. hapnium*.

Conclusion: The ITS locus is ideal for differentiating the *P. longum* from their adulterants due to abundant nucleotide variations between the close species. The presence of only adulterant species in all the three market samples is rather alarming to say the least, while the presence of *P. hapnium* which is a rare and endangered species endemic to the Western Ghats makes it even worse. It is very disturbing scenario as not only is an already endangered species being further threatened by indiscriminate harvesting, but the original tippalimula raw material is also inadvertently being adulterated with other species. The present study has provided proof of DNA barcode based authentication that can be utilized by regulatory agencies that will help to make herbal products more credible and acceptable.

Keywords: Pippali, Tippali, Ayurved, DNA Barcoding, ITS, *matK, rbcL* , trnH-psbA, Long pepper, Adulteration, *Piper longum*

08-13

LEISHMANIASIS: AN EMERGING VECTOR-BORNE PARASITIC DISEASES IN KERALA STATE

[1]Prasanta Saini, [1]N Pradeep Kumar, [2]Ashwani Kumar

[1]ICMR-Vector Control Research Centre (Field Station), Kottayam, Kerala, India.
[2]ICMR- Vector Control Research Centre, Puducherry, India.

Background: Leishmaniasis is a group of diseases caused by more than 20 species of Leishmania parasites and transmitted by Phlebotomine sandflies. India remains one of the worst affected country due to this disease. Although there is a decline in the leishmaniasis cases from endemic states in the Eastern region of India, both visceral as well as cutaneous form of this disease are being reported frequently from the Western Ghats region of Kerala.

Methods: Cross-sectional epidemiological and entomological investigations for leishmaniasis are being carried out in the state mainly among the tribal areas. Diagnosis of leishmaniasis cases was performed by haematological investigations, ultrasonography, rK39 immunochromatographic dipstick test and histopathological examination of bone marrow biopsy. In addition, all the patient samples were processed for molecular diagnosis using multiple genetic markers (minicircle kDNA PCR, RFLP analysis of 3′UTR HSP-70, larger segment of HSP-70 gene sequences and 6-PGDH gene sequence) towards species/strain level parasite identification.

Result: In this region, both visceral as well as cutaneous leishmaniasis are caused by the zymodeme MON-37 of *Leishmania donovani*. *Phlebotomus argentipes* is the predominant species of sandflies and had been incriminated as the vector of leishmaniasis. Domesticated dogs have been implicated as reservoir host for this disease.

Conclusion: Leishmaniasis is not a notifiable disease in Kerala. Our investigation depicts that *Leishmania donovani* causing both VL as well as CL is in emerging trend in Kerala. These findings warrant the development of systematic surveillance strategies towards its management and thereby the successful achievement of the national elimination goal.

Keywords: Visceral and cutaneous leishmaniasis, *Leishmania donovani*, zymodeme MON-37, Western Ghats; Kerala tribes.

08-14

HYBRID HYDROGEL DERIVED 3D PRINTABLE INK FOR BIOMEDICAL APPLICATIONS

Jyothi B. Nair[a] Lekshmi C. Nair[b]

Accubits Invent Pvt. Ltd., Service Road, Technopark Phase III Main Rd, Main Gate, Kazhakkoottam, Kerala 695582.

Background: Cellulose ethers are currently widely used in pharma and medical industries. Particularly carboxymethyl cellulose (CMC) has got tremendous attention due to its large availability, biocompatibility, simple and affordable synthesis, and stimuli-responsive behavior**.** Currently, 3D printing based on polymers is widely used for many applications due to the easiness of making patient-specific materials and for generating adequate porous structures to maintain humidity. Nowadays cellulose ethers, particularly CMC was used for bio-ink preparation for biomedical applications, especially in wound healing. Nevertheless, modification is required for improving the quality and therapeutic potential. In this context, we have prepared a hydrogel ink based on CMC and plant-derived green emitting carbon dot for 3D printing and exploring its potential in various medical applications, including normal skin incisions, full-thickness skin wounds, and diabetic foot ulcers.

Methods: The various ratios of CMC were prepared via the hydrothermal method. The plant-derived carbon dots were prepared by the solvo-thermal method. The functional properties of the hydrogel were carried out by IR and Raman spectroscopic techniques and morphology was analyzed via microscopic techniques. The optical properties were carried out by UV-Vis and fluorescence spectroscopic techniques.

Results: Herein, we have designed a hybrid hydrogel containing carboxy-methyl cellulose (CMC) as base material Phyto- derived green carbon dot as doping and fluorescent material for enhancing the activity and monitoring the biomedical process. From the different ratios (15%, 5%, 2.5%, 6%) 6% was tuned for manual printability. The printability of the ink was monitored manually by incorporating bromophenol blue as a colouring material. The carbon dot was mixed by using a mortar and pestle. The cocktail is synthesized via the hydrothermal method and is having enhances the activity by combining the properties of CMC and carbon dot.

Conclusion: The designed work is highly significant and innovative upon consideration of the following attributes including (i) It aims to engineer a novel multimodal CMC-C-Dot printing ink that can heal, and monitor, biomedical conditions especially diabetic wound ulcers (ii) It was synthesized from biocompatible natural plant sources using greener hydrothermal reactions, (iii) Together with a smartphone app the C-Dot will act as an indicator for healing process Additionally, the proposed dressing material offers a cooling effect and provides an analgesic effect. Herein both components are cited to have excellent biocompatibility, biodegradability, non-

toxicity, and cost-effectiveness. The novel approach for making a hybrid hydrogel scaffold for anti-inflammatory responses and self-wound healing application is expected to enhance the therapeutic output. In future, the cocktail will be used for generating smart wound dressing materials in clinics, which can be customized for individual requirements.

Keywords: Keywords: 3D printing, herbal plants, carbon dots, Hydrogel, diabetic wound ulcers

08-15

EFFECT OF SARASVATA GHRITA A CLASSICAL AYURVEDIC MEDICINE ON NEUROCHEMICAL MARKERS IN BRAIN TISSUES OF ALZHEIMER'S DISEASE INDUCED RAT

[1]Dr. Thamizh Selvam N, [2] Reshma Anns Raju, [3] Dr. Sanjaya Kumar YR, , [4] Dr. Srikanth Ala, [5] Dr. Sudesh N Gaidhani

CCRAS, New Delhi, [4]Research Officer-Pharmacology [5]Assistant Director-Pharmacology, National Ayurveda Research Institute for Panchakarma, (CCRAS, Ministry of AYUSH, Govt. of India), Cheruthuruthy, Thrissur, Kerala- 679 531

Sarasvata ghrita is a classical ayurvedic medicine widely prescribed in the management of various neurological complications including Alzheimer's disease. The present work was carried out to assess the neuroprotective effect of Sarasvata ghrita in Alzheimer's disease induced animals with reference to biochemical markers.

The study was conducted in Aluminium chloride induced AD model of Wistar Albino Rats. The study had six groups such as Healthy control group, disease control, Sarasvata treatment groups (low, average and high) and standard drug group; having 6 animals in each group comprising both male and female. The study duration was one month and throughout the experiment period, animals were provided with standard diet and water *ad libitum*. Aluminium chloride was administered (300 mg/kgb.wt) orally for all the groups except the control group animals and study drug Sarasvata ghrita was administered orally at the dose of 500, 750 and 1000 mg/kg b.wt for the treatment groups low, average and high respectively. The positive control group received oral administration of Rivastigmine (0.3mg/kg b.wt).

At the end of the experiment, animals were euthanized; blood and tissue samples were collected for detailed analysis. The neurochemical markers such as Brain derived neurotropic factor (BDNF), acetyl cholinesterase (AChE), were also estimated in brain tissues. The study evidenced the enhanced regulations of these parameters and thereby improving the health conditions of the animals. The antioxidant components such as catalase, glutathione peroxidase, glutathione and superoxide dismutase levels were also found to be significantly improved in brain tissues. So, the study scientifically documented the classical AYUSH system of medicine –'Sarasvata ghrita' for its neuroprotective property through extensive studies at biomarkers level.

Key words: Alzheimer's disease, BDNF, Acetylcholine esterase, Sarasvata ghrita

08-16

CLINICAL RELEVANCE OF MOLECULAR AND GENE EXPRESSION SIGNATURES IN AML PATIENTS WITH NORMAL CYTOGENETICS.

Hariharan S, Geetha N, Geetha Raj JA, Akhila Raj TV, Devipriya P, Vineetha RC

Regional Cancer Centre, Thiruvananthapuram

Acute Myeloid Leukemia (AML) is a heterogeneous hematological malignancy. Chromosomal and gene level abnormalities are the reason for the development of this disease. The chromosomal abnormalities are visible in more than 50% of AML patients. In majority of AML patients molecular abnormalities are present. AML patients without any visible chromosomal abnormalities were categorized as Cytogenetically Normal AML (NC-AML). As per WHO classification of AML, Chromosomal and molecular abnormalities are considered as the base of risk classification. Considering these abnormalities patients are classified as Good, Intermediate and Poor prognostic categories. NC-AML is considered as Intermediate prognostic category and is seemingly homogenous and consists of subsets of patients with diverse clinical outcomes. Which is related to acquired gene mutations as well as altered expression profiles within? Molecular screening aids to assess the possibility of drug resistance, relapse and also lead to the discovery of novel therapeutic targets. 2-4 ml of Bone marrow/2-5ml of PB samples were collected from 322 AML patients who were registered in the Medical oncology clinic of the Regional Cancer Centre, Trivandrum. The study was approved by the IRB and Human Ethical Committee of RCC. Cytogenetic analysis (Hi SKYV spectral imaging system, ASI) was performed on Bone marrow samples as per the standard procedure. FISH analysis was done using locus-specific probes. Spectral Karyotyping (Hi SKYV spectral imaging system, ASI) was performed to verify complicated karyotypes. By doing the above experiments AML patients with Normal Cytogenetics were identified. Thus a total of 100 patients were selected. Mutation screening of FLT3 ITD, NPM1, IDH1, IDH2, DNMT3A, ASXL1, CEBPA, RUNX1, TP53, MLL and WT1 were performed in CN AML patients. DNA were extracted from these samples, PCR carried out followed by Single-strand conformation Polymorphism (SSCP) and then by Sanger sequencing. Expression analysis of ERG, MN1, EV1 and BAALC were done by performing Real-time PCR (Quant Studio 6 Flex, Applied Biosystems, USA). 51 of them are females and 49 male patients with mean age 48.53 years. FLT3 ITD mutation was found in 20 patients (20%), NPM1 in 12(12%), WT1Exon7 in 8(8%), Exon9 in none of the patients (0%), IDH1 in 5 (5%), IDH2 in 4(4%), DNMT3A in 6(6%) and ASXL1 in one patient (1%). In Expression analysis, High ERG expression was found in 17 patients, low expression in 80 and there was no amplification in 3 patients. MN1 high expression was found in 9 patients, low expression in 87, and no amplification found in 4 patients. In BAALC expression analysis high expression was identified in 6 patients, low expression in 88, and no amplification in 6 patients. This panel of molecular markers was not done in CN AML patients in India till now. CEBPA, RUNX1, MLL and TP53 show statistical significance. ASXL, IDH1 show mild significance, studies with a large cohort will deliver more number mutation which provides more reliable outcomes.

08-17

SOCIOECONOMIC DIFFERENCES IN ANTHROPOMETRIC AND BIOCHEMICAL RISK FACTORS FOR NON-COMMUNICABLE DISEASES AMONG COLLEGE STUDENTS IN KOLLAM DISTRICT, KERALA

Ms Indu Suresh[1] & Dr Mini Joseph[2]

[1]Department of Home Science, Sree Narayana College for Women, Kollam, Kerala, [2]Department of Home Science, Government College for Women, Thiruvananthapuram, Kerala

Background: Proper surveillance of the risk factors of Non-Communicable Diseases (NCDs) which are the leading causes of death globally, aid in the concerted effort to the prevention and management of these life threatening diseases. Hence the study was conducted with the objective of assessing the biochemical and anthropometric risk factors for NCDs and their association with socioeconomic status among College students in Kollam district, Kerala.

Materials and methods: The study was conducted among one hundred randomly selected female College students in Kollam district, Kerala. Data was collected using a pretested questionnaire. The World Health Organisation STEPwise approach to noncommunicable disease risk factor Surveillance (STEPS) tool version 3.2 was adapted to gather information on biochemicaland anthropometric risk factors. Fasting blood samples were analysed for blood glucose, total cholesterol, High Density Lipoprotein (HDL) cholesterol and triglycerides. Anthropometric measures such as height, weight, hip circumference and waist circumference were taken. Multi correlation analysis and Chisquare tests were done.

Results: Biochemical assessment revealed that fasting blood sugar levels fell within the normal range for the subjects whereas 18 % had hypercholesterolemia. Abdominal obesity was found among 16% of the subjects. Multi correlation analysis revealed that significant correlation existed between biochemical risk factors such as total cholesterol and HDL cholesterol and the occupation of the head of the family, and also between the triglycerides and monthly income of the family. Chisqaure analysis showed a significant association between socioeconomic status and total cholesterol and body mass index of the subjects. Weight was found to be significantly correlated with family size of the subjects. Correlation analysis also revealed that height was significantly associated with fasting blood glucose and total cholesterol of the subjects.

Conclusion: It was interesting to notice that association was found among the factors assessed. Since youth is known for experimentation and susceptibility to adopt lifestyles predisposing to NCDs, assessment of major risk factors of NCDs and their awareness among youth is an important component of population-based NCD prevention strategy.

Keywords: Non-communicable diseases, biochemical risk factors, anthropometric risk factors, socioeconomic status.

POSTER PRESENTATION

08-18

NOVEL SMALL MOLECULE INHIBITORS TARGETING Na+ EFFLUX PUMP OF MALARIA PARASITE, *PLASMODIUM FALCIPARUM*

Akhila T P[1], Keerthy Reghunandanan[1], Nandini R Krishnan[1], Darsana K M[1], Shijulal Nelson Sathi[2*], Rajesh Chandramohandas[1*]

[1]Laboratory of Red Cell Diseases, Pathogen Biology DBT-Rajiv Gandhi Centre for Biotechnology, [2*]Computational Biology and Bioinformatics Laboratory, Transdisciplinary biology DBT-Rajiv Gandhi Centre for Biotechnology*

Background: Malaria is a life-threatening infectious disease caused by protozoan parasites belonging to the species *Plasmodium*. Due to the wide-spread resistance to existing antimalarial drugs, it is crucial to discover new drugs with unique targets and novel modes of action. In the present study, we set up *in silico* high-throughput virtual screening of chemical library made available through MMV known as Pandemic Response Box to identify potential small molecule inhibitors of *Pf*ATP4, a conserved Na+ efflux transporter in *Plasmodium*.

Methodology: The predicted structure of the *Pf*ATP4 was downloaded from UniProtKB in PDB format. The ligands were downloaded from the NCBI PubChem databases in 2D (SDF) format to perform screening against *Pf*ATP4. Molecular docking of ligands against *Pf*ATP4 was performed using Schrodinger following standard procedures.

Results: Out of 400 molecules screened**,** Two molecules, MMV1580490 and MMV1580840 Showed a glide score of -6, with the lowest binding energy. The total interaction energy of the reference compound, Spiroindolone (Cipargamin) was -3.03 kcal/mol, which was less than the total interaction energy of the lead compounds identified in our virtual experiments.

Conclusion: The two prime compounds identified, MMV1580490 and MMV1580840 were possessing superior inhibitory potential than the already known inhibitor of *Pf*ATP4, Cipargamin, making them ideal for follow up experiments. The strong interactions shown by these compounds predict that they can be used us potent inhibitors of *Pf*ATP4. Further studies should be conducted, including the *in vitro* validation of these molecules as potential drug targets.

Keywords: Malaria, MMV Pandemic Response Box, Molecular Docking, Schrödinger

08-19

PROSPECTIVE STUDY ON DETERMINING THE EFFECTS OF MATERNAL HYPERGLYCEMIA ON PLACENTA, MATERNAL AND CORD BLOOD IN PREGNANT WOMEN

Aswathy S[1,2], Surya Ramachandran[3] and Abdul Jaleel K.A[1]

Cardiovascular Diseases and Diabetes Biology, [1]Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram, [2]Manipal Academy of Higher Education, Manipal, Karnataka
[3]Gujarat Biotechnology University

Background: Intrauterine events can shape fetal life and influence the future health of the offspring. Pregnancy is a period in which the fetus develops in an incubation milieu of maternal fuels. These fuels cross from the maternal compartment to the fetal environment via the placenta.

The placenta regulates the intrauterine environment through fetal programming. Hyperglycemia is one of the major risk factor affecting the fetal environment. Any changes in the supply or function in the maternal fuels due to hyperglycemia influence the fetal life. In this work we are trying to study the effects of hyperglycemia in pregnant women in terms of inflammatory markers, oxidative stress and its association with expression of glucose transporters, insulin receptors and genes encoding hyperglycemia mediated endothelial dysfunction.

Method: Hyperglycemic pregnant women are the subjects of our study. Subjects were selected on the basis of the diagnostic criteria by IADPSG. Concentrations of inflammatory cytokines like TNF alpha, IL-6 was measured in maternal and cord blood of the pregnant women using ELISA kits. Also, oxidative stress was measured using TBARS assay. For morphological analysis, the placenta collected was fixed, embedded and cross sections were prepared. Then paraffin sections were stained with hematoxylin & eosin and analyses were performed by using Image Pro Plus Software. q-RT PCR was performed to determine the mRNA expression of glucose transporter genes, insulin receptor genes and genes encoding for hyperglycemia mediated endothelial dysfunction.

Results: We observed an increase in the inflammatory marker, TNF alpha and IL6 in both maternal and cord blood in hyperglycemic pregnant women. An increased oxidative stress was observed in hyperglycemic pregnant women as compared normoglycemic pregnant women. We observed fibrinoid deposits in the hyperglycemic placenta as compared to normoglycemic placenta. Also, the transcript levels of *SLC2A1, IRS1, GFPT1, AKR1B1, PRKCZ, AGER, DDOST, LGALS3* were elevated in hyperglycemic placental samples when compared to normoglycemic placental samples and the differential expression was significant ($p<0.05$)

Conclusions: The inflammatory cytokine levels of TNF alpha and IL-6 was found to be higher in hyperglycemic pregnant women as compared to normoglycemic pregnant women. Also the oxidative stress level was increased. Elevation in the expression of glucose transporters and insulin receptors indicate that there is an increased flow of glucose into placenta. This could further lead to a rise in the levels of TNF alpha and IL-6 which indicates the chances of inflammation and oxidative stress in the maternal and cord blood.

Keywords: Maternal hyperglycemia, Oxidative stress, Inflammation, Glucose transporters, Insulin receptors

08-20

DIFFERENTIAL METABOLIC PATHWAY IN B3A2 AND B2A2 TYPE CML IDENTIFIED USING MULTIOMICS APPROACH

Athira Raveendran[1], **Chandran K** [2] ,**VipinGopinath**[1], **Deepak Roshan VG**

Division of Genetics, Malabar Cancer Centre, Thalassery[1]*, Department of Clinical Hematology and medical oncology*[2] *, Malabar Cancer Centre, Thalassery*[2]

Background: Cancer cells have unlimited replicative potential, insensitivity to growth-inhibitory signals, evasion of apoptosis, cellular stress, and sustained angiogenesis, invasiveness and metastatic potential. Cancer cells adequately adapt cell metabolism and integrate several intracellular signaling to promote cell survival and proliferation. Molecular characteristic feature of Chronic myeloid leukemia (CML) is the presence of Philadelphia chromosome resulting from a reciprocal translocation between chromosomes 9 and 22 .Majority of CML patients harbor either

B3A2 or B2A2 and rarely express both transcripts. Both these transcripts shows differential molecular response to tyrosine kinase inhibitors. The undelying mechanism of differential molecular response is unknown.

Methods: We used bioinformatics tools to find the difference in molecular structure of B2A2and B2A2 isoforms. We conducted multi-omics comparative analysis, in which we used transcriptomic, proteomics and metabolomics profiling of K562 and KCL22 cell line and B3A2 and B2A2 patient sample to evaluate the phenomic alterations associated with B3A2 and B2A2 subtypes of CML. KEGG tool was used to perform pathway enrichment analysis.

Results: Few regions showed a distinct difference between the b2a2 and b3a2 isoforms. Overall, the gene expression and protein level data from our study suggest that metabolic pathway is significantly altered between B3A2 and B2A2 types. This may affect the molecular responses shown by patients having B2A2 and B3A2 subtype.

Conclusions: Understanding of the downstream molecular mechanism underlying the differential molecular response between B3A2 and B2A2 isoform will provide an advantage for developing new therapeutic management strategies.

Keywords: CML**,** leukemia, Metabolic pathway, B3A2, B2A2

08-21

MOLECULAR ANALYSIS ON NOSOCOMIAL SEPSIS OUTBREAK IN GOVERNMENT MEDICAL COLLEGE KOTTAYAM.

Chithra C Nath[1#], Sreejith S[2], Shoba Kurian Pulikkoottil[1], Radhakrishnan EK[2]

[1] Department of Microbiology, Government Medical College, Kottayam
[2] School of Biosciences, Mahatma Gandhi University, Kottayam
#Corresponding author- chithracnathknpy@gmail.com

Sepsis and related organ dysfunction have higher mortality rate in patients admitted in intensive care unit due to various disease conditions. Emergence of Carbapenemase producing *Enterobacterales* such as *Klebsiella pneumoniae*, the most common pathogen responsible for nosocomial infections possess a major threat to the patients as well as the clinicians. This study focuses on molecular identification of isolates obtained from patients with features of sepsis as well as environmental samples to find out the circulating nosocomial pathogens during an outbreak. Among the 250 positive blood cultures, *Klebsiella pnemoniae* were the most *common (*30%) followed by *Pseudomonas aeruginosa* (15%) and *Escherichia coli* (14%) in which 72 % of the *Klebsiella pneumoniae* were Carbapenemase producers. The suspected pathogens from the environmental samples showed similar phenotypic characters and antibiogram. The detailed phylogenetic analysis of pathogens using 16s rDNA revealed close identity with their respective hospital environmental isolates. The selected samples from nosocomial outbreaks showed high prevalence of the *K. pneumoniae* in different ICUs. The phylogenetic analysis confirmed the similarity of the pathogen with their environmental sources. The results identified a single *K. pneumoniae* strain as a common circulating pathogen among the various ICUs. This study revealed the importance of continuous monitoring of nosocomial outbreaks in hospitals. Early identification of pathogens and proper infection control measures may help to tackle such outbreaks. Emergence of Extensively Drug Resistant (XDR) and Pan Drug Resistant (PDR) among the cases clearly

reflects the need of implementing proper diagnostic as well as antibiotic stewardship in health care system.

08-22

MEASLES SPECIFIC ANTIBODY RESPONSE IN INFANTS BELOW 9 MONTHS OF AGE FROM TRIVANDRUM, KERALA

Jayalekshmi. D, Remya V.S, Archana M.A, Vishnu V.M, Remya. R, Iype Joseph, M.R.Pillai and Sara Jones

Pathogen Biology, Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram-695014, Kerala, India

Measles is a global public health problem and a leading cause of childhood morbidity and mortality. According to studies in 2020 most of the developed countries eliminated measles but the disease remains endemic in different regions because of low or minimal vaccination coverage. In India, though there are active immunization programs against the measles virus, recently due to covid-19 pandemic, most of the states in India failed to immunize children increasing susceptible populations and hence resulting in measles outbreaks in several states, including Kerala. Measles vaccine is routinely administered at the age of 9-12 months and at 15-18 months. The effectiveness of measles vaccine is greatly impacted by the levels of maternal antibody in children below 9 months of age. Maternal antibodies mainly interfere with antibody production and immune response and rate of decay of maternal antibody after child birth. The main aim of our study was conducted to understand the prevalence of measles antibodies in maternal and infant below nine months of age. We screened for measles-specific IgG antibodies in 32 children and 29 Mother's to understand the IgG titers in infants and mother. In children IgG specific antibodies were less than 9 NTU and mother ranged between 3.7 to 57 NTU. Significant association was found between negative immune response to under-nutrition, lack of exclusive breast feeding. Our investigation among the Kerala children also demonstrated that children under the recommended vaccination age of nine months are highly susceptible to measles.

Keywords: Antibody, Immune response, Measles, Kerala, Seropositive

08-23

RHYNCHOPHYLLINE-A PLANT ALKALOID REDUCES FOAM CELL FORMATION IN HIGH GLUCOSE ACTIVATED MACROPHAGES.

Jeeva Prasannan[1,2], Dr. Surya Ramachandran[3], Dr. Abdul Jaleel K.A[1]

Cardiovascular Diseases and Diabetes Biology, [1]Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram, Kerala, [2]Manipal Academy of Higher Education (MAHE)
[3]Gujarat Biotechnology University (GBU)

Background: Diabetes induces the development and accelerates the progression of atherosclerosis, a chronic inflammatory disorder that is a major source of cardiovascular diseases. Rhynchophylline is a plant-derived alkaloid with anti-inflammatory activity, known for its protective effect on the central nervous system and cardiovascular systems. As chronic inflammation is a connecting link between diabetes and atherosclerosis, the present work addresses the potential of Rhy in the prevention of hyperglycemia-induced atherosclerosis.

Method: THP1 monocytes cultured in 5mM (normal glucose) and 20mM (high glucose) glucose RPMI were used. PMA-differentiated macrophages were triggered to uptake the lipids by Ox-LDL treatment. The levels of secretory inflammatory cytokines were measured by ELISA and the gene expression analysis was done by RT-PCR. Total ROS levels in the cells were measured by cell ROX assay and TBARS assay. ORO staining and immunofluorescence assay were done to evaluate macrophage lipid uptake and foam cell formation. The gene expression of scavenger receptors CD36 and LOX-1 was done by RT-PCR.

Result: The gene expression and ELISA results showed that Rhy has a potent anti-inflammatory effect in Ox-LDL-induced inflammation, especially in high glucose conditions. The cell ROX assay and TBARS assay results demonstrate that Rhy can substantially decrease the Ox-LDL-induced oxidative stress in both glucose conditions. From ORO staining and immunofluorescence assay it is evident that Rhy can repress the Ox-LDL uptake by macrophages and foam cell formation by reducing the expression of scavenger receptors.

Conclusion: The present work demonstrates the role of Rhynchophylline in preventing macrophage lipid uptake and subsequent foam cell formation in hyperglycemia in addition to the anti-inflammatory and anti-oxidative stress effects.

Keywords: Diabetes, atherosclerosis, chronic inflammation, Rhynchophylline.

08-24

DISCOVERY AND VALIDATION OF EGRESS INHIBITORY SMALL MOLECULES AS POTENTIAL NOVEL ANTI-MALARIALS

Keerthy Reghunandanan[1], Alok Patra[2], Rajesh Chandramohanadas[1, 2*]

[1] Laboratory of Red Cell Diseases, DBT—Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram, Kerala [2*] Singapore University of Technology & Design, Singapore*

Background: A systematic, cellular phenotype based antimalarial screening study using the MMV Pathogen Box, a chemical library comprising of 400 diverse molecules, identified 12 compounds to inhibit the schizont stage (late asexual stage of development), of *P.falciparum* Among the hits, compounds MMV026356 and MMV675968 were taken for target engagement study, as these molecules reported to exhibit egress phenotypes in the previous literatures. Protein-target engagement utilised MS-CETSA (Mass spectrometry-Cellular thermal shift assay) proteomics and computational studies. The computational study predicted the most probable protein- targets for specific anti-malarial compounds.

Methodology: The study began with phenotype-based screening and prioritization of molecules using flowcytometry and microscopic validation. The priority hits were undergone mass spectrometry (CETSA). CETSA was followed by *in-silico* molecular docking and molecular dynamic simulation studies.

Results: Following the phenotypic screening and CETSA, in-silico screening produced the best docked stable conformations for MMV67968 these were discovered as ras-related protein Rab-18, 40S ribosomal protein S21e, 60S acidic ribosomal protein P2, acyl-CoA synthetase, and acyl-CoA binding protein, putative. And for compound MMV026356. This include acyl-CoA synthetase (ACS10) , methionine--tRNA ligase 53 (MRScyt),T-complex protein 1 subunit epsilon (CCT5) ,T-complex protein 1 subunit gamma (CCT3), heat shock protein 70 (HSP70-x).

Conclusion: The phenotype-based screening revealed 21 molecules that inhibited the schizont-ring transition (with ≥50% parasites failing to proceed to the next stage) at 1 μM. The 12 hits on subsequent rescreening were selective blockers of the schizont-ring transition were validated in microscopy. The target engagement study for the molecules MMV675968 and MMV026356 using CETSA -Proteomics revealed several drug-target proteins. MD simulations were carried out after successive molecular docking, which produced significant clear results of which suggest that the top ranked compounds are the highly possible targets of the compounds.

Keywords: Malaria, MMV Pathogen Box, Phenotype based screening, MS-CETSA proteomics, Molecular docking, Molecular dynamic simulation.

08-25

HIGH YIELD PRODUCTION AND PURIFICATION OF RECOMBINANT WEST NILE VIRUS NS1 PROTEIN

Meenakshi Mohan S[1], Rajesh Kumar[1]*

*[1] Department of Virus Applications, Institute of Advanced Virology (IAV), Bio 360 Life Science Park, Thonnakkal, Thiruvananthapuram, Kerala *Corresponding author: rajesh@iav.res.in*

Background: West Nile Virus is a positive sense, single stranded RNA virus of Flaviviridae family which is transmitted to humans through infected culex mosquitoes. Centers for Disease Control and Prevention (CDC) reports that West Nile Virus is the leading cause of mosquito borne illness in United States. To date there are no vaccines to prevent and no medications to treat them. Symptoms occur from 3 to 14 days after being bitten by an infected culex mosquito. So early diagnosis is very crucial in treating the West Nile infected individuals. West Nile viral genome consists of 3 structural and 7 non-structural proteins among which NS1 protein is considered as a key protein against host innate immunity and acts as a cofactor in viral RNA replication. It is a highly conserved secreted glycoprotein that won't package with the virion. NS1 has been used as a diagnostic marker for flavivirus infection due to its complement-fixing properties and specificity. Its role in disease pathogenesis, and the strong humoral immune response resulting from infection, make NS1 an excellent target for diagnostic and therapeutic candidate in flavivirus vaccines.

Method: The bacterial cell codon-optimized nucleic sequence of the WNV ns1 gene was cloned into pET-28a (+). The NS1 protein was expressed in *E. coli* BL21 (DE3) bacterial strain. The culture was induced with 1mM isopropyl b-D-thiogalactopyranoside (IPTG) at A_{600} 0.4–0.6 and incubated at 37°C for 3 h. The NS1 protein was purified from the inclusion bodies using the urea denaturation method followed by Ni–NTA affinity chromatography. The denatured protein was refolded using step vise removal of urea in phosphate buffer saline. The purity of the expressed and refolded protein was accessed by running 12% Sodium dodecyl sulfate (SDS) polyacrylamide gel electrophoresis.

Results: The WNV NS1 protein was fused to a 6x-His tag at the C-terminus. The majority of the protein was overexpressed in the inclusion bodies and was purified using the urea denaturation method and purified by metal affinity chromatography. The denatured protein was refolded using step vise removal of urea in phosphate buffer saline. The renatured protein was quantified using nanodrop and had a concentration of 0.54 mg/ml with >95% purity. On SDS-PAGE analysis, a band of the expected size of 42 kDa was observed, confirmed by Western blotting. The yield of the purified NS1 protein was 40 mg/l culture.

Conclusion: This work determines the size, quality and quantity of the isolated West Nile NS1 protein that can be further used for diagnostic kit development to detect early viral infections and generation of monoclonal antibody using hybridoma technology by immunizing animal models.

Key words: West Nile NS1 protein, Inclusion bodies, *E. coli*, Super broth, IPTG, SDS-PAGE.

08-26

CDKN2A,CCNE 1 ,CDK4 AND CDK2 CELL CYCLE GENES ASSOCIATED WITH PROGNOSIS IN COLORECTAL CANCER :TCGA ANALLYSIS

Nasheeda Rasheed K[1] Deepak Roshan[1] VG Nisamudeen MP[2] VipinGopinath[1]

Division of Genetics, Malabar Cancer Centre, Thalassery1, Department of surgical oncology, Malabar Cancer Centre, Thalassery [2]

Background : Colorectal cancer is the third most leading cancer on the globe and a macausing cancer related deaths. Colorectal cancer(CRC) has served as a genetic and biological paradigm for the evolution of solid tumors, and these insights have illuminated early detection, risk stratification, prevention, and treatment principles. About cancer related deaths 8.5% deaths happened due to CRC and 92% survival rate for stage1 patients compared to 10% in stage IV.CRC has a poor prognosis and there is a critical need for prognostic and diagnostic tools such as biomarkers to keep away CRC related deaths.

Method: DEGS (diffentially expressed genes) in CRC from TCGA using cBioportal .

The altered genes in cell cycle and DNA repair mechanism has been downloaded from cBioportal In a single-cancer query, users can explore and visualize genomic alterations in colon cancer adenoma and download gene expression data .Gene expression frequency analysed in onco print .Overall survival analysis done using kaplan meier survival plot .Correlation analysed using box - whisker plot between mutated genes in DNA repair mechanism and altered genes in cell cycle mechanism.

Result: We identified four genes CDK4 ,CCNE ,CDK2,CDKN2A in cell cycle with an overall poor survival with a significant p value of <0.001 using kaplan meier plot .

Conclusion: CDK2, CCNE1, CDK4 and CDKN2A involved in promoting the process of tumorigenesis through cell cycle pathway.As a result, the four genes could significantly affect the prognosis of colon cancer patients ultimately.

Key words: Colorectal Cancer, biomarker, TCGA, cBioportal

08-27

ANTIMICROBIAL BIOGENIC AGNP-CQD NANO COMPOSITE FROM SILKWORM EXCREMENT

Nayana A R[1], Kago Kabelo[1,] Dr. Keerthy T R[1*]

School of Biosciences, Mahatma Gandhi University, P.D Hills (P.O), Kottayam, Kerala, Pin: 686 560, India

Background: The main burning issue faced by medical practitioners in developing as well as developed countries is the spread of antibiotic resistance. Nanoparticles have shown great potential

in solving the problem of bacterial multidrug resistance and are regarded as viable alternatives to antibiotics. Silver nanoparticles (AgNPs) having antibacterial activity can be very useful in fighting against antibiotic resistance. Numerous studies have demonstrated that the synergistic effect of AgNPs with other materials can enhance antibacterial activity, while also efficiently decreasing the size and preventing the aggregation of AgNPs. Finding suitable surface support materials for silver nanoparticles can retain their antibacterial activity while having better stability. CQDs are a new type of metal-free fluorescent nanoparticle and have drawn wide attention from scholars due to their simple synthesis, low toxicity, good biocompatibility and easy surface modification.They have exceptional applications in numerous areas as protective coatings, as antimicrobial agents, electronic and optical devices and pollution stoppage materials. However, the bactericidal activity of CQDs is dependent on the chemistry and size of their surface. Nano composites can be composited with silver nanoparticles and carbon quantum dots for a more rational design, which combines the biological properties of carbon quantum dots with the antibacterial properties of silver nanoparticles for potential improvement.

In recent years, the world has been on the goals of sustainability and reuse, especially waste materials. Silkworm excreta are produced in tonnages each year and the most common usage is composting or manure. In customized Asian medicine, excreta have been used as a healing agent to treat infectious diseases, headache and abdominal pain, as well as lower LDL cholesterol and blood pressure. Hence, usage of silkworm excreta pellets in manufacture of AgNP-CQD nanocomposite will also aid in this new world sustainable goal.

Method: AgNP-CQDs composite was synthesized by a one-step green approach from silkworm excrement extract. Characterisation was done by use of UV spectrophotometer, Photo luminesces (PL) and Fourier-transform infrared spectroscopy (FTIR) as well as TEM analysis. Antimicrobial effects were tested against on both gram negative and gram positive organisms. The minimum inhibitory concentration (MIC) and minimum bactericidal concentration of Nano composite were also determined. Antioxidant activity of AgNP-CQDs composite were analysed by DPPH radical scavenging assay.

Results: Carbon nanoparticles production was confirmed firstly by visual change of solution from yellowish to a dark brown after high temperature treatment.These were further confirmed by UV spectrophotometry with peaks at 450nm and PL at the same peak. FTIR was also used for further verification.TEM image indicates that the prepared CQDs are fairly uniform and their sizes are below 10 nm.We used the synthesized CQDs as reducing and stabilizing agents for preparation of stable AgNPs-CQD nanocomposites. It possessed AgNPs naturally surrounded by CQDs, and the size of the particles was found to be uniform and stable *via* a series of characterization methods such as UV spectrophotometry, PL, FTIR and TEM analysis.The antibacterial properties of the composite material were studied, and it had good antibacterial properties against *S. aureus*, *E. coli*, *C.albicans* and *G.vaginalis*. In addition, the AgNPs-CQDs composite had a higher antioxidant activity value compared to vitamin C.

Conclusion: The AgNP-CQD nano composite biosynthesized from waste material silkworm excreta in the present study are stable, water-soluble and having photo luminescent property, which might be applied in a wide range of areas including biomedical applications. Supporting to this composite has anti-oxidant and antibacterial activity.

Key words: Carbon quantum dots, Silver nanoparticle, Nano composite, antibacterial activity

08-28

FORMULATION AND EVALUATION OF AYURVEDIC ANJANAM MADE USING *VERNONIA CINEREA* EXTRACT MEDIATED SILVER NANOPARTICLES.

[a]Priya Prasannakumar, [b]Babitha TD, [c]Dr Robert AntonyA, [d]Dr Sreeja R, [e]Savithamol C

[a] Govt Arts and Science college , Kozhinjampara, [b]Technical Supervisor, Oushadhi, , [c] Govt Arts and Science college , Kozhinjampara, Quality Control incharge, Oushadhi, Pharmacist, Oushadhi

Ayurvedic eyeliner, or Anjanam, is an eye ointment made with herbs that also acts as a cosmetic product. Since ancient times, people have used anjana to maintain eye health and enhance facial beauty. Medicated anjanam has the ability to cool the eyes, treat inflammation, and relax stressed, injured eyes. *Vernonia cinerea* is widely used in Ayurveda, Siddha, and folklore medicines to treat conjunctivitis and is purported to have anti-cataractogenic activity.
Of the many metallic nanoparticles used in biomedical applications, silver nanoparticles (AgNPs) are one of the most important and fascinating nanomaterials. An enhanced antibacterial effect has been reported by using silver nanoparticles. Our study is aimed at synthesizing silver nanoparticles (AgNPs) using the green method with the aqueous extract of *Vernonia cinerea*. The synthesis of AgNPs was confirmed by UV–Vis spectroscopy (UV–Vis.),Transmission electron microscopy (TEM) and Fourier transform infrared (FTIR) spectroscopy. The resulting product can be used as a novel cosmeceutical. This is then used to make anjanam with the help of the traditional method. The formulation is evaluated using different parameters, like pH, spreadability, organoleptic properties, and antimicrobial activity.

Keywords: *Vernoniacinerea* (VC); AgNPs, anjanam, antimicrobial activity.

08-29

DEVELOPMENT OF A HERBAL-SYNBIOTIC FORMULATION AS A VEHICLE OF A POTENT PROBIOTIC BACTERIA *LACTOBACILLUS PLANTARUM* KX519413 FROM HONEY BEE GUT

[1]Rakhie Narayanan, [2]B Aparna, [3]Keerthi T R

[1&2]School of Biosciences, Mahatma Gandhi University, Kerala, [3]School of Biosciences, Mahatma Gandhi University, Kerala

Background: Probiotics are available for consumption as dietary supplements or as lyophilized powder. The success of the mode of delivery of probiotics lies in the survivability of probiotics in it. The present study aims to develop a herbal- synbiotic formulation as a delivery vehicle for the probiotic *Lactobacillus plantarum*.

Method: Developed a herbal- synbiotic formulation with *L.plantarum*, ginger, tulsi, honey and acacia gum. The concentration of each component in the syrup combination was standardized based on the survivability of *L. plantarum* in it. The functional properties of the syrup was determined by its antibacterial activity, phagocytic index, and antioxidant activity.

Results: Honey and Acacia gum at a concentration of 60% in distilled water and herbal extracts at a concentration of 50% in distilled water was best for maintaining the cell count of *Lactobacillus*. The 30:30:10:10 volume ratio of honey: acacia gum: ginger: tulsi gave the highest stable Lactobacillus count. The enteric pathogens like *Escherichia coli* and *Vibrio cholera* exhibited sensitivity to the syrup in well diffusion assay. It also enhanced the phagocytic activity of

macrophages in vitro. Even though all the formulation components have antioxidant properties, the synergistic effect is less than the individual.

Conclusion: An attempt to formulate a herbal symbiotic combination is very promising but need several important parameters to be standardized before commercialization.

Keywords: Probiotic; Prebiotic; Herbal extract; Herbal- synbiotic formulation

08-30

HIGH FAT-HIGH FRUCTOSE DIET ELICITS HYPOGONADOTROPISM CULMINATING IN AUTOPHAGY-MEDIATED DEFECTIVE DIFFERENTIATION OF OVARIAN FOLLICLES

C.T. Rejani[1] and Venugopal Bhuvarahamurthy[1]

[1]Department of Medical Biochemistry, Dr. A.L.M. Postgraduate Institute of Basic Medical Sciences, University of Madras, Chennai, 600113, T.N., India.
rejanict.unom@gmail.com; bhuvarahamurthy@unom.ac.in

Nutritional status determines the attainment of reproductive potential in an individual. The intake of high fat-high sugar diet has been linked to adverse effects on female reproductive functions. The precise interplay of gonadotropins and steroid hormones is critical for follicle growth and differentiation. Furthermore, autophagy regulates ovarian follicle differentiation. However, how the high-fat-high fructose (HFD-HF) diet regulates gonadotropins and facilitates autophagy-mediated follicular differentiation in the ovary is obscure. We fed prepubertal rats (PND 25) an HFD-HF diet until PND 90. The diet altered T, E2, P4, PRL, and their receptors status in the ovary, resulting in gonadotropins decline. It also disturbed estrous cyclicity and delayed the vaginal opening of the HFD-HF-fed rats. Ovarian histomorphology exhibited numerous cystic and atretic follicles, along with disturbed follicular maturation and ovulation. Moreover, the reduction of FSHR; receptor proteins AR, Erβ, PR; and signaling proteins Wnt2 and β-catenin was also noticed in the ovary, whereas PRLR, inhibin, and pGSK3β were augmented. Interestingly, autophagy biomarkers, Beclin-1, ATG5, ATG12, LC3-II, and LAMP1 were reduced but SQSTM1/p62 was augmented in the ovaries of HFD-HF-fed rats, causing autolysosome to aggregation. In conclusion, exposure to a prepubertal HFD-HF diet leads to hypogonadotropism and the autophagy-mediated defective differentiation of ovarian follicles, abating fertility in adult rats.

08-31

SYNTHESIS AND BIOCHEMICAL CHARACTERIZATION OF CHLORHEXIDINE-GRAFTED NANOCHITOSAN FILMS

Rosemol Jacob M[1,2], Amruth P[1,2], Preethy Treesa Paul[1,2], Pavan Kumar Dara[1], Suseela Mathew[1], R Anandan[1*]

[1]Biochemistry and Nutrition Division, ICAR-Central Institute of Fisheries Technology, Cochin-682029, Kerala, [2]Faculty of Marine Sciences, Cochin University of Science and Technology, Cochin-682022, Kerala, kranandan@rediffmail.com

Background: Chitosan, a marine biopolymer chiefly derived from exoskeleton of crustaceans, is the most extensively exploited polysaccharide due to its excellent chemical versatility, mucoadhesion and biocompatibility properties. It is structurally N-acetyl glucosamine derivate

constituting amino and hydroxyl groups. Biomaterials based on chitosan have demonstrated significant benefits in a variety of applications, such as medication administration, clinical diagnostics, cell culture, and tissue engineering. However, the widespread use of chitosan-based biomaterials has been impeded due to the lack of control over the production processes via conventional approaches. The fabrication of high-performance chitosan-based multifunctional biomaterials with monodisperse size distribution and precisely regulated morphology and microstructures, which exhibit significant promise for biomedical applications, has recently been shown to be one of the most promising platforms. Chlorhexidine is a broad-spectrum antiseptic commonly used against gram-positive, gram-negative bacteria, fungi and viruses during periodontal therapy. Chlorhexidine's antiplaque effect is a result of the dicationic nature of the chlorhexidine molecule, which affords the agent the property of persistence of antimicrobial effect at the tooth surface, through both bactericidal and bacteriostatic effects. In the present study, an attempt has been made to synthesize chlorhexidine-grafted nanochitosan films with a variety of morphologies and integrated functionality for periodontal applications.

Method: Chlorhexidine grafted nanochitosan film was prepared from 1% chitosan using sodium tripolyphosphate (STPP) and polyvinyl alcohol (PVA). Briefly, sodium tripolyphosphate (STPP) was added drop by drop into 1% chitosan and kept on a magnetic stirrer for 1 h. The solution was centrifuged and the clear supernatant was subjected to ultra-sonication for the production of nanochitosan. Added 5 % PVA and 0.05% chlorhexidine with continuous stirring until getting a clear solution. The completely dissolved solution was poured onto the tray and kept overnight in hot air oven at 55 ^{o}C for obtaining chlorhexidine grafted nanochitosan film.

Result: The film obtained was characterized using Particle size/zeta Analyzer, Fourier-transform infrared spectroscopy, Scanning electron microscopy, Atomic force microscopy, Thermogravimetric analysis. In-depth analyses of the morphology and microstructures formation mechanism during the processes of chlorhexidine grafted nanochitosan materials have demonstrated that nano chitosan film reinforced with chlorhexidine crosslinked with PVA and TPP possesses excellent physio-mechanical, thermal, surface active and biological properties, which are essentially required for periodontal and wound healing applications. The biodegradable nature of chlorhexidine grafted nanochitosan film warrants that it could be a potential alternative for commercially available non-degradable synthetic polymeric films in biomedical sector.

Conclusion: The systematic summary of the preliminary investigations confirms the typical utility of chitosan-based multifunctional biomaterials in various biomedical sectors.

Keywords: Chitosan, Chlorhexidine, Nanochitosan, biomaterial.

08-32

STUDIES ON BIOLOGICAL POTENTIALS OF *KAEMPFERIA GALANGA .L* (AROMATIC GINGER)

Saritha Sadanandan Pillai[1], Dr. Nisha Raj S.[2], Annies Kesiya James [3], Dr.S.Sekaran[4]

[1] Noorul Islam Centre for Higher Education, Kumarakovil, Nagerkovil, [2]PG Department of Biotechnology, SAS SNDP Yogam College, Konni, Pathanamthitta, [3]PG Department of Biotechnology, SAS SNDP Yogam College, Konni, Pathanamthitta, [4]Department of Botany, S N College for Women, Kollam
E-mail: sarithasp1991@gmail.com

Medicinal plants are identified as a vast but rapidly threatened global resource.According to estimates from the World Health Organization, traditional medicine serves the primary healthcare needs of around 80% of the population in poor nations. The vast majority of medicinal plants, which are well-known for being utilised in conventional treatments, are taken from the wild.*Kaempferiagalanga(L)*, a member of the Zingiberaceae family, was found in the Pathanamthitta area. Rhizomatous herbs belonging to the genus *K.galanga* are found in the tropics and subtropics of Asia and Africa. It is grown for its fragrant rhizomes and can be found all throughout India's plains. Since this plant's rhizomes contain volatile oil and other vital substances with significant medical potential.This plant's rhizome has historically been used to treat a wide range of illnesses, and only a few biological tests have established its significance. The rhizome is high in essential oils and is used to treat indigestion, colds, headaches, pectoral and abdominal pains, expectorant, diuretic, carminative, stomachic, coughs, as well as asthma, hypertension, and stopping nasal blocks. There hasn't been any significant research to support the species, though.To address this lacuna,the proposed study will be carried out in order to identify the phytochemicals with medicinal properties by looking for specific secondary metabolites in *K.galanga,* such as flavonoids, alkaloids, terpenoids, saponins, proteins, glycosides, aminoacids, carbohydrate, steroids, and tannin.The study can conclude the potentiality of the selected rhizomes to be used for the treatment purpose in future and to promote these for further drug discovery.

Keywords: Phytochemical Screening, Expectorant, Rhizomes, Carminative

08-33

RELATIONSHIP OF TOTAL CHOLESTEROL AND LDL CHOLESTEROL WITH EACH OTHER, WITH AGE AND WITH OTHER LIPID PROFILE MEASURANDS.

Shaima Rashid, Dr Jose Jacob and Dr Sindu PC

Department of Biochemistry; Amala Cancer Research Centre; AIMS; Amala Nagar; Thrissur-680555

Back ground: The four commonly analyzed lipid profile measurands in Clinical Biochemistry Laboratory are serum triglycerides (TG), total cholesterol (TC), HDL cholesterol (HDL-C) and LDL-cholesterol (LDL-C). Among the lipid profile analytes, the commonly referred analyte is LDL-C. In this study the gender differences and correlations of TC and LDL-C were evaluated for diagnosis of common clinical conditions.

Method: The lipid profile data collected from the Clinical Biochemistry laboratory were analyzed for the mean differences, distribution and correlation characteristics after grouping them according to gender. Data representation was done by histogram and Box- Whisker plot Gender differences

were analysed by Student t test **(**Mann-Whitney U test). Correlation between different measurands was done by Spearman's method.

Results: TC, HDL-C and LDL-C were higher in the females. TC was found to be highly positively correlating with LDL-C in both male and female samples.TC was increased in 24.85 % of males and 28.68 % of females above 18 years of age. LDL-C increase was more in female sample (28.68%) than in the male samples (23.72%). Decreased HDL-C was observed in 41.24% of male samples and 31.78% of female samples.

Conclusion: This study showed that cholesterol analytes vary in their distribution, gender differences and in their correlations.

Keywords: Total Cholesterol, High Density Lipoprotein, Low Density Lipoprotein, Gender differences, Correlations

08-34

A PRELIMINARYT STUDY ON THE EFFECT OF PROBIOTIC *Bacillus sp.* IN ADULT ZEBRAFISH (*Danio rerio*) LIVER AFTER ETHANOL

Sisira V S [1], Venetia D'Rose[1], Dr Sarita G. Bhat [1,2]*

[1] Department of Biotechnology, Cochin University of Science and Technology, Kochi, India[2] Inter University Centre for Nanomaterials and Devices (IUCND)

Background: One of the most common types of liver disease globally, alcohol-related liver disease (ALD), which involves a variety of illnesses of varying severity, has recently attracted new attention. Scientific interest in this area is sparked, among other things, by the realization that alcohol consumption, regardless of the type of beverage consumed, poses a health risk and by the new therapeutic approaches using probiotics shows promising results. Zebrafish is emerged as a relevant system that can replicate different disease conditions that affect human beings and helps to trace human pathology.

Method: Acclimatized adult zebrafish were raised in an isolated glass fish tank containing RO water with varying range of ethanol concentration for 14 days. After the treatment regimen the zebrafishes were dissected and the liver samples were stained using Hematoxylin and Eosin to observe the cellular morphology changes. *Bacillus sp*. isolated from a sea fish which has shown probiotic potential (data not published) used as probiotic bacteria in this study. Probiotic supplementation of 10^6 CFU was used to treat ethanol treated fishes for 7 days by immersion method. After completing the treatment regime, the fishes were dissected, liver tissues collected and stained using H and E stain to see the reversal of ALD.

Results: As contrast to the control, there was mucus formation (turbidity) and a change in body color (pale) throughout the ethanol therapy. Along with this, other noticeable outcomes were the aggressive behavior of zebrafish and the restricted intake of feed. Control and ethanol-treated liver histopathology reveals swollen cytoplasm, ballooning hepatocyte degeneration and nuclear vacuolation and necrosis. According to the survival rate 0.8% and 1% are the best concentration to create the steatosis condition in zebrafish model by ethanol exposure. Probiotics *(Bacillus sp.)* have been the subject of research, and the findings have been shown to affect the reversion of ALD.

Conclusions: *Danio rerio* is a powerful model organism to study ALD. According to the survival rate 0.8% and 1% are the best concentration to create the steatosis condition in zebrafish

model by ethanol exposure. The results of the study in probiotics (*Bacillus sp*) have observable effects in the reversion of ALD.

Keywords: Alcoholic liver disease, ALD, zebrafish, *Danio rerio*, probiotic, steatosis, *Bacillus sp.*

08-35

EVALUATION OF SAFETY PARAMETERS OF *L.FERMENTUM* MBTUSKKTRF08 AS A PROBIOTICS ISOLATED FROM *IXORA CHINENSIS Lam.*

Sreelekshmi K[1] and Keerthi T.R[2]

[1] *Mahatma Gandhi University, Kottayam, Kerala*
[2]*Mahatma Gandhi University, Kottayam, Kerala.*

Background: Lactic acid bacteria is one of the most important probiotic bacteria. Much research has been conducted worldwide on this group of bacteria. *Limosilactobacillus fermentum* is one of the important bacteria in this group. In this study, *L.fermentum* MBTUSKKTRF08 was isolated from *Ixora chinensis Lam*. and showed that it had potential probiotic characteristics.

Method: In the present study, *In vitro* safety parameters of the *L.fermentum* isolated from flower (*Ixora chinensis Lam*.) was analysed by the following methods, DNAse activity, Anti hemolytic activity, Antibiotic activity, Plasmid analysis, Antimicrobial activity, Coaggregation, and Study of biofilm formation.

Results: The results obtained from this study, the isolate showed non hemolytic, non-DNase activity and were resistant towards Amikacin, Ampicillin, Ciprofloxacin, Gentamycin, Kanamycin, Methicillin, Streptomycin and vancomycin. The absence of plasmids in the isolate avoids the risk of potential transferability of these resistant genes. The antimicrobial activity of *L.fermentum* were determined by agar well diffusion method. Principle behind the antimicrobial activity has been determined by evaluating the production of organic acid, production of bacteriocin and siderophore production. The isolate have ability to co aggregate with five pathogen (*K.pneumoniae, P.aeroginosa, E.coli, V.cholerae and S.aureus*). The test strain possessed highest level of coaggregation with *K.pneumoniae* and lowest level coaggregation with *V.cholerae*. The results obtained from the quantification analysis of biofilm formation revealed that the strain is a weak biofilm producer at the optimum growth temperature of 37° C.

Conclusion: Safety evaluation is the most important criterion before using the selected probiotic for human consumption. This study proves their nonpathogenic nature and safety for consumption.

Keywords: Probiotic, *Limosilactobacillus fermentum*, Safety parameter study,

08-36

OUTBREAK INVESTIGATION OF ZIKA VIRUS INFECTION, THIRUVANANTHAPURAM, KERALA, 2021

Dr. N. Pradeep Kumar, **Dr. Aiswarya R S* and Dr. Ashwani Kumar**

ICMR-Vector Control Research Centre

Background: Since 1947, Zika virus (ZIKV) was only reported to circulate sporadically in Africa and South-East Asia (Faye et al, 2014). WHO declared the Zika virus (ZIKV) outbreak as a Public

Health Emergency of International Concern (PHEIC) on 1 st February 2016, owing to high incidence of neurological complications as well as Congenital Zika Syndrome in neonates caused by it in Brazil. India also reported sporadic cases in 2018, from the states of Gujarat, Maharashtra and Madhya Pradesh. During 2021, Zika virus outbreak was reported from Kerala and subsequently from other states.

Methods: An outbreak investigation was carried out at Thiruvananthapuram city on the request of State Health authorities to evaluate the situation and to contain it as many cases of ZIKV were reported.

Results: The investigation revealed active ZIKV transmission in Thiruvananthapuram city by at least three different species of Aedes mosquitoes (*Ae. aegypti, Ae. albopictus, Ae. vittatus*). This is the first report of *Ae. albopictus* and *Ae. vittatus* incrimination in ZIKV transmission from India. On further molecular analysis the crucial mutation responsible for microcephaly in neonates (S139N) was not present and the circulating strain was found to be of Asian lineage.

Conclusion: Enhanced case detection and containment measures was initiated in the areas experiencing high ZIKV transmission in Kerala. Since the outbreak of 2021, sporadic cases are being reported in Kerala state. Detailed investigations on the epidemiological and entomological factors involved in the outbreak as well as sero-surveillance of ZIKA had been initiated by ICMR-VCRC. A systematic surveillance strategy on this emerging arbo-viral disease is lacking and has to be initiated towards preventing future outbreaks of the disease.

Keywords:

ZIKV outbreak, Aedes, Thiruvananthapuram, India

08-37

MOLECULAR EPIDEMIOLOGY OF ENTEROVIRUS ASSOCIATED DISEASES IN KERALA

Aneesh B., Megha Chandran, E. Sreekumar, Aswathyraj S*.

Institute of Advanced Virology, Bio 360 Life Sciences Park
Thonnakkal, Thiruvananthapuram, Kerala- 695317,
**Corresponding author E mail: aswathyraj@iav.res.in*

Background: Enterovirus is a genus of picornaviruses identified as the causative agent of several human diseases, especially in children and newborns. They are associated with several clinical presentations including, respiratory illness, mucocutaneous presentation [hand-foot-mouth disease (HFMD) and conjunctivitis], CNS involvement (aseptic meningitis, encephalitis and acute flaccid paralysis), heart infection (myocarditis), etc. Data on recently circulating enteroviruses associated with HFMD in India are rare. As part of the non-polio Enterovirus surveillance program of Institute of Advanced Virology, specimens from Enterovirus suspected cases were collected and characterized the pathogen. The purpose of this study was to identify the EV serotype involved in various clinical presentations in Kerala during the year 2021-2022.

Methods: Clinical samples were obtained from various hospitals in Kerala. The viral RNA was extracted from the nasopharyngeal and vesicle swabs, serum as well as cerebrospinal fluid. The samples were screened by a pan-Enterovirus RT-PCR analysis. The VP3/VP1 gene was amplified

from the cDNA. The PCR positive samples were purified and sequenced and a phylogenetic tree was constructed. The virus type was determined through the subsequent BLAST analysis.

Results: Among the 30 suspected samples collected during the period from May 2022 to October 2022, 23 samples tested positive for Enterovirus RT PCR. The VP3/VP1 gene was amplified from cDNA, and sequenced. The nucleotide BLAST analysis revealed the pathogen, coxsackievirus virus. A phylogenetic tree was constructed and observed that the virus strains are phylogenetically related to the coxsackievirus virus strains A6 and A16 which were previously reported in France and India. One case with Acute Flaccid Paralysis showed coxsackievirus virus A21 infection.

Conclusion: The results presented here are generated from a prospective long-term study initiated recently, which requires a large number of samples to make an understanding of the various enterovirus types circulating in the Kerala population. However, the initial data suggest that the virus strains from all the characterized samples belong to Enterovirus A group.

Keywords: Enterovirus; Hand-Foot-Mouth Disease; Coxsackievirus; VP3/VP1 gene

08-38

ETHNO VETERINARY INVESTIGATIONS AMONG TRIBAL COMMUNITIES OF IDUKKI AND WAYAND DISTRICTS, KERALA

Anu Theresa Antony, Roshni S., Archana S., Anish N.P. and Manoj P.

DBT-Rajiv Gandhi Centre for Biotechnology, Thycaud, Thiruvananthapuram - 695014

Background: The tribal populations of Kerala in a large extend depended on medicinal plants for the prevention and control of livestock diseases. The knowledge, skills, methods, practices, and beliefs associated with ethno veterinary medicines and traditional animal health care are transferred vocally among various ethnic communities. The documentation of indigenous medicine is one of the aspects of the conservation and utilization of biodiversity.

Methods: In order to document the medicinal plants and their utilization among tribal people, field trips were carried out in 20 tribal settlements of Mala Arayan, Mannan, Urali, Muthuvan, Paliya, Ulladan, Kurichya, Kuruma, Paniya, and Kattunaikka communities in Idukki and Wayanad districts and collected information from 25 informants. The ethno medicinal information was collected through interviews among traditional healers using structured questionnaires.

Results: A total of 38 species of plants distributed in 38 genera belonging to 30 families were identified as commonly used ethno medicinal plants by tribal healers in Idukki and Wayanad districts. These plants were used to treat various diseases grouped under 16 major Diseases. To promote ethno-veterinary practices among dairy farmers conducted activities like establishment of promotion clusters, conduct awareness classes, distribution of medicinal plants, development of community knowledge register and a mobile application named ‘GauMithra’ which is made available in Playstore.

Conclusions: The indigenous knowledge of tribal communities about animal healthcare has been diminishing due to the rapid cultural changes and modernization. Scientific validation of the ethno veterinary practices and its exploration for potential therapeutics is the need of the hour.

Keywords: Ethno veterinary, traditional treatment, livestock diseases, medicinal plants

08-39

FORMULATION AND CHARACTERISATION OF MYOINOSITOL LOADED NANO EMULSIONS AS SELF-EMULSIFYING HYDROPHILIC DRUG CARRIERS FOR SKIN DELIVERY

Chandini. C. Mohan and Sarita G. Bhat

Cochin University of Science and Technology, Kochi- 682022, India

Background: Transdermal delivery is a convenient way of drug administration with numerous advantages such as low dose requirements and minimal side effects. However, currently used transdermal delivery systems in clinics are highly limited to drugs with moderate hydrophobicity, making it challenging for other potential hydrophilic drugs such as Myoinositol (MI) to achieve better clinical outcome. Nano emulsions offers versatility in formulating water in oil or oil in water systems with high efficiency based on solubility of the drugs for skin delivery.

Method: The present work mainly focuses on preparation and characterisation of self-emulsifying MI loaded w/o nano emulsions (MI-NE) via a facile method of spontaneous emulsification followed by solvent evaporation. Different formulations were evaluated based on entrapment efficiency, stability, and in-vitro pharmaco-kinetics parameters.

Results: Physical mixing of phospholipids with MI resulted in its better solubility in organic solvents. Self-emulsifying MI-NE within the size range of ~100nm with high entrapment efficiency and stability upon storage up to 3 month was developed. The selected formulation exhibited desirable drug delivery kinetics with a controlled release for 24h.

Conclusion: This work demonstrates a facile and cost-effective strategy for the development of NE with low surfactant concentrations and processing time to achieve as high efficiency hydrophilic drug carriers exhibiting controlled release.

Keywords: Nano emulsions, transdermal delivery, Hydrophilic drug carrier, Myo-inositol, Controlled delivery.

08-40

PLANT-DERIVED CARBON DOT- HYDROGEL COCKTAIL FOR WOUND HEALING APPLICATION

Lekshmi C Nair [a] and Jyothi B. Nair[b]

Accubits Invent Pvt. Ltd. Service Road, Technopark Phase III Main Rd, Main Gate, Kazhakkoottam, Kerala 695582.

Background: Despite extensive biomedical research advancements, healing of skin wounds with inflammation and bacterial infection still remains a deterring threat to public health especially diabetic wounds, due to its severity and non-healing nature. Till now there is no conventional guideline regarding the selection of wound dressing materials for curing the same. Currently, tulle dressings, Polyurethane films/forms, alginate dressings, and hydrocolloid dressing are used as curing agents for diabetic wound dressing. Advance developments for generating hybrid materials with excellent wound dressing ability, anti-inflammatory activity, biocompatibility, and real-time monitoring capability is urgently demanded in the clinic.

Methods: The carbon dots were prepared by solvothermal method and the hydrogel was prepared by hydrothermal method. The photophysical characterization was carried out by UV-Vis and fluorescence spectroscopic techniques. The functional group identification was carried out by IR and Raman spectroscopic techniques and morphology was analyzed via microscopic techniques.

Results: Herein, we have designed an intelligent self-healing hybrid hydrogel containing carboxy-methyl cellulose (CMC) as base material and neem leaves (Phyto) derived green-emitting and novel red-emitting carbon dot as a doping material for enhancing the activity and monitoring the healing process. The cocktail is synthesized via the hydrothermal method and it enhances the activity by combining the properties of CMC and carbon dot.

Conclusion: Herein, A hybrid cocktail of carbon dot and CMC was prepared by hydrothermal method, both components are cited to have excellent biocompatibility, biodegradability, non-toxicity, and cost-effectiveness. Moreover, the cocktail will be used for generating smart wound dressing materials in clinics, which can be customized for individual requirements. The presence of biocompatible, stimuli-responsive hydrogel not only provide therapeutic benefits but also impart wound healing property, additionally the presence of neem leaves-derived carbon dots impart additional healing potential. The non-invasive investigation of the healing process via fluorescence by using smartphones will be the future scope.

Keywords: Wound healing, Carbon dots, Fluorescence, Hydrogel, Biocompatibility

08-41

EXPRESSION, PURIFICATION, AND CHARACTERIZATION OF ZIKA NS1 ANTIGEN

Priya P[1£], Aneesh B[1£], Meenakshi Mohan S[1£], Aswathy Raj S[*1], Rajesh Kumar[1*]

[1] Institute of Advanced Virology, Bio 360 Life Science Park, Trivandrum, Kerala
**Corresponding author: rajesh@iav.res.in, aswathyraj@iav.res.in*
[£] Equally contributed to this work

Background: Zika virus (ZIKV) is an enveloped positive-strand RNA virus belonging to the Flavivirus family, which is transmitted to humans by infected Aedes mosquitoes. The majority of the infected population will not have symptoms or mild symptoms such as fever, rashes, and headache, whereas ZIKV infection during pregnancy can cause microcephaly and other brain defects such as congenital Zika syndrome. There are no clinically approved vaccines available to control or prevent ZIKV infection. Early diagnosis is crucial in treating symptomatic patients and preventing ZIKV transmission. Therefore, developing sensitive and accurate diagnostic methods is urgently needed to detect acute ZIKV infection. The glycoprotein non-structural protein 1 (NS1) is highly conserved among flaviviruses and is involved with the early steps of viral replication as well as late infection. It is one of the most used markers for the detection of acute or convalescent infection by flaviviruses and holds the potential to be used as an antigen in serological tests as well as in subunit vaccines. Therefore, producing a ZIKV NS1 with preserved structural and antigenic features may find different biotechnological applications.

Methods: Zika NS1 gene construct was codon optimized for bacterial expression system and cloned into a bacterial expression vector, pET28a (+) in *Nco*1 and *Not* 1 cloning site. The cloning of the insert was confirmed by restriction digestion analysis. The NS1 expression plasmid DNA was transformed in BL21(DE3) cells for protein expression. For initial standardization of expression of Zika NS1 gene, BL21 (DE3) strain of *Escherichia coli* bearing NS1plasmid was

grown in 5 mL of super broth medium at 37 °C with shaking at 200 rpm. The culture was induced with 1 mM isopropyl b- D-thiogalactopyranoside at A_{600} of 0.4-0.6 and incubated at 37°C for 3 h. The culture pellet resuspended in PBS buffer was sonicated, and the soluble fraction was collected. Bacterial cells pellet containing recombinant NS1 protein was solubilized for 1 h at room temperature in solubilization buffer (8 M Urea, 20 mM Imidazole) and purified by Nickel-NTA immobilized-metal affinity chromatography (IMAC) column. After elution with elution buffer (8 M Urea, 300 mM Imidazole), the most concentrated fractions of NS1 denatured recombinant proteins were pooled and dialyzed against PBS prior to characterization. Identification of the recombinant protein using LC-MS/MS was done. Secondary structure analysis of the purified protein was carried out using Circular Dichroism analysis of the sample in phosphate-buffered saline (pH-7.4).

Results: On SDS-PAGE analysis, bands of the expected size of 42 kDa that corresponds to NS1 protein were observed both in the soluble and inclusion bodies. This observation was further confirmed by western blot analysis using Anti-His mAb. The gel image and Western blot confirmed that most of the NS1 protein was detected in inclusion bodies. Large-scale protein production was carried out from bacterial pellet from 1 L culture by Urea method. The protein was purified using Ni-affinity chromatography and was confirmed by running a 10% SDS PAGE. The gel image showed that the purified protein from the inclusion bodies was 95% pure in nature. The gradient removal of urea was performed using dialysis to refold the NS1 protein. The final refolded protein was resuspended in Tris and PBS buffer. Further, the quality of the refolded protein was validated by western blotting using Anti-Zika NS1 commercial mAb and polyclonal IgGs from Zika-recovered individuals. The yield of the purified protein was 100mg/L of bacterial culture. The purified recombinant protein showed 42 kDa, which is similar to the predicted molecular weight of Zika NS1 protein. Mass spectrometric analysis of the purified NS1 shows peptide hits across the reported NS1 protein sequence in the Uniprot database. Secondary structure analysis inspected by CD spectropolarimeter showed fairly good agreement with the reported structure under PDB ID, 5K6K. The purified recombinant protein showed more beta sheets than alpha helices which could contribute to increased antigenicity.

Conclusions: The extracted recombinant Zika NS1 protein can be used for immunization of mice and hybridoma generation for monoclonal antibody production, which can help in the development of a diagnostic kit for detecting acute viral infection.

Keywords: Zika, Diagnosis, Recombinant Protein, Monoclonal Antibody

08-42

A SIMPLIFIED HIGH-THROUGHPUT PSEUDOVIRUS NEUTRALIZATION ASSAY TO EVALUATE THE IMMUNE RESPONSE TO RABIES VIRUS

Santhik Subhasingh Lupitha [1], Easwaran Sreekumar [1,2], Rajesh Kumar[1]*

[1] Department of Virus Applications, Institute of Advanced Virology (IAV), Bio 360 Life Science Park, Thonnakal, Thiruvananthapuram, Kerala, [2] Molecular Virology Laboratory, Rajiv Gandhi Centre for Biotechnology (RGCB), Thiruvananthapuram, Kerala
**Corresponding author rajesh@iav.res.in*

Background: Producing non-pathogenic, replication-defective pseudotyped viruses is a proven and practical alternative for studying many aspects of viral biology in a low biosafety containment level (BSL). In this study, we developed a highly efficient pseudovirus production system useful

for quantitating rabies virus-neutralizing antibody responses in a BSL-2 level that would, otherwise require a BSL-3 level facility.

Method: We used recombinant Vesicular stomatitis virus (rVSV-ΔG) to generate VSV pseudotypes containing the envelope glycoproteins(G) of Rabies virus. In this system, the G gene of the recombinant VSV is deleted, and secreted alkaline phosphatase gene (SEAP) or GFP is inserted as a reporter. The infectivity of these Rabies rVSV-ΔG pseudotypes is restricted to a single round of replication. HEK293T cells were transiently transfected with Rabies virus G full-length protein expressing plasmid DNA. After 24 hours of transfection, cells were infected with rVSV-ΔG encoding secreted alkaline phosphatase/ GFP reporter gene. The supernatant containing rVSV-ΔG pseudotyped with rabies envelope glycoproteins was collected after VSV-induced CPE. HEK293T and Vero cells were used as Rabies permissive cell lines for subsequent infection assays. GFP expression was visualized under a fluorescent microscope. Secreted alkaline phosphatase from the cells expressed upon the entry of the Rabies Pseudovirion was used to quantify the assay in a high-throughput manner using an ELISA reader.

Results: We developed an efficient pseudovirus-based system as against the traditional rapid fluorescent focus inhibition test (RFFIT) method that is used for quantitation of immune response to rabies vaccination. The new assay system is less labor-intensive; and avoid the handling of live rabies virus. The neutralization assays results can be analysed in BSL-2 containment using an ELISA reader. Also, the results are obtained much faster than the RFFIT assays (24h vs. 72h) and can be done in a high-throughput manner to handle large numbers of samples.

Conclusions: An efficient pseudovirus production system that could replace live virus-based traditional assays due to its safety, rapidity, reproducibility, and high throughput capacity was developed. It could support large scale screening of samples to evaluate immune response against rabies vaccination.

Keywords: Pseudovirion assay, Rabies virus, High-throughput screening, Vaccines

09 –LIFE SCIENCES

ORAL PRESENTATION

09.1

FERULIC ACID ATTENUATES DIABETIC LIVER DAMAGE BY ANTIOXIDANT AND ANTI-APOPTOTIC POTENTIAL

Anjali and S Mini*

Department of Biochemistry, University of Kerala, Kariavattom, Thiruvananthapuram- 695581, Kerala, India. Email: minis@keralauniversity.ac.in

Background: Diabetes is associated with oxidative stress and lipid peroxidation which damage the liver. A prolonged condition can lead to non-alcoholic fatty liver diseases and liver cirrhosis. The present study aimed to evaluate the hepatoprotective role of Ferulic acid (FA), a naturally occurring phenolic phytochemical, in Streptozotocin (STZ)-induced diabetes rats.

Method: 30 male albino Sprague Dawley rats were assigned to five groups: normal, normal+FA, diabetic, diabetic+FA, and diabetic+glibenclamide. Rats were made diabetic with STZ (40mg/kg body weight). FA was administrated orally at 50 mg/kg body weight/day, and it was compared with standard anti-diabetic drug glibenclamide (5 mg/kg body weight/day).

Results: FA supplementation maintains the blood glucose and insulin levels. The elevated liver enzymes were found to be decreased with FA treatment in STZ induced diabetic rats and decreased the levels of lipid peroxidation products, increased levels of antioxidant enzyme activities, and prevented the diabetes-induced hepatocyte apoptosis. Histopathological studies in the liver from diabetic rats revealed morphological changes and indicated the increased hepatocyte damage, which was reduced by the FA treatment.

Conclusion: The data provide evidence that FA supplementation could protect over diabetes-induced liver damage through its hypoglycemic, antioxidant and anti-apoptotic potential, which indicates the candidacy of FA as a diabetic adjuvant food additive.

Keywords: Diabetes mellitus, Liver damage, Phytochemical, Ferulic acid, Antioxidant activity.

09.2

A STUDY ON THE DIVERSITY OF PEPSINAE WASPS (HYMENOPTERA: POMPILIDAE) OF INDIA WITH NEW RECORD OF THE GENUS *HEMIPEPSIS* DAHLBOM, 1844 FROM KERALA

Anju K[1] and Thejass P[1*]

[1]P.G. & Research Department of Zoology, Government College Madappally, Vadakara, Kozhikode, Kerala – 673102, India.
E-mail: [1]anjukappu91@gmail.com; [1]thejassp@gmail.com*

Background: Family Pompilidae commonly known as “spider wasps” is one of the largest families among the aculeate wasps in Hymenoptera. It belongs to the suborder Apocrita and superfamily Vespoidea of order Hymenoptera. They are long-legged, solitary wasps that use a single spider as a food source for the larval development leading to their common name of spider wasps. It is a cosmopolitan family comprising over 5000 species in more than 230 genera from

five subfamilies worldwide. Pepsinae is a major subfamily of pompilid wasps. *Hemipepsis* Dahlbom, 1844 is a common genus in the Pepsinae subfamily with 19 identified species from India.

Methods: Pompilid specimens for the present study were collected from Kasaragod, Kozhikode and Thrissur districts of Kerala using sweep net and yellow pan trap. The specimens were then dried, pinned and examined under LEICA stereozoom microscope. The images were captured using a LEICA 500 digital camera attached. An account on the diversity of the subfamily Pepsinae was prepared based on the published works.

Result: From India, totally 20 genera and 66 species are reported from the subfamily Pepsinae. Among them, genus *Hemipepsis* Dahlbom, 1844 has the highest number of species. In the present work, two species *Hemipepsis consanguinea* (Saussure, 1867) and *Hemipepsis fulvipennis* (Fabricius, 1793) are collected and studied. This represents new record of the genus *Hemipepsis* from Kerala.

Conclusion. Though *Hemipepsis* is a common representative of the Pepsinae subfamily, only 19 species are recorded from India, which is a small fraction as compared to world species. Also the genus itself is not recorded from Kerala previously and this is the first record. It clearly indicates the poor status of Pompilidae taxonomy in India especially from Kerala.

Key words: Pompilidae, Pepsinae, Taxonomy, India, New record, Kerala.

09.3

ELECTRO ACTIVE ELECTRO SPUN P (VDF-HFP) / COLLAGEN - POLY DOPAMINE NANOPARTICLES LOADED FLEXIBLE NANO FIBERS FOR CHRONIC WOUND HEALING AND ENHANCED TISSUE REGENERATION.

Jiya Jose[a], Yogesh Dalvi[b], Sarita G Bhat [a]

[a] Cochin University of Science and Technology, Kalamassery, Kerala
[b] Pushpagiri Research Centre, Pushpagiri Institute of Medical Sciences and Research Centre, Tiruvalla, Kerala- 689101, Indi

Even though many polymer based scaffolds are available in the market it has confines in the processes of tissue regeneration and chronic wound healing. In view of this we developed a novel Electro active electrospun P (VDF-HFP) / collagen - poly dopamine nanoparticle (DHNPs) incorporated flexible scaffolds for chronic wound healing applications. Poly (vinylidenefluoride-co-hexafluoropropylene)(PVDF-HFP), is an excellent Piezoelectric polymer with enhanced bioactivity. Piezoelectric materials can generate electrical activity when deformed. Collagen is known to promote the cell proliferation and Poly dopamine NPs has antibacterial property. Through the electro spinning process we fabricated electro active scaffold and further coated with dopamine hydrochloride nanoparticles. The structure and physical properties of the scaffolds were characterized, and their cyto-compatibility, fibroblast proliferation, hemo-compatibility and in vivo wound healing ability were also evaluated. Highly porous structures were observed in SEM analysis and showed excellent antibacterial activity towards multiple drug resistant bacteria. Anti-biofilm activity also showed a drastic reduction in the attachment of bacterial cells. Further the cell proliferation assay and MTT assay revealed the bio compatibility and excellent cell proliferation due to the presence of collagen and electro active PVDF-HFP. *In vivo* studies demonstrated rapid

chronic wound healing and good tissue regeneration. As far as we know, it's a novel electro active electro spun membrane that shows promise for quick chronic wound healing.

Key words: Electro active, Antimicrobial, chronic wound, cell proliferation, wound healing

09.4

PHYTOCHEMICAL AND BIOLOGICAL ACTIVITY STUDIES ON THE INDIAN PITCHER PLANT, *NEPENTHES KHASIANA*

Gokul B S, Anil John J, Gayathri V, Sabulal B

Phytochemistry and Phytopharmacology Division, KSCSTE-Jawaharlal Nehru Tropical Botanic Garden and Research Institute, Pacha-Palode 695562, Thiruvananthapuram, Kerala

Background: *Nepenthes* is a genus of carnivorous plants, having unique ways of attracting preys into their leaf-evolved biological traps, known as pitchers. *Nepenthes khasiana* Hook f., the Indian pitcher plant, is native to the Khasi Hills of Meghalaya. Here we report the phytochemistry and biological activity studies of *N. khasiana.*

Methods: *N. khasiana* (whole plant) was collected from the JNTBGRI campus, shade dried and powdered. Plant powder (1.2 Kg) was Soxhlet extracted sequentially with hexane, chloroform and methanol. Crude extracts were subjected to repeated chromatography and isolated compounds were characterized by spectroscopic techniques. Cellular viability of isolated compounds on RAW 264.7 cells was tested by MTT assay. Total mRNA expression of inflammatory mediators was determined by qPCR in LPS treated RAW 264.7 cells.

Results: Phytochemical investigation of *N. khasiana* hexane (28 g), chloroform (15 g) and methanol (159 g) extracts resulted in the isolation of 27 compounds, of which 11 were characterized *viz*., plumbagin, lupenone, triacontanol, lupenol, β-sitosterol, cis-isoshinanolone, 1-methoxynonacosanol, stearic acid, 2,4-di-tert-butyl phenol, pentacosane and dimethyl L-malate. Structural elucidation of the remaining compounds is in progress. MTT assay showed that the tested compounds were non-cytotoxic up to 50 µg/mL against RAW 264.7 cells. *In vitro* treatment of cells with cis-isoshinanolone (10 µg/mL) resulted in significant elevation of anti-inflammatory markers IL-10 and INFγ, and remarkable reduction in the expression of IL-6 gene.

Conclusions: Phytochemical investigation of *N. khasiana* resulted in the isolation of 27 compounds, of which 11 were identified by spectral analysis. This is the first report of phytochemical and biological activity studies on this rare pitcher plant.

Keywords: *Nepenthes khasiana*, prey capture, phytochemistry, MTT assay

09.5

MODULATING THE NIS GENE EXPRESSION USING CERIUM OXIDE NANOPARTICLES IN THYROID CANCER

Gopika A.G, Dr. Ajith Vengellur, Divya Menon Ramesh, Nidhi G Krishna, Jisnet George

Cochin University of Science and Technology, Kochi

The production of ROS within cells and its impact on cellular physiology has long been known to be significant. It can act both as a cytotoxic as well as cell signaling molecule depending on their

concentration in the cell. When anti-oxidant defense is deregulated, excess ROS is produced causing oxidative stress (OS) which in turn causes cell death, modify DNA, proteins, dNTPs, lipids, membranes or causes epigenetic alterations. NADPH Oxidases are enzymes that are the chief producers of ROS at the subcellular level. Of which NADPH Oxidase 4 is prominent in the thyroid gland and has a significant role in the pathophysiology of the gland. The sodium/iodide symporter (NIS) is a glycoprotein that is located at the basolateral membrane of thyrocytes and that mediates the active transport of iodide for the synthesis of thyroid hormone. NIS mediated iodide uptake plays a major role in the radioactive ablation of thyroid cancer cells. But its applicability has been hindered due to the reduced expression of NIS. BRAF V600E mutation is commonly seen in papillary thyroid cancer cells which facilitates tumor cell growth and progression. And this mutation is known to cause the reduced expression of NIS. NOX4 mediated ROS has been known to downregulate the expression of NIS in BRAF V600E mutated cells. ROS scavengers can increase the NIS expression at both mRNA and proteins. One such ROS scavenger is Cerium oxide nanoparticles which exhibits antioxidant properties as it can cycle between +3 and +4 oxidation states. So, in this study, we tested the hypothesis that cerium oxide nanoparticles act as ROS scavengers and upregulate the NIS expression at mRNA levels. MDA T32 papillary thyroid cancer cell line is selected as the model for this study. The mRNA expression of the NIS after treatment with cerium oxide nanoparticles are studied by real time PCR.

09.6

SECONDARY METABOLITE COMPARISON BETWEEN CO-CULTURE AND PURE CULTURES OF STREPTOMYCES SPECIES NIIST-D63 AND NIIST-D47

D.K. Induja and Ravi Shankar Lankalapalli*

Chemical Sciences and Technology Division, CSIR-National Institute for Interdisciplinary Science and Technology, Thiruvananthapuram, 695019, Kerala, India
Academy of Scientific and Innovative Research (AcSIR), Ghaziabad, 201002, India
**Corresponding author – ravishankar@niist.res.in*

Background: The genetic potential of streptomyces has not been fully utilized because most of the secondary metabolite biosynthetic gene clusters (smBGCs) are silent under laboratory pure culture conditions. Coculture is an effective culture-based strategy for activating silent genes. One advantage of coculture is there is no need for prior knowledge of smBGCs or any genetic engineering tools.

Methods: This work explores the isolation, purification, structural elucidation of bioactive compounds and antibacterial activities from secondary metabolites of two selected streptomyces species and their coculture.

Results: Eight compounds were isolated from *Streptomyces thioluteus NIIST-D63* and three compounds were isolated from *Streptomyces luteoverticillatus NIIST-D47*. Through coculture 15 compounds were isolated. Among that six compounds produced only in co-culturing.

Conclusion: coculturing strategy of compatible microbes is an efficient tool to discover novel natural products in good yields by activating cryptic SM-BGCs. So repeated experiments by changing co-culture partners can produce novel compounds definitely.

Keywords: Secondary metabolites / Biosynthetic gene clusters / Coculture / *Streptomyces* species / Natural products.

09.7

IDENTIFICATION AND HYDROLYTIC ENZYME POTENTIAL OF ACTINOMYCETES FROM THE MANGROVE SEDIMENTS OF NORTH KERALA

Kiran Kishore and Sebastian C D

Division of Molecular Biology, Department of Zoology, University of Calicut

Background: Mangroves are woody plant communities that are accustomed to the harsh transitional zone between aquatic and terrestrial ecosystems and have evolved adaptations with the harsh environment. A variety of microbes are found in mangroves, and actinomycetes are one among them. Actinobacteria have been continuously reported as the prolific producers of microbial bioactive secondary metabolites for pharmaceutical aspect and agricultural applications. Mangrove actinomycetes are versatile in terms of its bioactivity, which actually motivates to intrinsically assess its bioactive potentiality.

Method: This works explores the diversity and hydrolytic enzyme potential of actinomycetes along the mangrove sediments of northern Kerala with respect to sediment characteristics. Temperature, pH, salinity, organic matter and sediment texture were analysed. Isolated actinomycetes colonies were screened for the production of various hydrolytic enzymes.

Results: A total of 124 isolates were obtained during the present study. pH of the sediment ranged from 6.5 – 7, temperature from 27-32°C. Kadalundi showed maximum CFU/ml and Chettuva showed lowest population. 90% of isolates exhibited various hydrolytic enzyme activity. The isolates obtained belonged to the genera Streptomyces.

Conclusion: The present study is mainly involved in the isolation and determining the hydrolytic potential of actinomycetes obtained from the mangrove sediments of Northern Kerala. 124 isolates were obtained of which 90% of the isolates showed hydrolytic potential. Maximum population of actinomycetes were obtained from Kadalundi station. The population of actinomycetes varied according to sediment characteristics.

Keywords: Mangroves, Actinomycetes**,** Hydrolytic enzymes, Sediment

09.8

SYMBIOTIC EFFECTIVENESS OF *CERATOBASIDIUM* SP. ISOLATES ON *VANDA TESSELLATA*, A VULNERABLE ORCHID OF WESTERN GHATS

Lekshmi S, and William Decruse S

Biotechnology and Bioinformatics Division, KSCSTE- JNTBGRI, Palode, Thiruvananthapuram, 695562.
Email: lekshmisuresh424@gmail.com

Background: Orchid seeds don't have nutritional stores, therefore need a mycorrhizal fungus to help them germinate and feed their young plants in the wild. The Rhizoctonia genus, which includes the Basidiomycota genera *Ceratobasidium, Thanetophorus, Tulasnella*, and *Sebacina*, is home to the most common orchid mycorrhizal fungi. In managed or restored settings, the existence of a suitable fungal mycobiont for seedling recruitment and plant nutritional support is thus critical for orchid long-term survival. The present work is to prove that the endophytic fungus belonging to *Ceratobasidium* sps. imparts *in vitro* symbiotic seed germination in *Vanda tessellata (*Roxb.) Hook. Ex G. Don, a threatened orchid species of Western Ghats.

Methods: Isolated five endophytic fungus from the roots of *Vanda thwaitesii* and *Thaprobanea spathulata* through root segment culture in fungal isolation medium and Potato Dextrose Agar Medium (FIM & PDA). Morphological and cytological characterization of the isolates was undertaken using standard methods. The isolates were identified through sequencing of ITS1 and ITS4 region and blast analysis. Mature seeds of *V. tessellata* were co-inoculated with five endophytic fungi in Oats Meal Agar medium (OMA). Five to seven replicates were maintained for each treatment and the whole experiment was repeated thrice. Seeds without fungus culture were taken as control. For asymbiotic germination, seeds were inoculated in Mitra+ CH medium.

Results: Five endophytic fungi designated as Wyd1, Wyd2, Idk, Vs1 & Vs2 isolated from *V. thwaitesii* and *T.spathulata* were characterized to exhibit right angled branching and possessed barrel to elliptical shaped monilioid cells in chains of 8 to several cells. All the isolates were binucleate. ITS sequencing followed by blast analysis revealed that Wyd1 have 91.01 % sequence similarity with *Ceratobasidium* sp. MK972669, Wyd2 & Idk have 99.82% similarity with *Ceratobasidium* sp. MT380175, Vs1 have 96.72% similarity with *Ceratobasidium lantanae camarae* strain MW361942 and Vs2 have 99.42% sequence similarity with *Rhizoctonia* sp. Oss2. AJ318421. Seed germination studies revealed that all the *Ceratobasidium* sp. isolates triggered symbiotic seed germination of *V.tessellata* on co-inoculation in Oats Meal Agar medium. A series of development starting with the promeristem formation, first leaf development or second leaf initiation occurred in 80- 88% of the protocorms in a time interval of 90 days. Asymbiotic culture facilitated 94% germination of seeds but further development was drastically slow.

Conclusions: Symbiotic fungi supported germination and seedling development in 90 days much faster than asymbiotic method of germination. The endomycorrhiza characterized and evaluated are proved useful for conservation and cultivation of the vulnerable orchid species as *Vanda tessellata*.

Key words: Endomycorrhiza, Symbiotic seed germination

09.9

SEED DEVELOPMENT, STORAGE AND PREDATION OF *HOPEA EROSA* (BEDD.) SLOOTEN, A CRITICALLY ENDANGERED TREE SPECIES OF WESTERN GHATS

Mithun Venugopal* [1] , Pradeep N.S [1], Krishnan P.N [1,2]

[1] KSCSTE-Malabar Botanical Garden and Institute for Plant Sciences, GA College Post, Kozhikode, 673014, Kerala, [2] Present address: Centre for Innovation in Science and Social Action (CISSA), T.C. 15/510, USRA - 55, Udarasiromani Road, Thiruvananthapuram,

Background: *Hopea erosa* is critically endangered and endemic species of Western Ghats in India. The species have an estimated continuing decline in the population size due to threats to the habitats and low recruitment rate in the populations, and it is expected to be having less than 250 mature individuals with fewer than 50 mature individuals per sub-population, the species is assessed as critically endangered under criteria C2a (i). The major threats to this species were naturally fallen seeds had very poor germination (10-15%) due to pest infestation, which affects the recruitment of this species in the wild.

Method: In the study reveals the biochemical composition of seed during development, tested the seed storage and viability of the seeds in 8 different storage conditions. Moreover studied about

the seed predator which makes serious damage to the seeds of *H. erosa* during seed development and storage.

Results: Seed development was initiated with an increase in seed moisture content and fresh seed and dry weight. The moisture content started decreasing 90 days after anthesis and recorded 43.84% by 180 DAA. Seeds of *H. erosa* are recalcitrant in nature and lose viability with a short span of 7 days. Of the different conventional methods, *H.erosa* seeds retained viability for 300 days with a slow moisture loss from the seeds stored in closed polycarbonate bottles at 20±2°C. A new species of *Alcidodes* was discovered from the seeds of this plant and its elongated snout penetrates the seeds deeply causes the severe damage. This destruction leads to the loss of viability.

Conclusions: Standardized a conventional technique whereby the viability of the seeds can be extended to 300 days without much expenses by storing the seeds at 20±2 °C. This storage condition helps the plant for *ex-situ* restoration programmes. The identity of the beetle needs to be confirmed using molecular tools.

Keywords: *Hopea erosa*, seed, biochemical, seed storage, viability, predator

09.10

OPTIMIZATION AND ENZYME PRODUCTION OF ENDOPHYTIC BACTERIA FROM *LAGENANDRA NAIRII* RAMAM. & RAJAN

Pooja Pushkaran and N S Pradeep

KSCSTE-Malabar Botanical Garden and Institute for Plant Sciences, GA College Post, Kozhikode 673 014, Kerala, India

Background: Endophytes interact with their host organisms within the ecological niche for their existence through the action of various hydrolytic enzymes. The activity of enzymes from endophytes may be novel or higher than that of host plant. *Lagenandra nairii*, an endemic aquatic plant only seen in Chalakkudy. A few endophytic bacteria were isolated from this plant and a Bacillus sps. showed high protease and amylase activity. Temperature, pH, carbon source and nitrogen source for maximum enzyme production were optimized. Moreover, the efficacy of the enzymes was analyzed in commercial aspects and it was realized that Bacillus sps. can produce the enzymes with high quality.

Method: This study explored the isolation of endophytic bacteria, morphological characterization of isolates by gram staining, endospore and biochemical test. After that enzyme screening and enzyme activity were studied and based on this, a particular isolate was selected. In addition, the enzyme was used for blood stain removal and starch hydrolysis.

Results: This is a novel work carried out in *Lagenandra nairii*. Five endophytic bacteria have been isolated and named as Rh29, Rh33, R13, L44 and R7 and was identified as Bacillus sps. and Aeromonas spp. respectively. All the isolates have more or less enzyme activity in this study. From the isolates, Rh29 showed high capability to produce commercially valuable enzymes, protease and amylase. Examination of its protease production showed that its optimum production was found in 120 hr at 40ºC in pH 8.5 with lactose and yeast extract as carbon and nitrogen source respectively. In the amylase production maximum activity was observed in 48 hr at 35ºC in pH 6.5 with mannitol and ammonium chloride. The enzyme efficiency was proved by experiments conducted on blood stain removal and starch hydrolysis.

Conclusions: Endophytes are commercially valuable group of microorganisms that display beneficial properties and often characteristic of their host plants. The findings in the present study concluded that particular Bacillus spp. carries high potential of enzyme production useful for industrial aspects.

Keywords: Endophytic bacteria, enzyme activity, optimization, applications

09.11

UTTROSIDE B FROM SOLANUM NIGRUM LINN IS A POTENT LEAD MOLECULE AGAINST NON-ALCOHOLIC STEATOHEPATITIS

Tennyson P. Rayginia[1,2], C.K. Keerthana [1,2], Sadiq C. Shifana[1], Anwar Shabna[1], Mundanattu Swetha[1,2], Ravi S. Lankalapalli[3], Ruby John Anto[1*]

[1] Division of Cancer Research, Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram 695014, [2] Department of Biotechnology, University of Kerala, Thiruvananthapuram 695011, [3]Chemical Sciences and Technology Division, CSIR-National Institute for Interdisciplinary Science and Technology, Thiruvananthapuram 695019

Background: Recent studies have identified non-alcoholic steatohepatitis (NASH) as one of the major metabolic risk factors of hepatocellular carcinoma (HCC). Currently there are no FDA-approved drugs for the treatment of NASH. We previously reported that uttroside B (Utt-B), a saponin isolated from the leaves of *Solanum nigrum* Linn (*S. nigrum)*, shows remarkable anti-HCC potency and is pharmacologically safe, *in vivo*. This innovation has been granted patents by the USA, Canada, Japan, and South Korea. Recently, Utt-B received 'orphan drug' designation from the US FDA. In the present study, we report the therapeutic potency of Utt-B against NASH, backed by *in vitro* and *in vivo* evidences.

Methods: Experiments were carried out using liver cancer cell line HepG2 and high fat diet fed-C57BL/6J mice. MTT assay, immunoblotting, qPCR, Oil Red O, direct red and hematoxylin and eosin staining were employed to assess the hepatoprotective and therapeutic efficacy of Utt-B against NASH.

Results: Utt-B alleviates lipid accumulation *in vitro*. Severe steatosis, inflammation and fibrosis were observed in NASH-induced mice, whereas treatment with Utt-B improved the pathologic features associated with NASH. Moreover, data from toxicity studies conducted in human subjects suggest that the whole leaf extract of *S. nigrum* containing IC50 concentration of Utt-B is pharmacologically safe in healthy volunteers and stabilizes the liver function parameters of fatty liver, NASH and HCC patients.

Conclusion: Our results indicate that Utt-B improves the pathologic features of NASH and thus can be developed as a candidate drug molecule to treat NAFLD, NASH and HCC.

Keywords: Non-alcoholic steatohepatits, Uttroside B, steatosis, inflammation, fibrosis

09.12

CHARACTERIZATION OF NOVEL CELL DEATH INDUCING ELICITOR FROM *PHYTOPHTHORA MEADII*

Shilpa Babu and Shaji Philip

Plant Pathology Division, Rubber Research Institute of India, Kottayam, 686009Kerala, India

Background: In this paper, we report Characterization of, a new elicitor protein. This elicitor was purified from the culture filtrate of *P. meadii* which was isolated from rubber tree leaf. The toxicity of the purified elicitor on detached rubber leaves was also investigated. We are studying the interaction between rubber tree and *P. meadii* in order to understand the main defence mechanism of Hevea against this fungus.

Method: For elicitor isolation *P.meadii* was grown in Henninger synthetic medium and culture filtrates was concentrated by lypholization to powder. To analyze cell death trypan blue staining and localization of hydrogen peroxide (H2O2) was detected by 3, 3'-diaminobenzidine (DAB) staining. Induction of systemic acquired resistance was analysed by infiltration of crude elicitor (tolerant FX 516 and susceptible RRIM 600) followed by inoculation with zoospore suspension. Crude elicitor was treated with Proteinase K. FTIR measurements were taken in a range from 600 to 4,000 cm-1. HR-LCMS analysis of the crude elicitor was performed. TOF/Q-TOF Mass Spectrometer (Model- G6550A) with Dual AJS ESI as ion source was used.

Results: Cell death induced by the elicitor was not visible at 12 hours after infiltration. However, it could be detected after Trypan blue staining (Fig). Cell death requires the accumulation of reactive oxygen species, at 12 hours post infiltration, accretion of H_2O_2 was detected using the DAB staining method. When the rubber leaves were infiltrated with an elicitor followed by pathogen inoculation, the infection rate was reduced. The FTIR spectrum of the cell death-inducing elicitor presented many absorption bands which were characteristics of glucans and proteins. HR-LCMS peaks were identified using the inbuilt library of LC-MS based on mass. Based on the available literature, 100 annotated metabolites were identified and most of the compounds were glyosidic

Conclusions: The results of the study suggest the effect of the elicitor on rubber plants mimics a characteristic HR, a rapid necrosis and expression of biochemical defence responses

Keywords: *Phytophthora meadii,* Rubber, Elicitor, Reactive oxygen species

09.13

MULTIOMICS APPROACHES REVEALED THE ALARMING ANTIMICROBIAL RESISTANCE CARRIAGE BY HEALTHY BROILERS IN RESPONSE TO THE ANTIBIOTIC INPUTS IN FEED CONCENTRATES AND POTENTIAL HEALTH RISK TO SOCIETY

Sreejith S.[1], Prathiush P.R.[2], Swapna Susan Abraham[2], Jyothis Mathew[1,] Radhakrishnan E.K.[1]

[1]School of Biosciences, Mahatma Gandhi University, Kottayam, [2] State Institute of Animal Diseases, Thiruvananthapuram.

Antimicrobial resistance (AMR) evolution associated with the livestock sector is an emerging threat to manage the infectious diseases. Unscientific usage of antibiotics in poultry farms can

greatly favour the evolution of antibiotic-resistant bacterial pathogens. Livestock farms can act as a high risk transmission hub of AMR to the society and environment. In the current study, broiler chicken farms (*Gallus gallus domesticus)* in central and south regions of Kerala were selected and the feed concentrates analysed for antibiotics using LC-MS/MS. Poultry feces samples from the respective farms were also used for the isolation of bacterial pathogens (*Enterobacteriaceae*) and antimicrobial sensitivity test. The potential multidrug resistant pathogens were further selected for whole genome sequencing (WGS), resistome annotation and phylogenetic analysis. The antimicrobial resistance transfer from the healthy broiler farms to the farm labourers were also studied using shotgun metagenomic approach. The LC MS/MS analysis showed the presence of heavy inputs of antibiotics such as tetracycline. The feed analysis also detected the presence of other antibiotics such s sulfadiazine, ciprofloxacin etc. Among the 250 isolates from the family of *Enterobacteriace*, *Escherichia coli* were the majority of isolates and showed resistance against tetracycline followed by aztreonam. *Klebisella pnuomoniae* was the second most isolated bacteria and shows similar resistance pattern with E coli. The highly multidrug resistant five isolates were subjected to whole genome sequencing and observed heavy abundance of resistance genes (more than 30 genes in each isolates). These extensively drug-resistant strains were also shown to have the presence of colistin resistance genes such as *arn*T, *ept*B 1 and MCR 9.1 and fosfomycin resistance such as FosA6 and *Fos*A2. Among these *Fos*A6, *arn*T, *Erm*R and MCR-9 genes were the first report for its prevalence in India. The comparative pathogenomics were conducted to correlate the presence of AMR genes and virulence and identified the pathogens to be highly pathogenic to humans. The shotgun metagenomics studies also identified the possible zoonotic transfer of pathogens and AMR genes to the labourers. The study demands high priority One-health surveillance of AMR transmission from various livestock farms to the society. This helps the medical and veterinary sectors to map the geographical distribution and diversity of potential pathogens and AMR genes and restructure the treatment regimes accordingly. Furthermore it is also important to control the unscientific usage of antibiotics in livestock feed and to follow proper antibiotic stewardship programs in livestock to prevent the antibiotic misuse by farmers.

09.14

POLYALTHIA KORINTII LEAF EXTRACT-MEDIATED GREEN SYNTHESISED IRON OXIDE NANOPARTICLES FOR BIOLOGICAL AND ENVIRONMENTAL APPLICATIONS

Tancia Rosalin [1, 2], Hana Mol K.E[1] and K.K.Elyas[1]

[1]*Department of Biotechnology, University of Calicut, Malappuram.*
[2] *Department of Biotechnology, SAFI Institute of Advanced Study, Vazhayoor, Malappuram.*

Background: The remarkable properties and wide applications of metal and metal oxides nanoparticles have attracted considerable interest worldwide. Literature reports have confirmed that phytochemical compounds in plant extracts can be used effectively as reducing agent to yield nanoparticles and are possible eco-friendly alternatives to chemical and physical methods. Therefore the present study is aimed at green synthesis of iron oxide nanoparticles using the aqueous leaves extract of *Polyalthia korintii*- a Western Ghats endemic species with ethnomedicinal claims; and evaluating their biomedical and environmental application possibilities.

Methods: Iron oxide nanoparticles were synthesised and characterised by UV-Vis spectrum and FTIR spectra recording, XRD, FESEM and EDX analysis. *In vitro* antioxidant analysis was

performed using DPPH and ABTS radical scavenging assays, Ferric reducing antioxidant power (FRAP) assay. Antimicrobial activity was checked on nine pathogenic bacteria using micro well dilution method and larvicidal activity was studied on the larvae of *Culex quinquefasciatus*. Cytotoxicity was tested on HCT116, K562 and HEK293 cell lines and lymphocytes by MTT assay. Acridine orange - ethidium bromide dual staining was done to detect the evidence of apoptosis induction. Dye degradation efficiency and catalytic activity were investigated employing the dyes used in textile industry.

Results: The synthesised nanoparticles were predominantly spherical and relatively of uniform shape, 40-60 nm particle size, crystalline nature, meghamite, and with elemental composition of Fe, O, C, O, P, Cl, Fe, S, K. Qualitative phytochemical analysis detected the presence of alkaloids, flavonoids, terpenoids, phenolics, and carbohydrates. The nanoparticle exhibited significant antioxidant, antibacterial and larvicidal activity. The results showed dose-dependent cytotoxicity of the biogenic nanoparticles with considerable reduction in cell number and cytomorphological evaluations leading to the observation of apoptotic characteristics. The induction of apoptosis was confirmed by dual staining. In the study, HCT 116 was more susceptible to the nanoparticles than K562 cells. Cytotoxicity evaluations on human lymphocytes, erythrocytes and HEK cell line clearly indicated that the nanoparticles displayed least toxicity on them. The nanoparticles were efficient in catalysing the degradation of the dyes at a faster rate.

Conclusion: An eco-friendly and cost-effective biosynthesis process was successfully employed for synthesis of iron oxide nanoparticles using leaf extract of *P. korintii* with involvement of no harmful chemicals. The phytoconstituents present on the plant had a significant impact on stability of nanoparticles. The results of this study shows that the nanoparticles were having antioxidant, antibacterial, antiproliferative, less toxicity on normal cells, larvicidal, and dye degradation activities. Overall, the results suggest that the green synthesised iron oxide nanoparticle from *Polyalthia korintii* leaves has potential biomedical and environmental applications.

Keyword: *Polyalthia korintii,* iron oxide nanoparticle, biomedical, environmental application

09.15

BIOPROSPECTING OF BACTERIA ISOLATED FROM BLACK PEPPER RHIZOSPHERE AND THEIR EFFECT ON PLANT GROWTH PROMOTION AND DISEASE SUPPRESSION

Asiya P[1], Amrutha Mohandas[2] , Sakeela V[1]

[1]M S Swaminathan Research Foundation Kalpetta , Puthoorvayal ,673121
[2]MAMO College Mukkam ,Manassery PO, Kozhikkode 63602P.O. MANASSERY,

The bacteria were isolated from the rhizosphere soils of black pepper from the Wayanad district. The cultural, morphological, and biochemical characterization of four isolates were carried out. The isolates were also tested for plant growth-enhancing properties such as IAA production, nitrogen fixation, and phosphate solubilization. The isolates PM 6 and PM8 were shown to be significantly superior to all other isolates, with IAA production ranging from 0.3 to.60 mg/ml and 0.34, and 0.69 mg/ml, respectively, as time increased from 30 minutes to one hour. The isolate PM8 produced more ammonia, 0.7 mg/ml, while PM6 produced 0.67 mg/ml. The isolate PM 8 produced higher hydrogen cyanide (37.93 g/ml), while PM6 produced 32.11 g/ml. In PM6 and PM8, seed germination was 86%. The vigor index in using 1668.4, while that in PM6 was 1147. The molecular characterization of the isolates was done using 16S r RNA gene sequencing and revealed that the

isolate PM8 was *Bacillus substilis.* The sequences were deposited in the NCBI database with Gene bank Accession number OM487042.

Keywords: PGPR, Vigour index, Accession number, *Bacillus substilis* .

09.16

OPTIMISATION OF REACTION CONDITIONS FOR THE SYNTHESIS OF SILVER NANOPARTICLES USING BANANA SAP

Deepa Mary Joseph[a*], Joseph Job[b]

[a] *Kuriakose Elias College, Mannanam, Kottayam,India, jesusdeepa.mary@gmail.com*
[b]*St.Berchmans College, Changanaserry, Kottayam, India*

Introduction: The present work was intended to develop and optimize a fast, green protocol [1] for the synthesis of silver nanoparticles. The work also aimed to characterize the silver nanoparticles produced and to test its antibacterial activity.

Methods: Silver nanoparticles were prepared by mixing 2% aqueous solution of banana sap and 1mM aqueous silver nitrate. The mixture was incubated in dark for 15 minutes. The formation of silver nanoparticles was followed using UV-VIS spectroscopy [2] and were characterised using Transmission Electron Microscopy (TEM) [2]. Factors which were significantly influencing the production of silver nanoparticles were identified using a 'one factor at a time' approach. The identified parameters were fine tuned to their optimum level through Box-Behnken design of Response Surface methodology [3]. The antibacterial activity [4] of the silver nanoparticles against *Escherichia coli, Pseudomonas aeruginosa*, *Serratia sp, Proteus vulgaris, Enterobacter sp* and *Staphylococcus aureus.* was analysed using the standard disc diffusion method.

Results and Discussion: A yellowish-brown silver nanoparticle suspension with a characteristic surface plasmon absorption band at 436 nm was produced. The optimum levels of the most influencing factors identified through Response Surface Methodology were concentration of $AgNO_3$ (2.75mM) and banana sap (1.38%) and the reaction temperature (31.76^oC). The shape and size of the nanoparticles were studied with the help of TEM. TEM studies revealed that the particles were almost crystalline with an average size of 9 nanometers. The synthesis of nanoparticles was completed within 15 minutes and the silver nanoparticles produced were stable over a week. The silver nanoparticle exhibited antibacterial activity against *Escherichia coli, Pseudomonas aeruginosa, Serratia.sp, Proteus vulgaris, Enterobacter.sp* and *Staphylococcus aureus.*

Conclusion: This present study introduced a simple, fast and eco-friendly protocol for the synthesis of silver nanoparticles using banana (*Musa sapientum* L Cv *Palayankodan*) sap. The significant parameters influencing the production of silver nanoparticles were determined and fine tuned. The nanoparticles produced were crystalline and uniform in size. The antibacterial efficacy of the nanoparticles was also verified.

POSTER PRESENTATION

09.17

PHARMACOLOGICAL INSIGHTS INTO DIETARY MILLETS FOR ITS ANTI-INFLAMMATORY POTENTIAL IN FREUND'S ADJUVANT-INDUCED MURINE MODEL

Abhirami S[1]. and A. Helen[1]

[1]Department of Biochemistry, University of Kerala, Thiruvananthapuram
abhisrabhi001@gmail.com,helenbiochem@gmail.com

Background: Millet is a small-seeded cereal that belongs to the *Poaceae* family that are rich sources of nutrients and bioactive compounds reported to have pharmaceutical benefits in various diseases. Presently health-conscious people having higher purchasing capacity are in search of nutritious foods and millets are having enough potential to ensure health benefits and well-being for reducing hazards from chronic sickness. The present study was carried out to evaluate the comparative anti-inflammatory effect of Finger millet (FM), Kodo millet (KM) and Foxtail millet (FoM) against Adjuvant- induced arthritis (AIA) in experimental models.

Methods: Female Wistar rats were divided into 6 groups. Group I was control, group II was AIA where arthritis was induced by the intradermal injection of 0.1 ml of Complete Freund's Adjuvant (CFA) into the right hind paw. Group III- Group V represents, AIA supplemented with 10% FM, 10% KM, and 10% FoM respectively. Group VI was AIA fed with Indomethacin (3 mg/kg/day). After 21 days, Paw thickness, the activities of inflammatory enzymes like cyclooxygenase (COX), lipoxygenase (5&15-LOX) Nitric oxide synthase (NOS) and myeloperoxidase (MPO), serum markers such as C-reactive protein (CRP), TNF-α, IL-6, IL-10 were analysed. Cytology of synovial fluid was done by PAPS staining.

Results: Millet supplementation significantly reduced the activities of inflammatory enzymes such as COX, LOX, and NOS in PBMCs; MPO and proinflammatory markers such as CRP, TNF-α and IL-6, in serum. Anti-inflammatory marker IL-10 significantly increased in the serum of millet fed groups. Cytology of synovial fluid showed that severe inflammation with reactive mesothelial cells in CFA group was decreased on millet supplementation.

Conclusion: This preliminary experiment demonstrates that the FM, KM, and FoM can modulate the inflammatory effect in AIA with most effect was observed in KM supplementation. The anti-inflammatory effect of millets emphasizes their potential to be used as a functional food in dietary therapy against inflammatory conditions.

Key words: Dietary Millets, Arthritis, Inflammatory enzymes, CRP, TNF-α, IL-6, IL-10

09.18

METHANOLIC EXTRACT OF *ACACIA CATECHU* AND WOUND HEALING -AN *IN VITRO* APPROACH

Amrutha D.S[1]. and A. Helen[1]

[1]Department of Biochemistry, University of Kerala, Kariavattom, Thiruvananthapuram 695581
amruthadileepkumar16@gmail.com, helenabiochem@gmail.com

Background: Skin wound healing is a very serious issue since the skin a critical barrier of the human body. It is a dynamic process, which include a cascade of events. Delayed wound healing is

a major health issue nowadays, mainly in diabetic patients. A perfect cure for wound healing is not possible till now. The centre of attention of current study is the wound healing property of *Acacia catechu* (*Sengelia catechu*) which is a deciduous plant native to South Asia and Southeast Asia including Indian Subcontinent. The study mainly focuses on the anti-inflammatory, anti-bacterial and angiogenesis potential of *Acacia catechu* by *in-vitro* methods.

Method: Crude Methanolic extracts of the plant (ACME) was collected by immersing the dried bark powder of *Acacia catechu* in methanol for 3 days at cold condition. FTIR and HR-LCMS were done to find out the functional groups and compounds present in ACME. The Anti-inflammatory activity was monitored in LPS induced RAW 264.7 cell lines at different time intervals. MTT was used to fix the dose of ACME in RAW 264.7 and the selected dose was used for further studies. Disc diffusion method was used to study antibacterial activity of ACME. Chick Chorioallantoic Membrane(CAM) used as a model for monitoring angiogenesis.

Results: The percentage yield was 4.51%. The FTIR spectra of ACME reveals the presence of different functional groups. LCMS results showed the presence of many compounds in which some of them have anti-diabetic, anti-inflammatory, antimicrobial activities and helps to overcome skin infections. The selected dose of ACME decreased the levels of TNF α, IL-6, and elevated the levels of IL-10 in RAW 264.7 cell lines. Agar diffusion method showed activity of ACME against *Pseudomonas aeruginosa* which showed 10 mm and 11 mm zone of inhibition on 50 and 100 mg/mL concentration. ACME possess angiogenic potential which was proven by CAM assay. All the concentrations tested-10,25 and 75 µg/mL enhances the new vessel formation in Chick embryo compared to the control

Conclusions: This work enlightened the activity of *Acacia catechu* as a medicine for wound healing, which shows good anti-inflammatory, antibacterial activity. The ongoing studies will be concentrated on the molecular level mechanism of wound healing in both *in vitro* and *in vivo* models.

Keywords: Wound Healing, Angiogenesis, *Acacia catechu*, Anti-inflammation

09.19

IN-VITRO EVALUATION OF ANTI-INFLAMMATORY ACTIVITY OF SILVER NANOPARTICLES BIOSYNTHESISED FROM *LAGENANDRA OVATA*(L.)THW. RHIZOME EXTRACT

Anju H. and S. Suhara Beevy

Department of Botany, University of Kerala, Kariavattom

Background : The development of novel products that improve the environment, industry, and human health is greatly enhanced by the use of nanotechnology combined with green chemistry. Silver nanoparticles (AgNPs) made from plant extracts showed notable biological characteristics, which boosted the use of green chemistry. In our study we have chosen *Lagenandra ovata*(L.)Thw which is an ethnobotanically important plant used as folk medicine. The plant contains various secondary metabolites required for the production of nanoparticles.

Method: Silver nanoparticles were synthesised from the rhizome of *L.ovata*. The rhizome were collected and extract was prepared. 1 Milli molar of silver nitrate was added to 90 ml double distilled water and to this 10 ml of prepared plant extract was added. They were characterised by

UV–visible NIR spectrophotometer, SEM analysis, XRD and FTIR. The *in vitro* anti-inflammatory activity was done by COX and LOX analysis.

Results: The colour of the solution turns to reddish brown, which indicated the presence of AgNPs. UV-vis absorption spectra showed broad surface plasmon resonance at 413nm. The AgNPs were almost spherical shaped particles and the size of the particles lies between 20 and 100 nm. The XRD pattern of silver nanoparticles extracted revealed the cubic crystalline structure. FTIR spectra exhibited various characteristic functional groups. The anti-inflammatory activity of AgNPs showed better effect than aqueous crude extract.

Conclusions: This work establishes that the silver nanoparticles synthesised from *L.ovata* shows better activity than the crude extract. It can be recommended as a potential anti-inflammatory agent for further in-depth pharmacological studies *in vivo* and can be used as a replacement to the commercially available drugs.

Keywords: *Lagenandra ovata*, silver nanoparticles, anti-inflammatory activity, COX and LOX.

09.20

ANTICANCER ACTIVITY OF *THOTTEA SILIQUOSA* ESSENTIAL OIL AND ITS ENCAPSULATED NANOPARTICLES IN SKBR3 CELLS

Greeshma BN[#], Ajikumaran NS , Sabulal B , Gayathri V[@]

 # Presenting author @ Corresponding Author
Phytochemistry and Phytopharmacology Division, KSCSTE- Jawaharlal Nehru Tropical Botanic Garden and Research Institute, Pacha-Palode, Thiruvananthapuram 695 562, Kerala

Background: *Thottea siliquosa* (Lam.) Ding Hou is ethnopharmacologicaly important medicinal plant belonging to the family Aristolochiaceae. In in ethno-medical practices its leaf essential oil is used to treat cancer, which is not yet scientifically validated. In order to determine the actual anticancer activity of the leaf essential oil of *T. siliquosa* and to override its limitation of the use of essential oils (EO) as pharmacological entity, the EO encapsulated nanoparticles along with leaf EO were validated scientifically to determine their anticancer activity on SKBR-3 cells.

Method: This work determines the anticancer activity of *T. siliquosa* leaf essential oil (TSEO) and its encapsulated nanoparticles (TSNP) on SKBR-3 breast cancer cell line. The EO was isolated by hydrodistillation and characterised by GC-FID and GC-MS and was encapsulated in chitosan alginate copolymer nanoparticles and characterised by DLS, zeta potential analysis and TEM. Cellular uptake assay was carried to examine the uptake of nanoparticles by SKBR3 cell line. The anti-cancer potential of TSEO and TSNP were assessed on SKBR3 cells by MTT assay, AO/EB stained fluorescent microscopic evaluation, Annexin V/PI tagged flowcytometric analysis, DCFDA assay for reactive oxygen species generation and sandwitch ELISA to measure the expression levels of RIPK1, RIPK3, MLKL, Caspase 3, Caspase 8 and TNF-α, and elucidated the mechanism of anticancer action.

Results: GC-FID and GC-MS revealed the presence of 50 compounds accounting for 99.68% of essential oil. The encapsulation efficiency of TSEO in nanoparticles and in vitro release of TSEO in 24 hours were 63.2% and 68% respectively. TEM and DLS of nanoparticles confirmed its size of 631.3 nm, and zeta potential value of -41.2 mV reveals its good stability. Cellular uptake assay indicated significant uptake of nanoparticles by SKBR3 cells. The flowcytometric analysis reveals necroptosis with an augmented classical apoptosis and these results were supported by the protein

expression levels of RIPK1, RIPK3, MLKL, caspase 3, and TNF-α. Significant ROS production was observed in TSNP treated SKBR3 cells, which also intern enhanced the necroptosis. In fluorescent microscopic observations of the TSNP treated SKBR3cells exhibits nuclear condensation, membrane blabbing and cell death. In all comparisons of anticancer activity on SKBR3 cells with TSEO with TSNP, the TSNP displayed significant higher activity than TSEO. In nut shell, the mechanism of anticancer activity of TSNP is through ROS and TNF-α induced activation of RIPK1 pathway of necroptosis with an augmented classical apoptotic pathway through caspase-3 cascade.

Conclusion: The current study scientifically validated the anticancer activity of TSEO and TSNP in SKBR3 cells with elucidated its mechanism of action. The limitation in using TSEO in cancer treatment was resolved here by synthesising TSNP, which will pave a new avenue for the development of new generations of anticancer agents.

Keywords: *Thottea siliquosa*, essential oil, nanoparticles, cytotoxicity

09.21

THERMOREGULATORY RESPONSES OF MALE AND FEMALE UNDER VARIOUS CLIMATIC CONDITIONS OF KERALA

Chithramol M. K[a], and Shine S. R[1a]

[a] *Department of Aerospace Engineering, Indian Institute of Space Science and Technology, Kerala - 695547, India, [1]shine@iist.ac.in*

Introduction: Many studies have observed that women and men differ in thermoregulatory responses under extremely hot and cold ambient. This might be due to differences in geometrical features, body mass distribution, subcutaneous fat content, and metabolic alterations caused by the release of sex hormones. The coastal regions of Kerala experience a hot/humid climate, while the hilly areas experience a cold/dry conditions. Investigation of thermoregulatory responses of men and women under these conditions could help determine the thermal comfort of men and women.

Method: The present study uses a comprehensive thermoregulation model to examine the thermoregulatory response of typical males and females under different climatic conditions in Kerala. The computational model developed using MATLAB comprises two systems that interact: active and passive. Heat transfer and blood flow are modeled using Pennes' Bio-Heat equation which is discretized using the finite-difference technique and solved by the Successive Over Relaxation iterative strategy.

Results and Discussion: Male and female thermoregulation models were exposed to thermoneutral, hot and cold ambient conditions. For hot conditions (38^0C, 75% relative humidity) the core temperature of men is 0.1 degrees higher. This could be attributed to the larger surface area to mass ratio of women. However, shivering earlier in women and reaches a superior value before men for cold ambient (16^0C, 40% relative humidity). Men have 0.3 degrees high core temperature. The greater radial temperature profile in men could be attributed to the existence of more muscles in men, which leads to a higher temperature via muscular shivering.

Conclusions: The current study shows that both males and females are more comfortable in a cold/dry environment than hot/humid climate. Male maintains a higher radial temperature profile at cold and hot environmental conditions. As the ambient temperature decreases, men show a

superior defense against cold/dry surroundings**.** However, for an increase in ambient temperature, women exhibit better protection against hot/humid climates.

Keywords: Human thermoregulation, Thermal Responses, Computational analysis, Kerala climate, Gender difference

09.22

POPULATION GENETICS OF *Phlebotomus argentipes* (DIPTERA: PSYCHODIDAE): VECTOR OF LEISHMANIASIS IN KERALA, INDIA

Fathima P. A, Prasanta Saini

ICMR Vector Control Research Centre Field Station, Kottayam, Kerala

Background: Leishmaniasis includes a group of clinical manifestations caused by the protozoan parasites belonging to the genus *Leishmania.* It is a vector borne infection solely transmitted by the hematophagous insects called sandflies. *Phlebotomus argentipes* is the predominant vector species involved. Recent investigations have delineated the Western Ghats region of Kerala as an emerging endemic zone of Leishmaniasis. The parasite, vector species as well as the reservoir host involved had been already reported from this zone. In depth morphological studies conducted in *P.argentipes* population across India and Srilanka reported it as a species complex comprising 3 sibling species . We investigated the population genetics of *P. argentipes* in the Western Ghats using both morphological and molecular tools and the intial findings are reported here.

Methods: Systematic entomological surveys, following standard methodologies (using light trap, manual aspirators and sticky trap) were carried out in the epidemiologically active zones of Western Ghats. Indoor as well as outdoor resting habitas were included in the surveys. Collected sandflies were identified up to species level using the standard taxonomic keys. *P. argentipes* samples were processed for multiple marker analysis through PCR amplification of mitochondrial (COI & Cyt b), ribosomal marker (18S rRNA) and nuclear marker (EF 1 α). Amplified sequences were analysed using MEGA to figure out the *P. argentipes* genetic diversity in the Western Ghats.

Results: The maximum density of *P. argentipes* was observed during the South West monsoon season. Indoor habitats and the cattle sheds were the preferred resting sites for *P. argentipes.* Among 1306 sandflies collected 334 were *P. argentipes.* Two groups of *P. argentipes* were observed during the morphometric analysis and similar finding was observed in the phylogentic analysis using COI & Cyt b sequences also.

Conclusion: These initial results proves the presence of *P. argentipes* species complex in the Western Ghats. Extensive sampling and analysis is required to validate the above findings.

Key-words: Phlebotomus argentipes, molecular marker, species complex, Western Ghats

09.23

PURIFICATION AND CHARACTERIZATION OF COLD ACTIVE LIPASE AND ITS APPLICATION IN THE SYNTHESIS OF BIODIESEL FROM WASTE OIL

Hafsa Kattatheyil*, Vishnupriya. S, Dr. A. A. Mohamed Hatha

Department of Marine Biology, Microbiology & Biochemistry
Cochin University of Science and Technology, Kochi, 682016
**Corresponding author e-mail ID: hafsakthyl@gmail.com*

Cold active enzymes are extremozymes produced by the psychrophiles and have attracted much attention as biocatalysts due to their capacity to resist extreme reaction conditions in the industrial processes. Lipases are a class of enzymes that catalyze the hydrolysis of long-chain triglycerides and constitute the most important group of biocatalysts for biotechnological applications. Cold active lipases are today the enzyme of choice for organic chemists,biophysicists, pharmacists,biotechnologists,microbiologists, and biochemists. In this study, lipolytic activity of 220 bacterial isolates from Arctic fjords were studied both by qualitative and quantitative methods. Lipase activity was measured using p-nitrophenyl palmitate (p-NPP) as a substrate. Among the 220 isolates, *Bacillus cereus* I_{13} was found to be the best lipase producer and this isolate has been selected for further studies. The effect of various parameters such as the incubation temperature, period, and effect of carbon and nitrogen sources on production of lipase by *B.cereus* I_{13} was investigated. Lipase produced from *Bacillus cereus* I_{13} was purified in a five-step process yielding 15-fold purification with a final yield of 94.5 U/mL. The SDS-PAGE of purified lipase displayed a single strong band,indicating a monomeric protein of 31 KDa size. Lipase from *B.cereus* I_{13} showed good activity in various temperature conditions as well as in the presence of organic solvents, suggesting their potential use in the catalyzing the biodiesel production from waste cooking oil by the transesterification reaction.

Keywords: *B.cereus* I_{13}, Cold active lipase, biodiesel, transesterification

09.24

EFFECT OF WHOLE GRAIN MILLETS IN HYPERCHOLESTEROLEMIC RATS ON DELAYING THE ONSET OF ATHEROSCLEROSIS

Haritha R[1] and A Helen[1]

[1]Department of Biochemistry, University of Kerala. Kariavattom,
Thiruvananthapuram-695581, Email: helenabiochem@gmail.com , harithar84@gmail.com

Introduction: Atherosclerosis is currently the main contributor to the global epidemic of cardiovascular disease. There is clear evidence that dietary habits can significantly minimize the risk of atherosclerosis. Millet is a cereal that are rich sources of vitamins and bioactive compounds having pharmaceutical benefits. Therefore, this study is to evaluate the hypolipidemic effect of dietary millets in hypercholesterolemic rats

Materials & methods: Animals were divided into 8 groups. Group 1 was control, group II were fed with high cholesterol diet (HCD), Group III to Group VIII were fed with 90% HCD + 10% millets ie, little millet, proso millet, pearl millet, kodo millet, finger millet, foxtail millet respectively. After experimental period of 60 days, serum lipid profile, tissue cholesterol levels,

activity of lipogenic enzymes, HMG-CoA reductase activity, activities of IL-10, IL1-β were analyzed in HCD challenged millets supplemented groups and compared with the HCD group.

Result: A significant decrease in serum and tissue cholesterol, decrease of lipogenic enzymes, reduced activity of hepatic HMG-CoA reductase, increase of IL-10 and significant decrease of IL1-$\boldsymbol{\beta}$ were observed in HCD challenged millets groups. The results were comparable to that of control groups.

Conclusion: Millets' ability to considerably slow the development of atherosclerosis was consequently confirmed. The antiatherogenic properties of millets show the significance of dietary changes in halting the development of atherosclerosis.

Keywords: Atherosclerosis, Millets, Lipid profile, Reverse cholesterol transport

09.25

THE ROLE OF EBV IN THYROID CANCER

Jisnet George, Dr. Ajith Vengellur, Divya Menon Ramesh, Gopika A G

Cochin University of Science and Technology, Kochi

Epstein - Barr Virus is an oncogenic virus that causes several cancers like Hodgkin's lymphoma, Burkitt's lymphoma, nasopharyngeal cancers, etc. The cancer genome studies of Epstein-Barr virus associated tumours revealed unique genomic alterations as well as epigenetic changes that play a role in the pathogenesis of EBV – associated tumours. Thyroid cancer is the most common endocrine malignancy and its onset and development are influenced by sex hormones, exposure to radiations and infectious agents like viruses such as Epstein-Barr Virus. Genetic and epigenetic alterations play a major role in the onset of thyroid cancer. Thyroid cancer has a very good prognosis and is treated with surgery and Radioiodine therapy. The effectiveness of Radioiodine therapy is dependent on the expression of NIS protein, which is an iodine transporter. The NIS expression in thyroid tumor is seen to be lower than in healthy thyroid tissue. This study mainly focus on cell line MDA-T32. Where our results suggest that there is EBV infection in Papillary Thyroid cancer cell line, MDA-T32, which may affect the NIS expression in thyroid cancer.

Keywords:

Epstein-Barr Virus (EBV), Latent gene, Thyroid cancer, Papillary thyroid cancer (PTC), MDA-T32 cell lines, Sodium/Iodide symporter (NIS).

09.26

EFFECT OF PHYTOCHEMICAL FROM *MYXOPYRUM SERRATULUM* FOR CARTILAGE REGENERATION

Jithu V S[1], Aswathy J[2]. and Annie Abraham[*]

[1]Department of Biochemistry, University of Kerala, Kariavattom, Thiruvananthapuram
[2]KSCSTE-Jawaharlal Nehru Tropical Botanic Garden and Research Institute, Palode, Thiruvananthapuram, Email: jithuviswambharan@gmail.com, aswathyjk2011@gmail.com, annieab2001@gmail.com

Introduction: Osteoarthritis (OA) is the most common form of arthritis and one of the leading causes of disability. This degenerative and progressive joint disease affects millions of people

worldwide Chondrocyte are the cell responsible for the production of proteins and metalloproteinase in articular cartilage. The cartilage loss ultimately results joint space narrowing leads to the development of OA. This traditional knowledge can be effectively utilized in new treatment strategies. The early studies based on plant derived secondary metabolites reveal the promising effect of these compounds against pathological conditions with little or no side effect. Hence, we intend to study the tissue regenerative properties of select phytochemical in chondrocytes for osteoarthritis.

Materials & methods: Percentage yield of extracts were calculated. Preliminary phytochemical screening and LCMS, FTIR and UV spectroscopy analysis were done. Total antioxidant capacity, reducing power assay were conducted. Antimicrobial activity of *Myxopyrum serratulum* ethanolic extract (MPSE) was evaluated in selected microorganism. The cell proliferative property was evaluated in L929 mouse fibroblast cell line and chondrocyte were isolated from rat knee joint. Cytocompatibility of MPSE against isolated chondrocyte was evaluated by MTT assay and GAG production evaluated by Safranin O and alcian blue staining method.

Result: From the results, MPSE has antioxidant as well as cell proliferative properties. The antimicrobial activity of MPSE exhibit excellent microbial inhibitory property against *Pseudomonas aerogenosa* and *staphylococcus aureus*. The MPSE have chondrocyte protective effect and treatment with MPSE enhances the production of GAG content in treated MPSE chondrocytes.

Conclusion: The MPSE are cytocompatible to chondrocytes could be devised for cartilage tissue engineering applications.

Keywords: Osteoarthritis, *Myxopyrum serratulum*, antioxidant, antimicrobial, cytocompatibility.

09.27

SCREENING OF ANTIBIOTIC RESISTANT BACTERIA ISOLATED FROM RAW COW MILK

Maya Mathew[1], Chaithanya M.V.[2], Sreejith S. [1], Biju P. [3], Jyothis Mathew[1], Radhakrishnan E.K.[1*]

[1]School of Biosciences, Mahatma Gandhi University, Kottayam
[2]University of Kannur, [3]Government Veterinary hospital, Ettumanoor
Corresponding author mail id: radhakrishnanek@mgu.ac.in

Antibiotic resistance is one of the top ten global health issues concerning the lives on earth. The improper usage of antibiotics can lead to the emergence of multidrug resistant bacterial species, with which treatment options against infectious diseases become strenuous. Milk is considered as a nutritious food for children and adults and provides a favorable environment for the growth of many microorganisms. As the pooling and mixing of raw milk prior to selling is a common practice with the local milk vendors in Kerala, chance of occurrence of cross-contamination increases. The presence of antibiotic resistant pathogenic bacterial species in raw milk ultimately affects public health and thereby making the treatment regimens ineffective against infections caused by them. In this study, the samples were enriched, and bacterial colonies were made as pure cultures. Identification of bacteria was carried out using biochemical tests and by 16S rDNA gene sequencing which identified the bacterial species as *Klebsiella*, *Pseudomonas*, *Serratia*, *Acinetobacter* and *Enterobactor*. Phenotypic and molecular screenings of antimicrobial resistance

among these isolates were analyzed. All of the isolates showed complete resistance to Rifampicin (100%) and 92% were showed resistance towards Vancomycin. Isolates also exhibited an increased resistance towards Amoxyclav (62.9%), Ampicillin (44.4%) and Azithromycin (37%). Antibiotic resistance gene *tet*B and bla_{CTX-M} were detected in 14% and 7.4% of isolates. The study thus indicates that the development of resistance to commonly employed antibiotics in veterinary sector has significant consequences in public health. Hence, the laws governing the sale and prescription of antibiotic administration in food-producing animals needs to be strengthened.

Key words: Antibiotic resistance, raw milk, 16s rDNA sequencing, *tet*B, $bla_{CTX-M.}$

09.28

EVALUATION OF BACTERIOPHAGES AS A BIOTHERAPEUTIC FOR CHRONIC WOUND INFECTIONS

Nivedya Mohan and Sarita Ganapathy Bhat

Department of Biotechnology, Cochin University of Science and Technology, Kochi

Background: The menace of antibiotic resistance is reported to claim the lives of more than 700,000 people globally every year. The yearly death toll due to widespread antimicrobial resistance (AMR) is expected to touch 10 million by the year 2050 with one person dying every three seconds if appropriate measures to tackle the threat of AMR are not taken immediately. It, thus, becomes crucial to find viable alternatives to the extensive use of antibiotics, specifically, in the health sector. Bacteriophages with their self-replicative ability, reduced cytotoxicity and targeted specificity are ideal candidates that can be employed to curb antibiotic use in the medical field. Phage therapy is, specifically, apt in the case of local infections like chronic wounds.

Method: This study mainly involves the isolation and characterization of bacteriophages capable of infecting multidrug resistant and biofilm forming strains of *Pseudomonas aeruginosa*, a prominent Gram negative wound pathogen, and the evaluation of the obtained phages as a therapeutic for resolving chronic wound infections. Bacteriophage screening was conducted to isolate lytic phages against wound strains of *P. aeruginosa.*

Results: Bacteriophages infecting *P. aeruginosa* wound strains were isolated from hospital sewage samples. Phage characterization studies showed that the optimal multiplicity of infection of the isolated *P. aeruginosa* phage was low and it had a broad host range, thereby, making it a plausible candidate for therapeutic applications.

Conclusion: This study is an addition to the growing body of literature, which indisputably establishes the fact that bacteriophages can act as important arsenal in the fight against multidrug resistant bacteria, specifically, in the case of local infections.

Keywords: Bacteriophage therapy, wound infections, Pseudomonas phages, Multidrug resistance

09.29

TINOSPORA CORDIFOLIA METABOLITE LIBRARY REVEALED POTENTIAL COMPOUNDS FOR TARGETING TNBC

Pournami P K 1 , Swetha KV 1 , Deepak Roshan VG 1 , KM Ramkumar 2 , Ramasamy PaulMurugan 3 & Vipin Gopinath 1

1 Department of CLS&TR, Malabar Cancer Centre, Thalassery, Kerala, 2 Department of Biotechnology, College of Engineering & Technology, SRM Institute of Science & Technology, Kattankulathur – Chennai, 3 Molecular Imaging Program at Stanford (MIPS), Canary Center for Cancer Early Detection, Department of Radiology, Stanford University School of Medicine, USA

Background: Triple negative breast cancer (TNBC) is a very aggressive and highly invading cancer type. The Hormone receptors (estrogen-ER & progesterone-PR) and HER-2 receptor are negative for this cancer and makes the targeted therapy more difficult than any other breast cancer. New targets are urgently needed for overcoming this lacuna. Plant based bioactive compounds can be introduced to the treatment regime so as to improve the treatment efficacy.

Method: Our study introduced a new therapeutic strategy for alleviate TNBC using metabolites derived from *Tinospora cordifolia*. Secondary metabolites of acetone extract of *Tinospora cordifolia* (TCA) were profiled using LC/MS and constructed a metabolite library. Metabolites were reverse docked and probable molecular protein targets identified. The compounds having potential protein targets in TNBC were a further analysed on MDA-MB 231 cell lines for their invitro cytotoxic and apoptotic activity.

Result: A total of 234 possible compounds identified and are reverse docked for identifying any human protein targets. 8 compounds got significant hits in reverse docking analysis. The PP121 and Thymoquinone (THY) were tested on MDA-MB 231 cell lines for cytotoxic and apoptotic activity. Both compounds showed significant cytotoxic and apoptotic activity on TNBC cell line. They could also exert a synergetic effect on the cell line.

Conclusion: The results suggest that *Tinospora cordifolia* derived bioactive compounds can be used in targeted therapy against TNBC. Further validation are needed on the study.

Keywords: Triple negative breast cancer, *Tinospora cordifolia,* PP121, Thymoquinone

09.30

SYNTHESIS OF SILVER NANOPARTICLES USING YEAST FLAVANOIDS AND THEIR ANTIBACTERIAL AGAINST SOME COMMON FOOD PATHOGENS

Princy, P. K[1*], Robert Antony, A.[2] and Mallikarjunaswamy G. E.[1]

[1] KSCSTE Kerala Forest Research Institute Sub Centre, Nilambur, Kerala-679329, [2]Department of Microbiology, Govt. Arts and Science College, Kozhinjampara, Palakkad, Kerala – 678 554, Email: princypk6@gmail.com

Background: The microbial-based AgNPs are less hazardous, eco-friendly, energy efficient and safer as compared to chemically synthesized counterparts. Secondary metabolites are significantly found in microbes, especially yeast flavonoids which have significant role in the synthesis of AgNPs. The flavonoids-based AgNPs have attained much attention in the last few years.

Method: Yeast isolates were cultivated on YMEPG medium and the biomass extracted with different organic solvents to obtain the flavanoids fraction of the yeast. Sodium hydroxide test, spectrophotometric and FT-IR analysis were done to confirm the flavaoids fractions. The silver tolerance test on the yeast cells silvernanoparticles was synthesised using flavanoid producing yeast cells. The silver nanoparticle was characterized by spectroscopic and FT-IR analysis. Antibacterial activity of AgNPs tested against food pathogens - *E.coil, Staphylococcus, Pseudomonas* and *Proteus*.

Result: The antibcaterial activity of the silver nanoparticle from yeast flavanoids was greater than the yeast flavanoids alone. Maximum activity obtained against *Staphylococcus* than any other bacterial pathogens. MIC was conducted for the silver nanoparticle against *Staphylococcus* and the results were analyzed.

Conclusions: The current research indicated that flavanoid derived AgNPs had noticeable activity compared with native flavanoid against bacterial isolates tested and could be used effectively against some multidrug resistant and hazardous bacteria used in food preservation.

Keywords: Yeast flavanoids, Silver nanoparticle, antibacterial activity & FT-IR.

09.31

BIFUNCTIONAL GOLD NANOCLUSTER AS A THERANOSTIC PROBE FOR THE MANAGEMENT OF ALZHEIMER'S DISEASE

Resmi A. N, M. E. Dhushyandhun, Sarathkumar E , Jayasree R S*

Sree Chitra Tirunal Institute for Medical Sciences and Technology, Thiruvananthapuram.
** jayasree@sctimst.ac.in*

Background: Theranostic nanomedicine is a promising approach in therapeutic paradigm. Various drugs with different mechanisms and targets have been developed for the treatment of neurodegenerative diseases; yet, the rate of success has been found to be negligible. Examples of neurodegenerative diseases include Alzheimer's disease, Parkinson's disease, Amyotrophic lateral sclerosis etc. The major limiting factor to the successful treatment of many of these neurodegenerative diseases is the presence of a polarized layer of endothelial cells comprising the blood–brain barrier (BBB) that prevents the brain uptake of almost all potential neurotherapeutics to the central nervous system. Therefore, the design of highly potent therapeutic agents that cross the BBB is a challenging field of advanced research which will facilitate better treatment progress for neurodegenerative diseases.

Method: This work focuses on a theranostics move towards, Alzheimer's disease (AD) which is one of the most common neurodegenerative diseases affecting the aged population. In order to deliver the drug across the barrier, we have developed a biocompatible, sub-atomic size, fluorescent dual function-gold nanocluster (AuC) for therapeutic and imaging applications and was thoroughly characterized for its physico chemical and biological properties.

Result: To avoid autofluorescence, we have synthesized highly self-assembled gold quantum clusters with a 610 nm fluorescence emission and possess a significant Stokes shift(225nm), long photostability, and good quantum yield. Subsequently, this gold cluster's good biocompatibility and imaging properties have been efficiently used to study the distribution of the nanocluster in the body. The efficacy of the nanocluster to dissolve amyloid fibrils was shown in vitro while its

ability to cross the blood-brain barrier was demonstrated both in vitro and in vivo. These results are evidence of the therapeutic potential of these nanoclusters.

Conclusions: In this work, we investigate the effect of these nanoclusters for their therapeutic and imaging efficacy in vitro and in vivo and determine whether this nanocluster can be used as an efficient inhibitor of AD progression.

Keywords: Gold nanocluster, Fluorescent, Theranostic probe, Blood-brain barrier, Alzheimer's disease

09.32

EVALUATION OF CYTOTOXIC POTENTIAL OF METHANOLIC EXTRACT AND FRACTIONS OF *CYCLEA PELTATA* LEAVES IN MCF-7 CELLS

Roshni S. S.[1], Sneha G.[1], Sujith S.[2], Preethy J.[3], Uma R.[4]

[1]Department of Veterinary Biochemistry, College of Veterinary and Animal Sciences, Mannuthy, [2]Department of Veterinary Pharmacology and Toxicology, College of Veterinary and Animal Sciences, Mannuthy, [3]Department of Veterinary Pharmacology and Toxicology, College of Veterinary and Animal Sciences, Pookode, Wayanad, [4]Department of Veterinary Biochemistry, College of Veterinary and Animal Sciences, Mannuthy

Background: Recent research focuses on the development of new drugs and alternatives to cancer therapy from plants. In this circumstance, the present study was performed to evaluate the cytotoxic potential of methanolic extract and fractions of *Cyclea peltata* leaves in MCF-7 cell lines.

Method: The *C. peltata* leaves were collected and extracted with methanol and fractionated suing solvents. The cytotoxicity study was carried out in MCF-7 cells using the MTT reduction assay at dose rates of 320, 160, 80, 40, 20 and10 µg/mL and the half maximal inhibitory concentration (IC_{50}) was determined. Morphological changes were screened by Acridine orange/Ethidium bromide and tetraethyl benzimidazol carbocyanine iodide (JC-1) staining techniques. The most potent fraction was subjected to GC-MS and FTIR for determining its active chemical components.

Results: *C. peltata* methanolic extract was found to be cytotoxic with IC_{50} value 117 µg/mL. The n-hexane fraction of methanolic extract with IC_{50} of 42 µg/mL showed maximum potency. In the treated cells, AO/EB staining detected apoptotic cells with orange- red fluorescence which were increasing in a dose dependent manner. Extracts and fractions induced intrinsic apoptotic pathway in the cells which was evident by the green fluorescence on JC-1 staining. GC-MS analysis of potent n-hexane fraction revealed the presence of Cycloheptasiloxane, tetradecamethyl- and methyl ester and FTIR analysis exposed the presence of deoxycholic acid among many compounds.

Conclusions: From this study it could be concluded that the hexane fraction was most potent in inducing cytotoxicity through induction of apoptosis.

Keywords: *C. peltata* leaves, MCF-7 cells, MTT assay, IC_{50}, Apoptosis, GC-MS and FTIR

09.33

BIOSYNTHESIS OF NICKEL NANOPARTICLES FROM DEFENSIVE SECRETION OF *LUPROPS TRISTIS* FABRICIUS. AND ITS BIOCHEMICAL PROPERTIES.

Ovungal Sabira

Division of Material Science, Department of Zoology, Sree Neelakanta Govt. Sanskrit College, Pattambi, Palakkad.

Background: Here, In this study simple approach was attempted to obtain a eco-friendly, economic, nontoxic way for synthesis of nickel nanopartiucles using an insect *Luprops tristis*. They release a defensive phenolic fluid that burns the skin when squeezed or pulled up.

Method: Defensive glands of the insects extruded out by gentle pressing on the abdomen; the glandular secretion collected to eppendorff tube containing deionised water by pressing on the extruded glands without any contamination from fecalmatter. These extract used for the synthesis of nickel nanoparticles. The nickel nanoparticles prepared by preparing reaction mixture by adding defensive gland extract and nickel chloride. Then heated in a domestic microwave oven (operating at a microwave power level of 350W) for a 15 minutes, and the transformation of colour of the solution noted. Nickel nanoparticles further stored for chemical characteristics such as UV spectroscopy , FTIR, SEM, TEM, Zeta potential and also for biological application such as antimicrobial activity, anticancer, antioxidant, and chromosomal aberration studies (anti mitosis).

Results: The synthesis of nickel nanoparticles (NiNPs) from the defensive secretion of insect *Luprops tristis* (LNiNPs) was verified here by UV-Vis spectroscopy. FTIR examination reveals the functional groups associated with the nanoparticles that act as the reducing and capping agent for the synthesis of nanoparticles from pure metal. The SEM study was identified the irregular spherical shape with rough surface. TEM study revealed the nanoparticle having a medium size of 8nm and Zeta potential analysis shows the higher stability of biosynthesised NiNPs with value -16.5mV. Disc diffusion study of LNiNPs demonstrated that bacterial inhibition was dose-dependent, that antimicrobial activity increased with increasing LNiNPs concentration, chromosomal aberrations of some kind can be seen in *Allium sepa L.* by the application of LNiNPs. The high antioxidant property of LNiNPs at higher concentrations was confirmed by UV spectroscopic analysis and also, which exhibit dose-dependent cytotoxicity against DLA cells.

Conclusion: Although *Luprops* is an annoyance to humans, it can be made useful by the biological application of these biosynthesised nickel nanoparticles such as antibacterial, antioxidant, anticancerous etc. Nanoparticles from an insect have not yet achieved this.

Keywords: Biosynthesis, Nickel nanoparticles, *Luprops tristis*, Chromosomal aberration.

09.34

EFFECTS OF A CO-CULTURE OF MARINE BENTHIC FILAMENTOUS CYANOBACTERIA AND *P.MONODON* POST LARVAE ON THE GROWTH, SURVIVAL AND IMMUNE RESPONSE

M Saranya[1], Valsamma Joseph[1], Balakrishnan Soumya[1], Ameer Ahna[1]

1. National centre for Aquatic animal Health 2. Cochin University of science and Technology

Background The development of aquaculture industry has been accompanied by substantial increase in the use of chemotherapeutic agents against bacterial and viral pathogens. Emergence of

drug resistant pathogens leads to many questions towards chemotherapeutic based treatment. The range of probiotic examined for use in aquaculture encompasses both Gram-negative and Gram-positive bacteria, although the use of other organism like cyanobacteria has also been explored. A common way to check suitability of any candidate in aquaculture animals is coculture study with the candidate. In this regard, present study deals with the efficiency of filamentous cyanobacteria on growth performance, survival rate and immune response of black tiger shrimp, *Penaeus monodon*.

Methods The filamentous cyanobacteria cocultured with postlarvae of *P.monodon* and measured the growth and survival at the end of the experiment. The negative impacts of cyanobacterial candidate on postlarvae measured by relative immune gene expression analysis using quantitative real time PCR (qRT-PCR).

Result Coculture experiment of filamentous cyanobacteria with P.monodon postlarvae shows that the animal group cocultured with cyanobacteria showed significant differences for the average weight gain, specific growth rate, feed conversion ratio ($p<0.071$) and survival rate($p<0.05$) compared to control group. The relative expression levels of immune genes Crustin, ProPO, Astakine, Transglutaminase and Alpha 2 macroglobulin in the test group were not significantly different from control ($p < 0.05$).

Conclusion Higher values in weight gain, SGR percentage, survival percentage and low value of FCR indicates the higher efficiency of cyanobacteria as feed in aquaculture animals. In the case of penaeid shrimp, enhance the immune responses of the host against pathogens or any physical stress. If the immune gene expression low or equal to control group that means the environment and the food is not causing any stress to this animals. On the basis of these coculture study results we could provide valuable information of potential abilities of filamentous cyanobacteria for shrimp aquaculture facilities as feed for better growth and immunity.

Key words Filamentous cyanobacteria, Crustin, ProPO, Astakine, Transglutaminase, Alpha 2 macroglobulin, qRT-PCR

09.35

DIVERSITY OF CULEX MOSQUITOES BREEDING IN BRACKISH WATER HABITATS IN NORTH KERALA AND THEIR POTENTIAL IMPACT ON DISEASE TRANSMISSION

Shamna. A.K and Sumodan P.K

Post Graduate and Research Department of Zoology, Government College, Madappally, Vadakara-673102, Kerala

Background: Culex vectors can tolerate high salinity and complete their development in the brackish water habitats. Kerala is a coastal state with an extensive coast line of 590 km. A survey was conducted to investigate mosquito breeding in brackish water habitats, especially disease vectors and also to estimate the salinity tolerance of the local populations of the species from January 2019 to January 2021 in the coastal belt of North Kerala.

Methods: Larvae were collected from Ezhome, Eramala, Pakkayil, chombala and Kadalundi of North Kerala. Fresh, brackish and saline waters are respectively defined as containing <0.5,0.5-30 and >30 ppt salt. Salinities of the collected water samples were also determined and salinity tolerance estimation were also done in the research laboratory.

Results: *Culex sitiens, Culex quinquifasciatus, Culex bitaneorhynchus, Culex tritaneorhynchus* and *Culex gelidus* larvae were encountered in the study. The salinity of the breeding habitats ranged between 4 to 30 ppt. All of the encountered species are vectors of arboviral diseases. Salinity tolerance estimation shows that the larvae of collected mosquitoes can tolerate salinity in the range of 8-32 ppt. The survey of different types of habitats like stagnant water bodies in mangroves, marshy swamps, Kaipad rice fields etc. found Culex sitiens and Culex quinquifasciatus to be the most dominant species.

Conclusion: These mosquito species prefer to breed in putrefied water with garbage and it was found in almost every stagnant, brackish water site in full sunlight. This necessitates a need for constant monitoring of brackish water breeding habitats of the state and initiate appropriate control measures wherever necessary, in order to prevent mosquito borne diseases.

Keywords: *Culex gelidus, Culex sitiens, Culex quinquifasciatus, Culex tritaneorhynchus and Culex bitaneorhynchus,* brackish water, salinity

09.36

GREEN SYNTHESIS OF ZINC OXIDE ZERUMBONE NANOPARTICLES: TOWARDS IMPROVING ANTIBACTERIAL AND ANTICANCER EFFICACY

Shilpa T[1]**, Sanjay Kumar R** and **R Aswati Nair**[2]

Department of Biochemistry and Molecular Biology, Central University of Kerala, Periye P.O., Kasaragod-671320

Background: Nano formulations using phytochemicals has received increased research attention over the last decade in modern drug discovery considering its potential to overcome the poor solubility and bioavailability of natural products. Present study aimed at green synthesis of Zinc oxide nanoparticles (ZnO-NPs) using the sesquiterpenoid, Zerumbone (Zer) sourced from of *Zingiber zerumbet* rhizome, which is reported to exhibit diverse pharmacological properties. The synthesized Zer-ZnO-NPs were evaluated for antibacterial and anticancer activity towards determining modulation of its efficacy compared to Zer.

Method: Green synthesis of ZnO-NPs was carried out by precipitation method, using $ZnSO_4.7H_2O$ (0.1 M) and NaOH (0.2 M) as precursors with and without the addition of Zer (0.3 g/ml) and characterized by UV-Vis spectra, X-ray diffraction (XRD) and Field emission scanning electron microscope (FESEM) analysis. Antibacterial activity of Zer-ZnO-NP, ZnO-NP and Zer was evaluated in three nosocomial pathogens namely *Escherichia coli*, *Pseudomonas aeruginosa* and *Staphylococcus aureus*. Cytotoxic potential of the synthesized Zer-ZnO-NP was determined in HeLa cells and compared the activity obtained with Zer.

Results: Optical and physical properties of Zer-ZnO-NPs were found to match with the typical ZnO-NP properties. Reduction in size (17 nm) of the green synthesized Zer-ZnO-NPs compared to ZnO NP (19 nm) was determined by XRD analysis. Antibacterial activity was found to be enhanced for Zer-ZnO-NPs compared to Zer alone in all the tested bacteria. Cytotoxicity of Zer-ZnO-NPs was observed to be higher (89%) compared to Zer alone (76%) in HeLa cells.

Conclusions: Enhanced bioactivity of Zer as NP formulation as determined in present study indicates its therapeutic efficacy thus constituting a potential approach to overcome the poor bioavailability of Zer.

Keywords: Zerumbone, Sesquiterpenoid, Zinc Oxide

09.37

CYTOTOXIC POTENTIAL OF METHANOLIC EXTRACT OF *CUCURBITA. PEPO L* SEED AND ITS FRACTIONS IN MCF-7 CELLS

Sneha Geevarghese[1], Roshni S S[1], Preethy J[2], Uma R[3]

[1]College of Veterinary and Animal Sciences Mannuthy, [2]Department of Veterinary Pharmacology and Toxicology, College of Veterinary and Animal Sciences Pookode Wayanad, [3]Department of Veterinary Biochemistry, College of Veterinary and Animal Sciences Mannuthy

Background: Seeds have gained popularity in recent years due to the high nutraceutical and therapeutic value of their bioactive components. In this context the present study was conducted to evaluate the cytotoxic potential of methanolic extract of *C.pepo L* seed and its fractions in MCF-7 cells.

Method: Seeds of *C.pepo L* were collected, dried, extracted using methanol in soxhlet apparatus and fractionated using hexane, dichloromethane, n-butanol and water. MCF-7 cells was cultured in RPMI-1640 media, trypsinised, plated into 96 well plates for MTT assay and IC_{50} was calculated. Acridine orange/Ethidium bromide and tetraethyl benzimidazol carbocyanine iodide staining techniques was done to elucidate the mechanism of cytotoxicity at half IC_{50}, IC_{50} and double IC_{50} doses. The most potent extract was analysed for its chemical components using GC-MS and FTIR.

Results: The MTT assay revealed dose-dependent cytotoxicity of methanolic extract of *C. pepo L* in MCF-7 cells, with an IC_{50} value of 34µg/mL. In AO/EB staining, when cells were treated with IC_{50} and double IC_{50} concentrations of the *C.pepo L* seed methanolic extract, late apoptotic cells with orange-red fluorescence were observed. JC-1 staining showed green fluorescence, when cells were treated with different concentrations of the extract. GC-MS analysis and FTIR of methanolic extract revealed the presence of many phytochemicals including hexadecanoic acid, methyl stearate, Deoxycholic acid, and 17 Octadecynoic acid respectively.

Conclusions: From this study it can be concluded that methanolic extract of seeds of *C. pepo L* seed antiproliferative against MCF-7 breast cancer cell lines and the effect was by inducing apoptosis through intrinsic pathway.

Keywords: *Cucurbita pepo L*, MTT assay, IC_{50}, AO/EB and JC-1 staining

09.38

A STUDY ON THE DIVERSITY OF INDIAN OPHIONINE WASPS (HYMENOPTERA: ICHNEUMONIDAE) WITH NEW RECORDS OF *ENICOSPILUS* SPECIES FROM KERALA.

T. K. Soumya[1] and K. Sudheer[2]

[1]Department of Zoology, Government College Madappally, Vadakara, Kerala, India. Email: tksou25@gmail.com, [2]Department of Zoology, The Zamorin's Guruvayurappan College, Kozhikode, Kerala, India., Email:drksudheer@zgcollege.in

Background: The Subfamily Ophioninae (Order Hymenoptera) is one of the moderately large group of species-rich subfamilies of family Ichneumonidae. Ophionines are solitary Koinobiont endoparasitoid wasps that utilizes the larvae of holometabolous insects, particularly those of Lepidoptera and Coleoptera. Majority of the species are important in biological control of

agricultural pests. Adult wasps usually have testaceous body, large ocelli, large eyes, long antenna and laterally compressed abdomen. In India, taxonomic studies on the Subfamily Ophioninae are mainly done from the northern states, and only limited number of works have been done from South India. The present paper focus on the diversity of Ophionine wasps of India with new records of species from Kerala.

Methods: The specimens were collected using light trap from Malappuram and Kozhikode districts of Kerala. The collected specimens were then dried, mounted using entomological pin and examined under a LEICA M205 stereozoom microscope. Diversity of Indian Ophioninae was prepared by referring all the relevant literature.

Results: In India, the subfamily Ophioninae is represented by 108 species under 7 genera, viz., *Ophion* Fabricius, *Leptophion* Cameron, *Enicospilus* Stephens, *Sclerophion* Gauld, *Orientospilus* Morley, *Dicamptus* Szepligeti and *Euryophion* Cameron. From Kerala, only 11 species have been reported. Four Ophionine wasps, viz., *Enicospilus erythocerus* (*Cameron*, 1905), *E. capensis* (Thunberg, 1822), *E. flavocephalus* (Kirby, 1900), and *E. flavicaput* (Morley, 1912) are newly recorded from Kerala. Diagnostic characters, figures, host data and distribution of the newly reported species are provided.

Conclusion: Very few species were reported from Kerala and the hotspot area of Western ghats which indicates the lack of work in the taxonomy of the subfamily and further studies will reveal more species including new ones from the region. Advanced studies can reveal the biocontrol potential of this species for eradicating the pests.

Keywords: Ophioninae, *Enicospilus*, New records, Kerala.

09.39

ISOLATION AND CHARACTERISATION OF PEPSIN SOLUBLE COLLAGEN FROM CONGER EEL

Sreelekshmi. Aravind K[1]., Varuna P. Panicker., Nimna Ajay., Chinnu M. V., Uma R

Department of Veterinary Biochemistry, College of Veterinary and Animal Sciences, Mannuthy, Thrissur

Back ground: Collagen, the most abundant structural protein in the extracellular matrix has wide application in medical, tissue engineering and pharmaceutical industry. Present work aimed at isolation and characterisation of pepsin soluble collagen (PSC) from Daggertooth pike conger *(Muraenesox cinereus).*

Methods: The pepsin soluble collagen (PSC) was successfully extracted from the skin of Daggertooth pike conger *(Muraenesox cinereus)* by using the conventional method of salt precipitation followed by dialysis. Structural characterisation of the isolate was carried out using SDS-PAGE, FTIR, UV spectrophotometry, CD spectroscopy and SEM.

Results: Pepsin-soluble collagen showed a yield of 10.12 percent on wet matter basis and 25.5 percent on dry matter basis. The triple helical structure of collagen was confirmed by FTIR and UV spectrophotometry. Isolated PSC was confirmed as type 1 collagen by SDS-PAGE analysis. FTIR spectra of PSC suggested that the secondary structure of the triple helical collagen was intact even after pepsin digestion. Pepsin-soluble collagen was soluble in acidic pH with maximum solubility at pH 4. The solubility was found to be decreased with an increase in the concentration of NaCl with a minimum solubility of 4 per cent. The present PSC isolate from eel fish exhibited

comparatively high thermal stability of 36 °C. Morphological analysis by SEM revealed a porous structure and comparatively high thermal stability makes it a promising biomaterial.

Conclusion: Structural analysis of the PSC isolated revealed stable triple helix with porous structure. Structural characteristics and thermal stability wound make it as a promising biomaterial in biomedical applications.

Keywords: - Pepsin soluble collagen, Pepsin, Daggertooth pike conger, Amino acid

09.40

FRESHWATER ALGAL DIVERSITY IN A TROPICAL WET EVERGREEN FOREST, SHOLAYAR, KERALA

Sreeraj KB[1], Bibina PB[1], Sreejith KA[2] and Sreekumar VB[1]

[1] Department of Forest Botany, [2]Department of Forest Ecology,
KSCSTE-Kerala Forest Research Institute, Peechi, Thrissur, Kerala 680653.

Background: Lower life forms are poorly documented from the tropical forests of Kerala and this was the pioneer attempt to document fresh water algae from the study area. The study has been conducted in a 10 ha. Forest dynamics permanent plot established and maintained by Kerala Forest Research Institute.

Method: Collections of freshwater algae were made by random sampling method from the permanent plot in the Sholayar reserve forest. Photomicrographs and measurements were made with a Leica DMC 2900 digital camera and LAS (Leica Application Suite) capture and image analysis software. The identification of the algal taxa up to species level was carried out with the help of keys and descriptions given by standard publications.

Results: A total of 51 algal species belonging to 4 classes (viz. Chlorophyceae, Bacillariophyceae, Euglenineae and Cyanophyceae), 8 orders, 13 families and 20 genera were collected from the sampling site. Out of the 51 species studied, 20 belong to the Class Chlorophyceae, 15 to Bacillariophyceae, 12 to Euglenineae and 4 to Cyanophyceae. Among the genera, the genus *Cosmarium* represented maximum number of species.

Conclusions: The present study could document 51 species of freshwater algae from various micro habitats of 10ha permanent plot. This will contribute to the biodiversity checklist of the long-term monitoring site which will act as a baseline data for long-term biodiversity monitoring. Regular monitoring of fresh water algae from the study area is suggested to understand the long-term environmental impact, especially the change in climate on diversity and distribution of algae.

Keywords: Freshwater algae, 10ha permanent plot, Sholayar Reserve Forest, Cholorophyceae

09.41

IN-VITRO TOXICITY, BIOIMAGING POTENTIAL AND ANTIOXIDANT ACTIVITY OF NATURAL CARBON NANODOTS FROM *SPATHODEA CAMPANULATA P. BEAUV* IN LUNG CANCER CELL LINE A549

[1]Sujith M.S[1], Nijila K[1] and M. Zubair[1]

Department of Zoology, University of Calicut, Malappuram, Kerala – 673 635, India.

Background: Natural Carbon Nano Dots (CDs) are prepared from natural resources, they are a new type of carbon nanomaterials with luminescence characteristics, low toxicity, good biocompatibility, simple preparation, abundance of raw materials and easy surface functionalization, it can be used as a nanotheranostics agent.

Methods: The aqueous extract of fresh leaves of *Spathodea campanulata P.Beauv,* carbonized applying microwaves and characterized by PL, UV-VIS and FTIR spectroscopy, XRD and HR-TEM. The CDs evaluated for cytotoxicity by MTT assay and bioimaging in A549 cells and free radical scavenging efficacy also evaluated.

Results: *Spathodea campanulata P.Beauv* CDs are synthesized which is photoluminescent, size less than 10nm, less crystalline and containing hydroxyl and carboxylic functional groups, which shows low toxicity with IC50 value of 595.4619µg/mL in A549 cells and has bioimaging potential also antioxidant efficacy with IC50=12.9324µg/mL .

Conclusion: The in-vitro studies shows that *Spathodea campanulata P.Beauv* CD can be used as a good nanotheranostics agent.

Keywords: Carbon nanodots, photoluminescence, bioimaging, nanotheranostics.

09.42

SYNTHESIS AND CHARACTERIZATION OF SILVER NANOPARTICLES FROM "SPIKE MOSS"

N. S. Swanila[1] and Nisha P.[2]

[1] Maharajas College Ernakulam, [2] St. Xavier's College for Women, Aluva.

Background: Green synthesis of silver nanoparticles is a cost effective and eco-friendly method of synthesis. *Selaginella delicatula* is a medicinal species of the ancient lycophyte family Selaginellaceae. It is widely distributed in Kerala. Aqueous extract of *Selaginella delicatula* is used for the study

Method: 1mm solution of silver nitrate and aqueous extract of *Selaginella delicatula* were used for the green synthesis of silver nanoparticles. Phytochemicals present in the plant extract act as the reducing and capping agent. Silver nanoparticles were formed when the plant extract was added with silver nitrate solution and it was detected by the colour change of the reaction mixture. Formation of silver nanoparticles was confirmed by UV-Vis spectroscopy and further it is subjected to the characterization studies viz., FT-IR, XRD and HR-TEM.

Results: An Absorption maximum of 422 nm was reported in UV-Vis spectroscopy. The presence of phytochemicals responsible for bio-reduction and stabilization was evident in the FT-IR spectrum of AgNPs. XRD showed peaks corresponding to the standard peak of metallic silver and

revealed the face centered cubic structure. It also showed peaks that might be of phytochemicals. HR-TEM studies implied the size of green synthesised silver nanoparticles in the range 10.54–50.09 nm with a fringe width of 0.24 nm.

Conclusions: The green synthesis of silver nanoparticles has no negative effects on the environment or organisms. It is a sustainable method of synthesis as it needs less manpower, time, and cost of production. The present study is a preliminary work and it needs to be done in depth to explore its applications and make it useful.

Keywords: Green synthesis, Silver nanoparticles, *Selaginella delicatula*.

09.43

DAPSONE SHOWING CYTOTOXIC EFFECT ON MCF7 CELL

Swetha K. V [1], Deepak Roshan V.G. [1], Vipin Gopinath [1], Satheesan B [2]

Division of Genetics, Malabar Cancer Centre, Thalassery[1], Division of Surgical Oncology, Malabar Cancer Centre, Thalassery[2]

ABSTRACT

Drug repurposing is also known as drug or drug repositioning is aim to find new therapeutic indication for traditional, clinically approved drugs. 4, 4'-sulfonyldianiline or diaminodiphenyl sulfone, (DAPSONE) is an antibiotic for the treatment of variety of of neutrophilic dermatoses. The present study aimed to investigate the therapeutic potential Dapsone can serve as chemotherapeutic agent against human breast cancer MCF-7 RSP and MCF-7 RR cell lines. The cytotoxic effect of DAPSONE against breast cancer cells were evaluated using MTT assay. The related mechanism of cell death was further determined by morphological changes observation, and drug combination index. The results showed that Dapsone treatment substantially induced cell death in a dose-dependent and time-dependent manner on MCF-7 cells. Dapsone showed a highly cytotoxic effect on MCF7 concentration Half-maximal inhibitory concentration (IC50) 4mM respectively. Consistently, we observed antiproliferative effect of Dapsone was associated with apoptosis on breast cancer cell lines by determination of morphological changes. Moreover, this drug demonstrated a synergistic activity triggering cell death in MCF7 cells. Conclusion, Dapsone has a potent cytotoxic effect resulting in the death of human breast cancer MCF-7 RSP and RR cell lines, demonstrating its potential target for breast cancer drug.

Keywords: Dapsone , MCF 7, breast cancer, cytotoxicity.

09.44

DEVELOPMENT OF GRAPHENE OXIDE BASED DETECTION OF N-TERMINAL BRAIN NATRIURETIC PEPTIDE (NT-PROBNP) FOR THE DIAGNOSIS OF HEART FAILURE

Vani M, Dr Manoj G S, Dr Rahul S

Sree Chitra Thirunal Institute of Medical Science and Technology, Thiruvananthapuram.

Heart failure is a flourishing health problem characterized by the inability of the heart to meet the circulatory demands of the body. In recent times, N-terminal brain natriuretic peptide (NT-

proBNP) has been accepted as a new diagnostic and prognostic biomarker for heart failure (Lüthje et al., 2007). Where the NT-proBNP is derived from the precursor peptide, proBNP which is synthesized mainly in heart ventricles and is cleaved into active hormone BNP and inactive NT-proBNP. Compared with BNP, the NT-proBNP contains 76 amino acids and has better stability in circulating blood. Considering this, it has been widely used as a biomarker of cardiovascular disease and in particular a marker of heart failure (Haixia Li et al., 2016). NT- ProBNP assessment needs to be done multiple times in a patient who diagnosis with heart failure. A low cost point of care method detection of NT-ProBNP at higher sensitivity will be beneficial for millions of HF patients in India as well as in other low and middle income country settings. The inclusion of nanomaterials in the sandwich immunological assay is a critical step to improve the sensitivity and specificity of the assay. Presently, there are different labels such as colloidal gold nanoparticles, quantum dots, and fluorescence beads used for the bioconjugation methods and assay developments. However, based on the available literatures the Graphene oxide nanoparticles will be a potential biosensor in biological systems and IVD applications (In-vitro disgnostic), owing to its characteristic affinity towards specific biomolecules and also for its low toxicity and eco-friendly nature. Here we intends the evaluation of the bioconjugation and its characterization of graphene oxide nanoparticle with specific antibody, which exhibit very low detection limit, speed, sensitivity, selectivity and high conductivity making an ideal candidate for In-vitro diagnostic kit (Janire Peña-Bahamonde et al., 2018).

09.45

NANOENCAPSULATED BACOSIDE A AND BACOPASIDE I: OVERCOMING BLOOD-BRAIN BARRIER TO TREAT SEIZURES

Vini C Sekhar[1], Kamalesh K Gulia[2], Ayswaria Deepti[3], Baby Chakrapani PS[3], Sabulal Baby[1], Gayathri Viswanathan[1*]

[1]Phytochemistry and Phytopharmacology Division, KSCSTE-Jawaharlal Nehru Tropical Botanic Garden and Research Institute, Pacha-Palode, Thiruvananthapuram 695562,
[2] Division of Sleep Research, Biomedical Technology Wing, Sree Chitra Tirunal Institute for Medical Sciences and Technology, Trivandrum, [3]Centre for Neuroscience, Department of Biotechnology, Cochin University of Science and Technology, Cochin – 682022, Kerala
** gayathrieaswer@gmail.com*

Background: *Bacopa monnieri* has traditionally been used as a medication to treat or prevent several neurological illnesses due to its capacity to nourish neurons. Numerous studies show that neuroprotective pharmaceuticals do not effectively penetrate the brain parenchyma. Drug delivery across the blood-brain barrier may be enhanced by the use of nanoparticle (NP) formulations capable of encapsulating therapeutically useful compounds. The purpose of this study was to investigate the effects of polymer-encapsulated bacoside A and bacopaside I nanoparticles on kainic acid-induced seizures.

Methods: Bacoside A (BM3) and bacopaside I (BM4) were sequentially extracted and purified from *B. monnieri* using normal and reverse phase column chromatography. PLGA-PEG encapsulated nanoparticles (BM3NP and BM4NP) were synthesized using the nano-precipitation method. After the physicochemical characterization and functional group confirmation of nanoparticles, cell viability was evaluated using mouse neuroblastoma (N2a cells) by the MTT assay. Neuronal differentiation from stem cells was studied by performing immunostaining for neuron-specific β-tubulin (TuJ1). Anti-seizure effects of BM3, BM4, BM3NP and BM4NP were

tested using specific epileptic markers by semi-quantitative mRNA expression in N2a cells *(in vitro*), while *in vivo* changes in the cortical EEG and sleep were monitored in KA-induced rat seizure model.

Results: The size of the BM3NPs and BM4NPs were 165.5 nm and 689.6 nm respectively with an admissible polydispersity index. BM3 and BM4 treatment showed IC50 value at a concentration of 738 and 1225 µg/mL respectively on N2a cells whereas BM3NP and BM4NP portrayed IC50 value only at 1609 and 2962 µg/mL respectively. BM3NP and BM4NP treatment showed the highest percentages of $TuJ1^{+ve}$ cells which indicate neuronal differentiation. BM3NP and BM4NP decreased the expression of epileptic markers like fractalkine, HMGB1, FOXO3a and many pro-inflammatory cytokines. The KA-treated rats after administration of BM3NPs and BM4NPs acquired a calmer state attaining a significant reduction in the spikes and sleep latency and an increase in the time spent in NREM sleep compared to the KA group.

Conclusion: Both *in vitro* and *in vivo* results indicate the therapeutic potential of BM3NP and BM4NP in neutralizing the KA-induced activation of neurons.

Keywords: Bacoside A, Bacopaside I, Nanoparticle, Seizure, Blood-brain barrier.

09.46

SPECIES COMPOSITION, DISTRIBUTION AND HABITATS OF MALARIAL VECTOR SPECIES IN NORTH KERALA WITH SPECIAL EMPHASIS ON DOMINANT VECTOR *ANOPHELES STEPHENSI* (DIPTERA: CULICIDAE) AND THEIR POTENTIAL ROLE IN TRANSMISSION

Vipinya C, Sumodan P K

Post Graduate and Research Department of Zoology, Government College, Madappally, Vadakara- 673102, Kerala.

Background: Malaria, global public health problem and India has highest risk than any other south east Asian countries. Malaria control requires assessing the abundance and vector diversity in potential malaria treats areas. Mainly six *Anopheles* species act as primary vector of Malaria. The present study plan to investigate the distribution and abundance of these primary vectors in North Kerala and which species is responsible for Majority of Malaria cases in this area too.

Methods: Collection was done by following two methods; immature and adult collection. Immature collection was carried out in all possible breeding habitats using 300 ml bowls and dippers. Adults were collected using aspirators from houses and Cattle sheds. The study was conducted in five North Malabar districts viz., Kasaragod, Kannur, Kozhikode, Wayanad and Malappuram from 2020 to 2022. Data on malaria cases from these districts were obtained from the daily bulletins published by Directorate of Health Services, Thiruvananthapuram, Kerala.

Results: We had collected four primary vectors, *An.stephensi, An.culicifacies, An.fluviatilis and An.dirus*. surveyed all types of breeding habitats and *Anopheles stephensi* was found breeding in 6 breeding habitats viz., buildings under construction, cement tanks, wells, ponds, boats and ground level water tanks. *An.culicifacies* was collected from rock pools with aquatic vegetation. *An.fluviatilis* and *An.dirus* from water holding near to flowing forest streams with aquatic vegetation.

Conclusion: Malaria is one of the most severe public health problems worldwide. This study revealed the presence and distribution of vector species. Understanding the vector diversity is essential for planning effective control strategy against these species.

Key words: Malaria, Primary vectors, vector diversity.

09.47

IDENTIFICATION OF POLYMORPHISMS IN THE IMMUNE-RELATED GENES AND THEIR ASSOCIATION WITH MASTITIS IN A CROSSBRED CATTLE POPULATION OF KERALA STATE

Arifa Abdulkhader[1*], K.V. Meganath[2], S. Vignesh[3], P.M. Rojan[2], E.M. Muhammed[2], R.L. Rathish[3], V.N. Muhasin Asaf[2] and C.N. Dinesh[2]

Department of Animal Genetics and Breeding, College of Veterinary and Animal Sciences, Pookode, Kerala Veterinary and Animal Sciences University

Background: Mastitis is an important economic disease affecting dairy animals. Ever since it has been known that resistance or susceptibility to mastitis has a strong genetic basis, efforts have been directed to identify animals that are naturally resistant to mastitis and gene markers that are associated with mastitis resistance. Polymorphism in several other immune response and host defence genes and their association with resistance or susceptibility to mastitis in cattle have been studied earlier.

The objectives of the present work were to study the single nucleotide polymorphisms (SNPs) in five immune-related genes and to find out the association of these SNPs to resistance to mastitis in crossbred cattle. The SNPs and genes considered were rs467234707 of *epidermal growth factor receptor pathway substrate 15 like 1* (*EPS15L1*), rs433539538 of *pentraxin 3* (*PTX3*), rs45930378 of *microtubule-associated serine/threonine kinase 3* (*MAST3*), rs480534837 of *platelet-derived growth factor D* (*PDGFD*) and rs800533391 of *stabilin-2 precursor* (*STAB2*), respectively.

Methods: The population under the study included 105 lactating crossbred cattle maintained in various farms located in the Wayanad and Kozhikode districts of Kerala state. Blood and milk samples were collected from each animal. The quality of milk was graded by somatic cell count (SCC). The blood samples were used for DNA extraction. The genotyping and polymorphism studies were carried out using the polymerase chain reaction-restriction fragment length polymorphism (PCR-RFLP) assay.

Results: Based on SCC, 48.57 per cent, 40.0 per cent and 11.43 per cent of animals were found to have healthy udder, subclinical mastitis and clinical mastitis, respectively. The PCR-RFLP assay revealed that the SNPs present in *EPS15L1*, *PTX3*, *PDGFD* and *STAB2* genes were monomorphic. However, the SNP of the *MAST3* gene was found to have TT and TA genotypes with frequencies 0.924 and 0.076, respectively. The Chi-square test revealed that there was no association between these genotypes and udder health.

Conclusion: The monomorphic nature of SNPs of *EPS15L1, PTX3, PDGFD* and *STAB2* genes indicated the absence of mutation and the conserved nature of the loci in the population under study. Though the SNP of gene *MAST3* was dimorphic, the population was in Hardy-Weinberg equilibrium which indicated the absence of forces that change the gene and genotypic frequencies occurring in a population.

Keywords: Cattle, Mastitis resistance/susceptibility, Immune response genes, SNP.

09.48

OMEGA-3 FATTY ACID CONCENTRATE FROM DUNALIELLA SALINA POSSESSES ANTI-INFLAMMATORY PROPERTIES INCLUDING BLOCKADE OF NF-KB NUCLEAR TRANSLOCATION.

Chitranjali T[1] and G Muraleedhara Kurup[2]

[1]National Homoeopathy Research Institute in Mental Health, Kurichy, Kottayam
[2]Department of Biochemistry, University of Kerala, Thiruvananthapuram

Introduction:The health benefits of omega-3 polyunsaturated fatty acids (ω-3 PUFA), mainly eicosapentaenoic acid (EPA 20:5) and docosahexaenoic acid (DHA, 22:6), have been long known. While the major commercial source is marine fish oil, in this study we suggest the marine micro algae, Dunaliella salina as an alternate source of omega-3 fatty acids.

Objective: In the present study we evaluated the anti-inflammatory properties of the Dunaliella salina derived omega-3 fatty acid concentrate by testing its effect on TNF-α, IL-6, MMPs and COX-2 directly. We also studied the effect of the omega-3 fatty acid concentrate on LPS induced translocation of nuclear factor-κB (NF-κB) into the nucleus.

Results: Treatment with algal omega-3 fatty acid concentrate (Ds- ω-3 FA) resulted in significant down-regulation of LPS-induced production of TNF-α and IL-6 by PBMCs. The concentrate was also found to be a potent blocker of cyclooxygenase(COX-2) and matrix metalloproteinase (MMP-2 and MMP-9) expression. The present study reveals the anti-inflammatory properties of Ds- ω-3 FA concentrate including the inhibition of NF-κB translocation.

Keywords: Eicosapentaenoic acid; docosahexaenoic acid; inflammation; cyclooxygenase; matrix Metalloproteinases

09.49

IN VITRO PROPAGATION OF AN ENDANGERED AND INDIGENOUS AQUATIC ORNAMENTAL PLANT-*LAGENANDRA NAIRII* RAMAM. & RAJAN-THROUGH PROLIFERATION OF MULTIPLE SHOOTS FROM APICAL BUD EXPLANTS

[1]Sheeja George E., [2]Aneykutty Joseph and [1]Dhanya C

[1]Post Graduate Department of Botany, Sree Narayana College, Cherthala, Alapuzha District-688582, Kerala, [2] Department of Marine Biology, Microbiology & Biochemistry,School of Marine Sciences, Cochin University of Science and Technology, Fine Arts Avenue, Kochi-682016, Kerala, India

Background: *Lagenandra nairii* Ramam & Rajan- belonging to the family Araceae- is an endangered aquatic plant endemic to Athirampally waterfalls of Trichur district of Kerala. The plant has high demands in the International aquarium industry. Wild collection from its natural habitat for export is not recommendable as it may lead to the extinction of this valuable aquatic plant. Natural methods of propagation are inadequate for large scale production of this plant to meet the market demands. Therefore, tissue culture technique can be adopted as a powerful tool for mass propagation of this plant. Present study was aimed to standardize an efficient tissue culture protocol for large scale production of L.nairii through direct multiple shoot organogenesis.

Materials and method: Mother plants were colleted from Malabar Botanical Garden, Olavanna, Kozhikode. Apical buds from the rhizome were used as the explants. Surface sterilization

procedure was standardized by treating the explants with various concentrations of commercial beach (Robin Liquid Bleach) for varying time durations. Explants in ½ strength and full strength of MS media (Murashige & Skoog media,1962) to determine the appropriate strength of the MS medium for culture initiation in the plant. Sub culturing in MS media containing cytokinins in various concentrations and combinations of auxins and cytokinins was done to standardize the shoot elongation medium. For getting shoot elongation, the shoots were then subcultered in lower concentrations of PGRs. PGR free MS medium and MS media containing auxins in various concentrations and combinations of auxins and cytokinins were tried for root formation. Various PGRs used included BAP, Kinetin, IAA, NAA, IBA. The cultures were kept in 200 lux for 6 to 16 hrs at $26^0 \pm 2^0$C.

Results & Discussion: Treating the explants with 15% commercial bleach for 20 minutes followed by a quick dip in 100% Ethanol could give maximum number of contamination-free cultures. Full strength of salts in the MS medium was ideal for culture establishment after two weeks. Shoot multiplication was maximum in MS medium containing 4 mg/l BAP. FMS medium containing 0.5 mgl^{-1} BAP could induce maximum shoot elongation and FMS basal medium was the best one for producing maximum number of roots.

Summary & Conclusion: The protocol standardized in the present study for rapid micropropagation of the aquatic ornamental plant-*Lagenandra nairii* can be utilized for its mass propagation to meet the market demands. The protocol is also useful for ex-situ conservation of this endangered and endemic ornamental aquatic plant.

Keywords: *Lagenandra nairii*, explants, plant growth regulators, ornamental plant, endemic, endangered, micropropagation

09.50

ASSESSMENT OF MORPHOLOGICAL AND GENETIC VARIABILITY IN ANNATTO (*BIXA ORELLANA* L.)

Nisha Joseph[1]* and E. A. Siril[2]

[1]Post graduate and Research Department of Botany, Catholicate College, Pathanamthitta, [2]Department of Botany, University of Kerala, Kariavattom, Thiruvananthapuram

Background: Annatto, (*Bixa orellana* L.) is a small, multipurpose tree, belonging to family Bixaceae. It is cultivated as garden plant and also as crop plant. It is one of the commonly used natural colorant yielding yellow to red color, having wide applications in dairy and cosmetic industries. Annatto is a cross pollinated species and is thus highly heterozygous in nature. The fruit yield is frequently low and variable and not always correlated with bixin production. The present study was aimed to find out the genetic diversity of this taxon collected from northern, southern and central parts of Kerala.

Method: The different floral petal colors (white, amaranth rose, petunia purple or cobalt violet) were determined from selected plants with reflectance spectrophotometry. Colour of fruits also varies among the selected morphs. They are 1) green-fruited 2) green-fruited with reddish spines 3) red-fruited, 4) brown large-fruited and 5) with brown distorted fruits. Qualitative and quantitative characters were analysed for the variants. Genetic variability studies were carried out with RAPD primers.

Result: Phenotypic measures of other floral traits, seed set, seed output and seed weight also revealed variation between different floral morphs. Records on seed set varied significantly for different floral color morphs. Maximum fruit maturation (58 %) was observed in amaranth rose and least fruit maturation (25 %) in the white morph. In the Random Amplified Polymorphic DNA (RAPD) analysis, out of 88 bands generated with nine operon primers, 70 were polymorphic.

Conclusion: The different color morphs of *Bixa orellana* showed differences in RAPD profile indicating a genetic basis for floral color variation and consequent differences in seed set.

Key words: *Bixa orellana*, genetic diversity, RAPD, morphological variation

09.51

VOLATILE COMPOSITION, BIOLOGICAL PROPERTIES AND *INVITRO* PROPAGATION OF *SATUREJA BIFLORA* GROWING IN INDIA – A POTENTIAL THERAPEUTIC CANDIDATE

Dr.Lekha Kumar[1]*, Dr.T.J.Sincy[2] and Dr.V.Narmatha Bai[3]

[1]Department of Botany (PG), PSG College of Arts& Science, Coimbatore -14, [2]Department of Botany, Nirmala College for Women, Coimbatore -18, [3]Department of Botany, Bharathiar University, Coimbatore-46

Hydrodistilled volatile oil obtained from the leaves of *Satureja biflora* growing in Nilgiris, India was analysed using GC-MS which resulted in the identification of 49 components. The major components were geraniol (43.13%) and β-citral (31.77%) followed by bornyl acetate (2.38%), phthalic acid (2.18%), geranic acid (1.93%) and caryophyllene oxide (1.25%). The essential oil was evaluated for its *in vitro* antioxidant activity by employing 2, 2-diphenyl-1-picrylhydrzyl (DPPH), metal chelating, hydrogen peroxide and total antioxidant methods. Free radical scavenging activity in the DPPH system was determined to be 345.1± 1.17µg/ml. The metal chelating activity was found to be 183.7±0.46 µg/ml. Hydrogen peroxide activity was measured as 215.8 ± 0.09µg/ml and the total antioxidant activity was calculated as 314.1 ± 0.74µg/ml. *In vitro* cytotoxicity was assessed in vero cell lines (African, Green monkey Kidney, Normal). The 50 percent cytotoxic concentration (CTC 50) was determined by the standard MTT assay and calculated as 240µg/ml. Establishment of multiple shoots was successful on full strength MS medium supplemented with cytokinins such as, BA (1mg/l), TDZ (1.5mg/l) and Zeatin (3mg/l) individually. The regenerated shoots were rooted successfully on half strength MS medium. *In vitro* rooted shoots were acclimatized successfully.

Keywords: *Satureja biflora*, Essential oil, Antioxidant activity, Cytotoxicity, *Invitro* propagation

09.52

ASSESSMENT OF INSECT FAUNAL DIVERSITY IN THE ORGANIC AND NON-ORGANIC PADDY CROPLANDS OF REGIONAL AGRICULTURAL RESEARCH STATION, PATTAMBI, PALAKKAD DISTRICT, KERALA

Sreeja.P and E.M Manogem

Department of Zoology, University of Calicut, Malappuram-673635, Kerala

The Rice ecosystem is one such highly altered natural ecosystem which is the habitat of a wide variety of insects. It has been reported worldwide that over 800 species of insects are recorded in the rice ecosystem, and mainly 100 species of insects attack rice. The abundance and diversity of

insects vary according to the paddy growth stages. In the present scenario, the information on the biodiversity of paddy fields and cultivation regimes is very scanty. Hence the current study explores the insect faunal diversity and abundance from the organic and non-organic model paddy croplands of the Regional Agricultural Research Station, Pattambi Palakkad district. The present study was carried out for five months, from November 2021 to March 2022. Weekly once the samples were taken at dawn from 7 to 8 am and dusk from 4 to 5 pm to access the maximum insect species composition of the particular study area. The collected orders of the study include Coleoptera, Lepidoptera, Orthoptera, Odonata, Diptera, and Hymenoptera. The most abundant insect orders were Coleoptera (31.35%), Lepidoptera(21.12%), Hemiptera(20.15%), Odonata(11.20%), Hymenoptera(7.51%) and the least abundant order Orthoptera(0.51%). Further, the present study indicates that organic paddy fields provided suitable breeding sites for the insects due to prevailing environmental and habitat conditions compared to non-organic paddy fields with unfavourable habitat conditions. A total of seven orders containing 13 families and 17 species were collected from the sites. The highest number of individuals was collected from organic paddy fields (1210). The species diversity was more significant in Hemiptera, followed by Lepidoptera, Coleoptera, Diptera, Odonata and Orthoptera. The species that showed the highest abundance were *Scripophaga incertula*(17.80%), *Dicladispa armigera*(11.71%), and the lowest was *Scripophaga innotata*(1.53%). Few ecological parameters showed a significant relationship between insect occurrence and habitat. The apprehension on the knowledge of the impact of insecticides on species abundance and distribution can pave the way for selecting components for integrated pest management strategies for considering the aspects of species diversity and conservation.

Key words:Ecosystem,Insect pests,Diversity,Abundance

09.53

ANTI- INFLAMMATORY EFFECT OF VANILLIN ON LPS STIMULATED RAW 264.7 MACROPHAGES

Sruthi N. Kumar, Dr. Prakash Kumar B, Dr. R Harikumaran Nair

School of Biosciences, Mahatma Gandhi University, Kottayam, Kerala.

Background

While inflammation is regarded as a major ailment and a source of pain and trauma, at its core, inflammation is a protective response, helping clear cellular debris and invading pathogens, setting the stage for repair and tissue regeneration. Excessive and/or prolonged inflammation leads to extensive damage to tissues, paving the way for organ dysfunction and mortality. Conventional treatment of inflammation involves the use of Non-Steroidal Anti-Inflammatory Drugs (NSAIDs), the use of which has been fraught with severe side effects. It is therefore imperative to identify and develop natural anti-inflammatory agents that offer a safer and efficient alternative to NSAIDs.

Methods

To assess the effect of Vanillin on cell viability, the MTT assay was performed. Based on IC50 values, three concentrations that were well tolerated by the macrophage cells were selected for further analysis. Activated macrophages produce pro-inflammatory cytokines such as TNFα and IL1β, which are known to play key roles in furthering inflammation and in the pathophysiology of inflammatory pain. Anti-inflammatory potential of Vanillin was assessed in terms of lowered levels of pro-inflammatory cytokines produced by cells after LPS Stimulation, through ELISA.

Results

Vanillin at concentrations of 10µg/mL, 1 µg/mL, 0.1 µg/mL, and 0.01 µg/mL were found to be well tolerated by cells. Anti-inflammatory potential of Vanillin was assessed using ELISA after LPS stimulation of the macrophages. The results indicate potent activity, which may be harnessed as a therapeutic agent. At the highest tested dose (10 µg/mL), Vanillin reduced the production of TNF α and IL 1 β by 30.94% and 69.10% respectively.

Conclusion

The study shows that Vanillin is a promising anti- inflammatory agent. The inhibition of TNF α and IL 1 β, both vital cytokines with pro-inflammatory roles suggest that the compound probably exerts its action by interfering with a) the NFκB pathway activation, or b) inhibiting Caspase1or TNF α Converting Enzyme (TACE) that cleave pro IL 1 β and TNF α into their respective active forms. Further studies are needed to elucidate the mechanism by which Vanillin exerts its anti-inflammatory property.

Keywords: Bioactive compound, spice, inflammation, proinflammatory cytokine

10 –MATHEMATICAL & STATISTICAL SCIENCES ORAL PRESENTATION

Student Category

10.01

MULTI-RESOLUTION ANALYSIS ON THE SPACE OF ANALYTIC FUNCTIONS AND FRAME STRUCTURE OF THE SZEGO KERNEL

Anusree Sreedharan, Noufal Asharaf

Department of Mathematics, Cochin University of Science and Technology, Kerala, India

Background : Multi-Resolution Analysis (MRA) is the widely used technique for analysis and compression of signals. In MRA we will break the signal into its components and when we combine all back together we will get the initial signal. A frame of an inner product space is a generalization of a basis of a vector space that may be linearly dependent. A frame provides a redundant and stable way of representing a signal.

M**ethods :** This work focuses on studying Blaschke functions to construct the Multi-Resolution Analysis on the Hardy space of unit circle. Similar to the Whitney cube decomposition of the unit disc, we determine a decomposition using a non Blashke sequence. This decomposition will be helpful to reconstruct an analytic function from the sample values measured at the non-Blaschke sequence. With respect to the chosen non-Blaschke sequence, we investigate the corresponding Szego kernel's frame structure.

Results: We constructed an orthonormal basis for this space, the Malmquist-Takenaka system the most frequently used rational orthogonal system in ECG processing and its compression. We studied the MATLAB toolbox RAIT which is used for this purpose and the Szego kernel corresponding to the sampling sequence we have selected will form a Banach frame.

Conclusions: We can represent any function in the space in terms of the sampling sequence and the toolbox RAIT is independent of the particular problem and can be used for processing signals generally.

Keywords: Multi-Resolution analysis, Blaschke functions, Malmquist-Takenaka system

10.02

ESTIMATION OF CDPU NUMBER USING GRAPH NEURAL NETWORKS

Hiba Hameed[1], Beena Koshy[2], Rajeev Rajan[3]

[1]College of Engineering, Trivandrum, [2]Dept. of Mathematics, Catholicate College, Pathanamthitta, [3]Government Engineering College, Thiruvananthapuram

Background: Graph labeling has wide application in computer science, network theory, image processing and communication networks. Connectivity, scalability, and routing in communication channels can also be analyzed using graph models. Automatic routing of data **i**n a network can be achieved using graph labelling [1]. This paper discusses the automatic estimation of a new graph labeling technique-Complementary Distance Pattern Uniform set (CDPU) using graph neural networks.

Methods: Estimation of CDPU number for a graph can be addressed using graph neural networks by predicting a single number for an entire graph. For this purpose, we use the graph neural network model proposed in the paper. ChebNet generalizes convolutional neural networks to work with non-Euclidean data domain by using a spectral approach. A spectral approach offers a well-defined localization operator. For fast spectral filtering, ChebNet uses the recursive formulation with the following parametric filter.

Results: The proposed network uses three ChebNet convolution layers with ReLU activations. We obtained accuracy of 60.65% for CDPU estimation

Conclusion: CDPU number can be used for the asymptotic analysis of running time for the memory operations. A graph neural network-based approach is effectively utilized to estimate CDPU number automatically. The proposed network uses three ChebNet convolution layers with ReLU activations. We obtained accuracy of 60.65% for CDPU estimation

10.03

STABILITY OF SOME VARIANT OF WEYL TYPE THEOREMS UNDER COMPACT PERTURBATION

Simi Thomas[1], T Prasad[2] And Shery Fernandez[3]

[1]Department of Mathematics, CUSAT, [2]Department of Mathematics, University of Calicut, [3] Department of Mathematics, CUSAT

Background: In 1909 Hermann Weyl, working at some differential equa-tions, observed that the essential spectrum of a self adjoint operator on Hilbert space: when you take it away from the spectrum, you are left with the isolated eigenvalues of finite multiplicity. This classic result is called Weyl's theorem. In 1966, L. Coburn studied this for several classes of non normal operators. This soon generalized to normal operators and then to more and more classes of operators, bounded and unbounded, on Banach space and also in Hilbert space.

Method: To find the mathematical solution of a system, it is enough to know the spectrum of the operator corresponding to the system. So Weyl type theorems and its stability under compact perturbation are particularly interesting. More studies are done on this area and certain Weyl type theo-rems are stable under compact perturbation. So we extend these results to recent variants of the Weyl type theorem.

Results: We discuss the stability of property (UW_E), one of the Weyl type theorems under compact perturbations. We prove the property (UW_E) invariant under compact perturbation if and only if the set of isolated points of the Wolf spectrum is empty and the complement of the Weyl essential ap-proximate point spectrum is connected. Also, we showed that the conditions in the above result are imperative with some examples. We also formulate some conditions that property (UW_E) holds for the functions of operators. Conclusion: This work explains the stability of some stronger versions of Weyl type theorems to know operator's structure more clearly.

Keywords: Weyl theorems, Compact operators, Perturbation, Toeplitz operators.

10.04

NORMAL CATEGORIES OF SEMIGROUP OF ORDER-PRESERVING TRANSFORMATIONS ON A FINITE CHAIN

K K Sneha

Cochin University of Science and Technology, Cochin, Kerala, India

Abstract

Cross-connection theory developed by K. S. S. Nambooripad provides the construction of a regular semigroup from its principal left(right) ideals using a certain category called normal category. Here we use cross-connection theory to study the structure of the semigroup *OXn,* of non-invertible order-preserving transformations on a finite chain $Xn = \{1 \leq 2 \leq \cdots \leq n\}$. In the present work, we characterize normal categories associated with the regular semigroup *OXn.* This article considers the ideal categories of *OXn* and identifies the principal left ideal category L(*S*) as power set category *Po*(*Xn*), the principal right ideal category, R(*S*) as $_o$ (*Xn*) category of ordered partitions of X_n. Further, we construct the cone semigroup *T* L(*S*) and prove that *T* L(*S*) is isomorphic to OX_n.

Keywords: semigroup, Normal category, Normal cones, Full transformation semigroup, H-functors.

10.05

STATISTICAL ANALYSIS OF BIOMEDICAL DATA WITH A TRIGONOMETRIC DISTRIBUTION

Veena G[1] and Lishamol Tomy[2]

[1]Department of Statistics, St.Thomas College, Palai, Kerala-686574, India, Email: veenagpillai@hotmail.com, [2]Department of Statistics, Deva Matha College, Kuravilangad, Kerala-686633, India, Email: lishatomy@gmail.com

Abstract

People are uncertain about their chances of recovery when they are treated for cancer, covid19, or any other disease after being diagnosed, also when they participate in clinical trials for a new drug. While many factors go into determining a solution, Statistics can help. Doctors utilize survival statistics to evaluate a patient's prognosis. The prognosis is the probability of recovery. In light of this, we develop a flexible trigonometric extension of the well-known modified Lindley distribution. We use features from the sine generalized family of distributions to create an original one-parameter survival distribution, called the sine modified Lindley distribution. First, we introduce it conceptually and discuss its key characteristics, such as functional, reliability, and moment analysis. The usefulness and the applicability of the sine modified Lindley distribution are illustrated through a detailed study using simulation and with real-world data. Using the goodness-of-fit method, we discover that the new model is useful in modelling the survival periods of guinea pigs administered with tubercle bacilli, growth hormone medication administered to children and the size of tumours of patients enduring cancer. This model, we believe, will be useful in modelling the survival durations of diseases similar to cancer, as well as in other fields related to sciences such as nanoscience.

Keywords: goodness-of-fit; biomedical data; lindley distribution; trigonometric function; continuous distribution

10.06

SEMISIMPLICITY OF TWISTED GROUP RINGS AND GENERALIZED MASCHKE'S THEOREM

Alanka Thomas and P.G.Romeo

Department of Mathematics, CUSAT, Kochi, Kerala Pin:682022

Background: Classical Maschke's theorem says that the group algebra K[G] is semisimple if G is finite and the characteristic of K does not divide the order of G. As a twisted group ring over a division ring is a generalization of the group algebra, it is natural to ask a condition for which twisted group rings are semisimple. While studying group lattices, K.S.S. Nambooripad generalized Maschke's theorem for twisted group rings over a field. This work aims to generalize Maschke's theorem to twisted group rings over division rings.

Method: To prove a condition for the semisimplicity of twisted group rings over a division ring, we use the same proof technique as in twisted group rings over a field. The converse of the main theorem is true for twisted group rings arising from split extensions, and its proof involves properties of modules and group modules.

Results: We prove that if the characteristic of a division ring K does not divide the order of a finite group G, twisted group ring K(G; H) is semisimple, for any Schreier extension H of K by G. The converse of this theorem is not generally valid, but it holds for twisted group rings generated by split extensions of K by G. As there is a one-to-one correspondence between twisted group rings and group lattices over division rings, we end up with some consequences of the semisimplicity on group lattices.

Conclusions: This work establishes a condition for the semisimplicity of twisted group rings over division rings. The obtained result is a generalization of the Classical theorem due to Maschke for the semisimplicity of group algebras.

Keywords: Twisted group rings, Semisimplicity, Group lattices

POSTER PRESENTATION

10.07

INVOLVEMENT OF STATISTICAL DAMAGE MODELING IN NANOTECHNOLOGY USING PATIL-SESHADRI CONDITION

Amritha K. Madhav[1] and **Lishamol Tomy** [2]

[1] *Department of Statistics, Nirmala College, Muvattupuzha, Kerala, 686661, India.Email: amrithakmadhav555@gmail.com,* [2] *Department of Statistics, Deva Matha College, Kuravilangad, Kerala, 686633, India.Email: lishatomy@gmail.com*

Background: This paper describes a special model called 'damage model' introduced by the living legend of Indian Statistics Prof. C. R. Rao in Rao (1965). We try to discuss some univariate continuous distributions, that belongs to linear exponential family as damaged distributions. And damage modeling is done by using the context of Patil-Seshadri condition.

Methods: We are trying to present some of the applications of damage modeling in nanotechnology especially by referring to reliability research on nanotechnology, semiconductor technology, fine migration, cutting and controlled modification, micro scale second gradient approximation, radiation damage in nuclear fuel, moisture damage modeling at nano-level, computation nanotechnology in MCCS environment.

Results: Some of the data may look like or misunderstood to be following the a specific probability distributions but they are actually following negative exponential distribution and find applications in different arena of science.

Keywords: Additive damage model, Patil-Seshadri condition, Characterizations, Nanotechnology, Negative exponential distribution.

10.08

ON AN EXTENSION OF WELL ORDERED SETS

Angela Sunny and Sini P

Department of Mathematics, University of Calicut, Malappuram,Kerala, India, Pin Code: 673635 Email: angelasunny@uoc.ac.in

A partially ordered set is said to be semi-well ordered if every non-empty subset has either a least or greatest element. Here we extend the theory of well ordered sets to semi-well ordered sets. The set of positive integers together with Sharkovsky's ordering is an interesting example of a semi-well ordered set. We discuss various properties and characterizations of it. We find all order ideals of a semi-well ordered set and investigate its properties. We see that if a set is semi-well ordered then the set of all order ideals of it is also semi-well ordered. We define semi-ordinals as the order type of semi-well ordered sets and provide a unique representation of it. We analyze the arithmetic of semi-ordinals and their properties.

10.09

MATHEMATICAL IDEAS BEHIND COVID MODELING AND HUMAN WELFARE

Deeksha Joshi, Rian Chakaraborty, Muhammed Faheem A T, Aiswarya M

Kerala School of Mathematices, Kunnamangalam, Kozhikode Pin 673571

How does mathematics play a role in human welfare? The bugaboo of epsilon, delta, theta, functions, numbers, curves, and what not, do they really signify something in real life? A big yes. [There are several applications mathematical modeling in society, one such is modeling of pandemic diseases.]

In the spirit of mathematical modeling of pandemic diseases, I would like to draw the attention to a more recent and direct application of mathematics, namely COVID modeling, in which we are going to see how mortality rate, relation between active and death cases, active cases and recover cases in India are being calculated. We'll be seeing how much relatable the data is with our computations.

Materials and Methods: A good knowledge and applications of tools of mathematics helps in understanding the physical phenomena and their applications. As it involves to formulate the real-

life situations or to convert the problems in mathematical explanations to a real or believable situation in any area of LIFE SCIENCES, PHYSICS AND CHEMISTRY (including nano technology and nano science)

In present p I'll be using probability density functions, BAYES FORMULA, exponentials, quadratic and linear graphs, error approximation and some easy computations, which will give us a model to calculate the prediction. We are going to deal with some examples using probability and exponential graphs.

Result and Conclusion: The study reveals that the analysis of data with certain given condition, one can calculate future happening events. . Similar type of modeling is applied for nanotechnology, weather and economic forecasting and etc.

10.10

ASSYMETRIC DOUBLE XGAMMA DISTRIBUTION AND ITS APPLICATION TO MICROARRAY GENE EXPRESSION DATA

Bindu Punathumparambath

Department of Statistics, Govt. Arts & Science College, Kozhikode
Email: ppbindukannan@gmail.com

ABSTRACT

Background: Microarrays have become an important tool for studying the molecular basis of complex disease traits and fundamental biological processes. A common purpose of microarray experiments is the detection of genes that are differentially expressed under two conditions such as treatment versus control. In the present study we developed double Xgamma and asymmetric double Xgamma distribution and explored various properties. The maximum likelihood estimation procedure is employed to estimate the parameters of the proposed distribution and an algorithm in R package is developed to carry out the estimation. A simulation study is conducted to validate the algorithm. Finally, we show that the asymmetric Double Xgamma distribution is suitable for modeling microarray gene expression data.

Methods

Double Xgamma **Distribution**

Double Xgamma distribution with parameters θ *and* μ, denoted by DXG (μ, θ) is given by

$$f(x) = \frac{\theta^2}{2(1+\theta)} \left(1 + \frac{\theta}{2}(x-\mu)^2\right) e^{-\theta|x-\mu|}, -\infty < x < \infty, \theta > 0, \mu\epsilon \quad .$$

Asymmetric Double Xgamma **Distribution**

The probability density function (pdf) Asymmetric Double Xgamma distribution with parameters μ, θ, κ denoted by AXG(μ, θ, κ) is given by

$$ff(x) = \frac{\theta^2}{2(1+\theta)} \frac{\kappa}{1+\kappa^2} \begin{cases} \left(1 + \frac{\theta^2}{2}\left(\frac{x-\mu}{\kappa}\right)^2\right) e^{-\theta\left|\frac{x-\mu}{\kappa}\right|}, & x < \mu \\ \left(1 + \frac{\kappa^2\theta^2}{2}(x-\mu)^2\right) e^{-\kappa\theta|x-\mu|}, & x > \mu \end{cases}$$

Where $-\infty < x, \mu, < \infty, \kappa > 0$ and parameters (μ, θ, κ) are the location, shape and skewness parameters, respectively.

Results and conclusions: The asymmetric Double Xgamma (AXG) distribution introduced in this paper is useful in analysing datasets that are asymmetric, leptokurtic, and heavy-tailed and it can model impulsiveness and skewness observed in gene expression data.

Keywords: Asymmetric double Xgamma distribution, double Xgamma distribution, Xgamma distribution, Microarray gene expression

10.11

DATA UNCERTAINTY REDUCTION IN HYDROLOGICAL MODELLING -A CASE STUDY OF PREDICTION OF THE STREAM FLOW DISCHARGE IN CHALIYAR RIVER BASIN, KERALA USING SWAT MODEL.

Naveena K, Surendran U and Baheerah Shada

Centre for Water Resources Development & Management, Kunnamangalam, Kozhikode – 673571, naveenak@cwrdm.org

Background: Missing observation in input can significantly increase the level of uncertainty in hydrological modelling. The Soil & Water Assessment Tool (SWAT) is a small watershed to river basin-scale model and can be used predominantly to predict stream flow. First order markov chain algorithm was adopted under ARCSWAT model to impute the missing observation. Study is required to compare its efficiency with other imputation models so we can efficiently increase the accuracy of prediction of hydrological models.

Method: This work aims to explore the efficiently of SWAT model to predict stream flow by comparison of different univariate and multivariate imputation models over use first order Markov chain algorithm to fill missing values.

Results: The coefficient of determination (R^2=0.914) and Nash Sutcliffe Efficiency (NSE=0.85) shows that predicting stream flow using SWAT model is very efficient when the missing input data was imputed using Kalman smoothing ARIMA technique. The R^2 value of prediction when the missing rainfall values were imputed using First order markov chain algorithm was 0.23 with an NSE value of -0.38.

Conclusions: This work establishes the effectiveness of SWAT model in stream flow prediction when data uncertainties are minimum and also the effectiveness of Kalman Smoothing Auto Regressive Moving Average imputation technique over first order markov chain algorithm.

Keywords: SWAT, Markov Chain, Kalman Smoothing ARIMA, Stream flow discharge

11-PHYSICAL SCIENCE

ORAL PRESENTATION

11.1

PVA-FUNCTIONALIZED GREIGITE NANOPARTICLES FOR MAGNETIC HYPERTHERMIA

A. R. Aarathy[1], B. B. Lahiri[2, 3], S. Savitha Pillai[1] and John Philip[2,3]

[1]Department of Physics, University of Kerala, Thiruvananthapuram, Kerala, India, PIN 695581
[2]Smart Materials Section, Materials Characterization Group, Metallurgy and Materials Group, Indira Gandhi Centre for Atomic Research, Kalpakkam, Tamil Nadu, India, PIN 603102
[3]Homi Bhabha National Institute, Training School Complex, Anushaktinagar, Mumbai, India, Pin 400094

Background: Greigite (Fe_3S_4), having a collinear ferrimagnetic structure, is an isostructural compound of magnetite (Fe_3O_4), and is advisable for magnetic hyperthermia, a therapeutic modality of cancer. In the present study, greigite nanoparticles (NPs) are coated with the synthetic and hydrophilic polymer polyvinyl alcohol (PVA) and its efficiency for magnetic hyperthermia is systematically probed.

Method: Greigite nanoparticles are synthesized by a one-step solvothermal route in the nitrogen atmosphere. The as-synthesized Fe_3S_4 NPs are coated with the polymer PVA.

Results: The X-ray diffraction (XRD) pattern of Fe_3S_4 NPs confirms the face-centered cubic (fcc) phase having the space group Fd3m. The electron microscopy studies reveal the flake or flower-like morphology of greigite. Dynamic light scattering implies good colloidal stability for PVA-coated greigite NPs. The *in vitro* cytotoxicity studies indicate that the greigite NPs are biocompatible. The AC magnetic field-induced heating studies show that the specific absorption rate (SAR) value has increased for PVA-coated greigite NPs compared to the bare sample due to improved colloidal stability. The obtained AC induction heating efficiency is found to be significantly higher than the previously reported values.

Conclusion: The surface functionalization of greigite with PVA reveals its potential to be a possible candidate for magnetic hyperthermia.

Keywords: Greigite nanoparticles, solvothermal synthesis, polyvinyl alcohol, magnetic hyperthermia

11.2

FLEXIBLE COMPOSITES OF SILICONE RUBBER REINFORCED WITH rGO and SYCO FOR ENHANCED MICROWAVE ABSORPTION

Aswathi A, Vidhya Lalan, Subodh G*

Department of Physics, University of Kerala, Thiruvananthapuram, Kerala-695581
**E-mail: gsubodh@gmail.com*

Background: The demand for high-performance microwave absorbing materials (MAMs) is increasing while witnessing ubiquitous microwave pollution related to the Internet of Things (IoT). There is an urgent need for developing shielding materials to prevent electromagnetic

interference (EMI) from mobile phones and wireless devices, which work in the low-frequency range of 1 GHz to 8 GHz.

Methods: The ideal way to solve the EMI problem is to synthesize composites that combine dielectric and magnetic components with optimal structure. In this work, we prepare SYCO by combined citrate- EDTA method and reduced graphene oxide(rGO) by solvothermal microwave-assisted method. These are subsequently incorporated into polydimethylsiloxane (PDMS) matrix to fabricate flexible rGO-SYCO/ PDMS composite through mold pressing.

Results: Crystal structure, broadband electromagnetic parameters, and microwave absorption properties are systematically studied. The absorption properties are analyzed from 1 to 25 GHz for RGS-80(80wt% of rGO-SYCO to paraffin wax) which exhibits two minimum reflection losses of -91.86 dB, and -28.39 dB for a thickness of 5.7mm at 15.1 GHz and 4.4 GHz, with an effective absorption bandwidth (EAB) of 2.41 GHz (13.87 to 16.28 GHz) and 3.02 GHz (3.19to 6.21 GHz) respectively.

Conclusions: This work establishes the development of a microwave absorber and now it is progressing in a direction to tune this absorption towards L and S bands. From all these observations, it is possible to extend this absorption study as an application to PDMS matrix with rGO-SYCO as the filler.

Keywords: $Sr_3YCo_4O_{10+\delta}$, reduced graphene oxide, Microwave absorption, L and S bands, Broadband electromagnetic properties.

11.3

PHOTOCATALYTIC DEGRADATION OF TEXTILE DYES BY NOVEL LEAD FREE PEROVSKITE OF CESIUM TITANIUM ($CSTIBR_3$) NANORODS PREPARED VIA SOLVOTHERMAL METHOD

Benazeera Beegum K A, Christeena Thomas, Saranya Sasi, Dr Alex Mathew, Dr Reshmi R

Optoelectronic and Nanomaterials Research Laboratory, Department of Physics, Union Christian College, Aluva, Kerala, India—683102.

Background: The novel lead free perovskite of cesium titanium bromide ($CsTiBr_3$) nanorods prepared via solvothermal method is first time used as catalyst for the degradation of textile dyes viz Rhodamine B and Congo red. Rhodamine B(RdB) is an amphoteric dye commonly used in textile industry and as a fluorochrome. Congo red (CR) is an azo dye, which is also a textile dye. As both dyes are toxic to living organisms, removal of the dyes from textile waste water is worthy of importance. The nanorods of $CsTiBr_3$ degrades 56% and 32% of 10ppm of RdB and CR respectively under xenon lamp irradiation of one hour.

Method: The precursors Cesium Bromide (CsBr) and Titanium Bromide ($TiBr_4$) in 5molar Hydrobromic acid in the molar ratio of 1:1.3 were mixed together. The solution was transferred into teflon beaker and enclosed in an autoclave. The autoclave was kept in a hot air oven at a temperature of 200^0C for 24 hours. The filtered out precipitate of $CsTiBr_3$ is used for characterisation. 5mg of $CsTiBr_3$ is used as the catalyst for 5ml of 10ppm solution of RdB and CR solution in water. The catalyst added dye solutions are kept under xenon lamp irradiation and the UV-Vis spectrum is taken at regular intervals of time.

Results: The XRD pattern confirms the formation of $CsTiBr_3$. The formation of nanorods of $CsTiBr_3$ are evident from the FESEM images. This is the first time report on the photocatalytic degradation of textile dyes by environmental friendly $CsTiBr_3$ nanorods. 56% degradation of RdB and 32% degradation of CR dye solutions are achieved within one hour exposure of xenon lamp by using 5mg of $CsTiBr_3$ as catalyst in 5ml dye solution. The photocatalysis process follows pseudo first-order kinetics and the rate of the process is calculated as 0.014 s^{-1} and 0.013s^{-1} for RDB and CR degradation.

Conclusion: The nanorods of $CsTiBr_3$ prepared via solvothermal method is first time used for the photocatalytic degradation of carcinogenic textile dyes viz Rhodamine B and Congo red. The phototcatalytic ability of $CsTiBr_3$ can be utilised for the purification of excretory waste water from textile industry.

Keywords: Novel lead free perovskite, nanorods of $CsTiBr_3$ and photocatalytic degradation.

11.4

FACILE SYNTHESIS OF GRAPHENE SUPPORTED $NICO_2O_4$ NANOPARTICLES FOR THE CATALYTIC HYDROGENATION OF 4-NITROPHENOL

Bibin Jacob[1,2], Manoj Mohan[1,2], Dhanyaprabha K C[1,2], Hysen Thomas[1,2*]

[1]Depaertment of physics, Christian College, Chengannur, Kerala, India – 689122
[2]University of Kerala, Thiruvananthapuram, Kerala, India
[*]Corresponding author. Email: hysenthomas@gmail.com

Background: The hydrogenative reduction of non-biodegradable and toxic 4NP to 4-Aminophenol (4AP) with $NaBH_4$ is identified as the most efficient method for its treatment in wastewater. In addition to that, 4AP is a biodegradable product with a lot of commercial importance, especially in pharmaceutical industries. But the hydrogenative 4NP to 4AP conversion occurs only in the presence of an appropriate catalyst due to the restrictive kinetic barrier between the nitrophenolate and borohydride ions. So, the development of efficient catalyst materials which can promote the hydrogenation reaction is highly essential.

Method: Graphene supported $NiCo_2O_4$ (GNCO) catalysts were prepared through a facile two step process. The graphene oxide (4mg/mL) – $NiCo_2O_4$ colloids were reduced using ascorbic acid at 95^0C to produce the GNCO composites. The GNCO catalysts mediated 4NP hydrogenation was monitored using UV-Visible absorption spectroscopy by measuring the absorbance of nitrophenolate ions at 400 nm with time.

Results: The physicochemical properties of the GNCO catalysts were investigated systematically using different characterization techniques and the analysis results confirmed the successful anchoring of cubic phase $NiCo_2O_4$ nanoparticles to the reduced graphene oxide sheets. The X-ray photoelectron spectroscopy analysis unveiled the creation of surface oxygen vacancies on $NiCo_2O_4$ during the composite formation. The Zeta potential analysis verified the presence of more surface positive charges on the GNCO composites. The induced positive surface charges are significant in the enhancement of catalytic activity. The GNCO catalysts exhibited excellent catalytic activity for the 4NP hydrogenation reaction with an activity factor of 356.5 $min^{-1}g^{-1}$ and which is even comparable to some of the noble metal-based catalysts reported. The catalyst was reused for five times without much loss in its activity. The activation energy for the 4NP hydrogenation reaction using the GNCO hybrids was found to be 25.8 kJ/mol and is well within the range for surface catalysed reactions. The decrease in the catalytic activity with the increase in the 4NP

concentration and the increase in the activity with $NaBH_4$ concentration indicated that the GNCO mediated 4NP hydrogenation reaction follows Langmuir – Hinshelwood model for heterogeneous catalysis.

Conclusion: In summary, the GNCO composites were prepared through a simple two step process. The prepared composites exhibited profound catalytic activity for the 4NP hydrogenation reaction. The activity factor of GNCO catalyst (356.5 min^{-1} g^{-1}) was higher than most of the nickel and cobalt based catalysts and also comparable to some of the reported noble metal-based ones.

Keywords: Reduced graphene oxide, $NiCo_2O_4$, Oxygen vacancy, p-Nitrophenol, Catalytic reduction

11.5

THERMAL TRANSPORT IN ONE DIMENSIONAL LATTICES WITH ASYMMETRIC INTERPARTICLE INTERACTION

Binju Raichel Baby and Dr. Santhosh G

University College Palayam, Thiruvananthapuram

Background: Transfer of heat energy by the interaction of neighboring particles is generally governed by the rate equation given by Fourier Law. This is true for 3D systems, but a deviation from Fourier law is observed in lower dimensions. Studies are conducted to root out any possibility of normal heat conduction in 1D systems. A recent study predicts normal conduction in 1D momentum-conserving systems when there is some asymmetry in the interaction potential.

Method: Considered a new system by introducing an asymmetry to the standard anharmonic cubic potential. Nonequilibrium molecular dynamics simulations were used to study the transport properties. System sizes up to 4098 were considered with fixed boundary conditions. The dependence of conductivity κ on system size was studied for both asymmetric case and anharmonic case. Also, the effect of asymmetric interaction potential on conductivity was studied by varying the degree of asymmetry in the interaction potential.

Results: The temperature profile obtained was almost linear in the middle region, indicating the validity of Fourier law. Conductivity κ versus system size graph for different asymmetric parameters showed that finite conductivity is more apparent for significant asymmetry. Also, from comparing the obtained result with a purely anharmonic case, it is more evident that conductivity diverges to a finite value for smaller system sizes with asymmetry.

Conclusions: Normal heat conduction is possible in 1D systems, and asymmetric interaction potential can lead to finite conductivity.

Keywords: Anomalous Heat Conduction, Non-Equilibrium Molecular Dynamic Simulations, Asymmetric Interaction Potential

11.6

MAGNETOELECTRIC COUPLING STUDY OF $BaTiO_3$ - $MgFe_2O_4$ MULTIFERROIC LAMINATED COMPOSITES

[a]Harsha Mol R, [a]Dhanyaprabha KC, [a]Bipin Jacob, [a]Manoj Mohan, [a]Hysen Thomas

[a] *Christian College, Chengannur, University of Kerala, India*

Background: The field of solid-state physics is composed of modern and fast advancing research. The applications concentrate on exercising the electric and magnetic effects inside the material of interest. The provision of getting control on the electric character by varying the magnetic field over the solid, (or) that of the magnetic character by varying electric field over the solid removes a lot of constraints within solid state applications. The coexistence of magnetic and electric order combines properties of the solid, that can be used for storage, processing and transmission of information.

Method: This work explores the virtues of magneto-electric multiferroic solids that possess entangled electric and magnetic orders. The magneto-electric multiferroic material was made in the laminated form, with ferroelectric $BaTiO_3$ and ferromagnetic $MgFe_2O_4$. The laminated composite bi layer and tri layer systems was synthesized by Cofiring technique.

Results: The ferroelectric $BaTiO_3$ and ferromagnetic $MgFe_2O_4$ was synthesized by solgel and polyol method respectively. The crystal structure of $BaTiO_3$ was confirmed to be tetragonal and that of $MgFe_2O_4$ was confirmed to be spinel cubic through XRD studies. The existence of magnetic order in $MgFe_2O_4$was confirmed through VSM analysis. The ferroelectric ordering in $BaTiO_3$ was confirmed by the P-E loop study. The existence of room temperature magnetoelectric coupling in the laminated system was confirmed by lock-in amplifier method. The magnetoelectric coupling coefficient shows an increasing trend as number of layers increases.

Conclusion: The magneto-electric coupling is found to be larger for Tri-layer or sandwiched structure because the number of interfaces for strain transfer is high compared to the Bi-layer structure. Also the ME coupling can be enhanced by increasing the number of layers in the laminated composites.

Keywords: Magneto-electric Multiferroics, Laminated Composite, Bi-layer and Tri-layer system.

11.7

DIELECTRIC RESPONSE OF NOVEL TRI-PHASE CERAMIC POLYMER COMPOSITE TO REALIZE KU-BAND ANTENNA

Jagadeesh M, Santha N, Jawahar I N and Subodh G

Department of Physics, University of Kerala, Karyavattom campus, Trivandrum-695581, Kerala

Background: Ceramic-polymer composites that combine the superior electric properties of ceramics and the mechanical flexibility and processing possibilities of polymers are potential candidates for microwave electronic components. However, ceramic-polymer composite fabrication by conventional sintering raises several technical issues due to inequivalent densification and different thermal expansion. Ultra-low temperature sintering technique offers an opportunity for the discovery, design and fabrication of new composites at ultra-low temperature (<300^{o}C) with the help of specific external pressure. The effect of different wt% of

ethylenediaminetetraacetic acid (EDTA) which is a chelating agent, on the densification, microstructure, and broadband dielectric properties of these composites has been studied.

Method: In the present work, we combine high-volume fractions of Li_2TiO_3 (LT) ceramic with polytetrafluoroethylene (PTFE) at ultra-low temperatures (<150°C) in a single step in a very short time without any additional transient liquid phase.

Results: Crystal structure and phase purity were confirmed by XRD. X-ray photoelectron and FTIR spectroscopic studies were used to explain the densification mechanism in these composites. The presence of (OH)- ion on the surface of LT and the variation of ceramic-polymer interphase by EDTA are significant in the densification of LT-PTFE composites. A cylindrical dielectric resonator antenna (CDRA) was designed, simulated and fabricated with 0.7LT-0.3PTFE-5EDTA composite having excellent thermal and dielectric properties. Antenna properties were experimentally verified. The return loss, VSWR and gain of the CDRA were examined, and the experimental results match well with the simulated results.

Conclusion: This study reveals that the addition of EDTA improves the density and dielectric properties of the LT-PTFE composites, and 0.7LT-0.3PTFE-5EDTA composite is a potential candidate for the fabrication of a low loss, light-weight, wide bandwidth CDRA for applications in the Ku-band.

Keywords: lithium titanate, PTFE, EDTA, ultra-low sintering, broad-band dielectric properties, resonator antenna

11.8

A SIMULATION APPROACH FOR QUALITATIVE ELEMENTAL ANALYSIS BY LASER-INDUCED BREAKDOWN SPECTROSCOPY

Leya Pauly, Shanila M, Lekha Mary John, K. K. Anoop*

*Applied Optics Division, Department of Physics, Cochin University of Science and Technology, Cochin-682022, India, *Email: anoopkk@cusat.ac.in*

Background: Laser Induced Breakdown spectroscopy (LIBS) has gained huge interest as an emerging atomic emission spectroscopic technique for the qualitative and quantitative elemental analysis. When compared to the traditional spectroscopic methods such as Inductively Coupled Plasma Mass Spectroscopy (ICPMS), Energy Dispersive Xray Spectroscopy (EDX), and Atomic Absorbance Spectroscopy (AAS), the LIBS technique and its applications in fields like planetary exploration, nuclear industry, biomedical filed etc, have advanced enormously, due to its unique peculiarities like almost non-destructive surface examination, and ability to perform remote and real-time analysis. The qualitative analysis done by comparing the observed LIBS spectra with the strong and persistent lines of Atomic Spectral Database (ASD) of NIST is a tedious process. The simulation approach developed for qualitative elemental analysis has resolved this issue making LIBS a unique tool in analytical spectroscopy.

Method: Herein, we performed the laser ablation of standard binary and ternary alloy samples using Nd:YAG laser pulse of wavelength 1064 nm, pulse energy 30 mJ, and pulse duration 10 ns. We measured the LIBS spectra of the alloy samples by keeping them in stainless steel vacuum chamber at rough vacuum conditions. We simulated the optical emission spectra of the most probable elements at typical laser produced plasma (LPP) conditions (at an electron temperature of 1eV and an electron density of 10^{17} cm^{-3}). The synthetic spectra were then compared with

experimental LIBS spectra, obtained from laser produced plasma of the alloy samples, to identify all elements present in the sample matrix.

Results: The qualitative analysis of binary alloy sample through the simulation approach has identified the persistent lines of Cu I at 510.554 nm, 515.323 nm, and 521.820 nm and Zn I at 330.258 nm, 334.501 nm, and 636.234 nm. Hence, the binary alloy sample is composition of Copper and Zinc (Brass sample). The simulation approach has also identified the emission lines of Co I at 412.131 nm, and 535.3 nm, persistent lines of Cr I at 425.433 nm, 427.480 nm, 428.973 nm, 520.450 nm, 520.602 nm, and 520. 841 nm and persistent lines of Mo I at 550.649 nm, 553.303 nm, and 557.044 nm in the ternary alloy sample. This is the standard composition of Vitallium alloy.

Conclusion: This work demonstrates that simulation approach can be effectively utilized in Laser Induced Breakdown Spectroscopy, for the efficient qualitative analysis of multi-elemental samples like alloys. The time-consuming database comparison method for analysing different emission lines in the spectra can be greatly simplified by the simulation technique.

Keywords: Laser Induced Breakdown Spectroscopy (LIBS), Laser Ablation, Optical emission spectra, Laser Produced Plasma, Qualitative Analysis, Simulation approach.

11.9

MAGNETIZATION DYNAMICS OF RARE EARTH ION La SUBSTITUTED MULTIFERROIC PEROVSKITE OXIDE $Bi_{1-X}La_XFeO_3$

Manoj Mohan[1,2], Bibin Jacob[1,2], Dhanyaprabha K C[1,2], Hysen Thomas [1,2*]

[1]Department of Physics, Christian College Chengannur, University of Kerala, Kerala-689122, India ,
[2]University of Kerala, Thiruvananthapuram, Kerala-695581, India
[*]Corresponding author: hysenthomas@gmail.com

Abstract

Multiferroics are materials which possess multiple functionalities due the coexistence of different ferroic orders (Ferroelectric, Ferro/ antiferro magnetic [1]). Among this class $BiFeO_3$ (BFO) is the one reported to have room temperature applications [2]. In present study BFO has been synthesized through facile citrate gel auto combustion method with substitution of rare earth ion La at the A-site. The compound $Bi_{1-x}La_xFeO_3$ was prepared for different level of substitution concentration (x= 0.25, 0.5, 0.75) and analysed for its physical properties to understand the variation associated to La substitution. The structural analysis reveals the La substitution induces a transition from rhombohedral (R3c) to orthorhombic (Pnma) system and suppresses the formation of parasitic phases. The M-H analysis reveals a complex-magnetic structure, with magnetization resulting from the competition between different magnetic orderings. This feature can be ascribed to "*pot belly and wasp-waist*" type mechanism. The remnant magnetization (M_r) found to increase with La substitution and the maximum value was found for x = 0.5 ($M_r = 4.3x10^{-3}$emu/g). The thermo magnetization studies reveal large irreversibility, and super paramagnetic blocking around 50 K. The distributive nature of blocking temperature can be ascribed to size effect.

Keywords: Multiferroics, $BiFeO_3$, FC-ZFC, Spin glass.

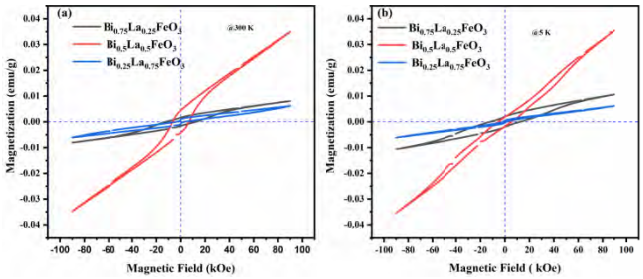

Figure 1 M-H loop of $B_{1-x}La_xFeO_3$ for x=0.25, 0.50 and 0.75. a) at 300 K, b) at 5 K

11.10

TAILORING PHOTOPHYSICAL RESPONSE IN MULTIFUNCTIONAL SRLALITEO$_6$: ER^{3+} DOUBLE PEROVSKITES

Pooja K V, Subodh G*

Department of Physics, University of Kerala, Thiruvananthapuram, Kerala
**E-mail: gsubodh@gmail.com*

Background: Perovskite materials possess exceptional structural and compositional flexibility to act as host materials for various activators such as lanthanides and transition metal ions**.** Recently, there is an increasing demand for double perovskite phosphors. Among them, lanthanide-doped upconversion phosphors are widely explored owing to their high chemical stability, large anti-stokes shift, and longer lifetime

Method: The compounds are synthesized via conventional solid-state reaction route.

Results: XRD and Raman analysis confirmed the crystal structure to be monoclinic with the space group *P2$_1$/n*. The indirect bandgap of the compounds slightly increases from 3.7 to 3.9 eV with the increase in the Er^{3+} concentration, corresponding to the decrease in cell volume. Upon 980 nm laser excitation, typical bands at 527, 547 and 660 nm were observed, corresponding to $^4H_{11/2}$,$^4S_{3/2}$→$^4I_{15/2}$ and $^4F_{9/2}$→$^4I_{15/2}$ transitions respectively. Maximum intensity is observed for 8 mol% of Er^{3+}. Power-dependent measurements indicate that the observed upconversion emission is a two-photon process. It was observed that in the temperature range of 80-230 K, the intensity of 527 nm emission gradually increases, whereas the intensity of 547 nm emission shows a decrease in intensity. The activation energy for the green emission is obtained as 0.27 eV from the Arrhenius plot. Furthermore, intense green emission bands at 527 and 547 nm were also observed upon 378 nm excitation, with maximum intensity for 8 mol% of Er^{3+}.

Conclusions: The present work investigates the crystal structure and photophysical response of Er^{3+}- activated $SrLaLiTeO_6$ double perovskites for the first time. The property of Er^{3+} to exhibit simultaneous up and down conversion PL unfolds a variety of possibilities. By appropriate co-doping strategies, and by choosing desired stimuli such as excitation wavelength or temperature, it is possible to tune the application spectrum from LEDs to optical thermometry and anti-counterfeiting.

Keywords: Perovskites, Solid state reaction route, Upconversion, Optical thermometry, LEDs, Anti-counterfeiting.

11.11

INFULENCE OF GROWTH PARAMETERS OF FEW LAYERS OF WS_2 THIN FILMS BY PULSED LASER ABLATION FOR TFT APPLICATION

Saranya Sasi[1], Midhun P S[2] , Antony Sharon[3], M.K Jayaraj[4] and Reshmi R[1]

[1] Optoelectronic and Nanomaterial's Research Laboratory, Department of Physics, Union Christian College, Aluva-683102, [2] Department. of Physics, Cochin University of Science and Technology-682022, [3] Centre of excellence in Advanced Materials, Cochin University of Science and Technology-682022, [4] University of Calicut, Thenjipalam-673635,Kerala

Background: Emergence of two dimensional materials paved a new path for a variety of optoelectronic devices. Beyond graphene 2D transition metal dichalcogenides are widely investigated because of its layer dependent tunable properties. Pulsed laser deposition (PLD) is a versatile but a least investigated technique for the deposition of Tungsten disulphide (WS_2).

Method: Pulsed laser deposition using the fourth harmonics of Q switched Nd YAG laser (266nm) is employed for the deposition few layered WS_2 films on Si/SiO_2 substrates. The target for the ablation was made by pelletising the bulk WS_2 powder with subsequent sintering.

Results: Few layers of WS_2 thin films were grown on Si/SiO_2 substrates by PLD at room temperature followed by a post annealing treatment. Raman confirms the few layer formation of WS_2 thin films. The effect of annealing temperature and laser power on the growth of WS_2 thin films were investigated. Crystallinity is found to be increase with annealing temperature and laser power. However, the higher laser power degrades the stoichiometry by the desorption of sulphur atoms. Hence an optimized growth condition need to be addressed for uniform growth of WS_2 thin films for TFT application.

Conclusions: PLD is recognised as the effective tool for the deposition of WS_2 thin films. The deposition with controlled growth parameters can yield high quality films, which can be exploited for the fabrication of optoelectronic devices.

Keywords: Transition metal dichalcogenides, Pulsed laser deposition

11.12

DEVELOPMENT OF FLUORINE DOPED TIN OXIDE THIN FILMS FOR COST-EFFECTIVE PLASMONIC SENSING APPLICATIONS

Vishnu K N, I Packia Selvam and S N Potty

Centre for Materials for Electronics Technology (C-MET), Scientific Society, Ministry of Electronics & Information Technology, Government of India, Athani P.O, Thrissur 680 581

Background: Plasmonic application require free electrons and thus gold and silver have been used traditionally for plasmonic applications in visible and near infrared (NIR) region. The plasmonic devices are therefore expensive because of the use of gold or silver. Hence, low cost materials are needed for various plasmonic applications. In this study, fluorine-doped tin oxide (FTO) has been investigated as a low-cost alternative in the field of plasmonics.

Method: FTO thin films were prepared in this study by simple and low-cost spray coating method. The films were sprayed onto glass substrates using a precursor solution made of tin (IV) chloride

pentahydrate, iso propyl alcohol and hydrofluoric acid. Flow rate of 2 ml/min. and substrate temperature of 723 K was used for the coating.

Results: X-ray diffraction studies confirmed the polycrystalline nature of the films with tetragonal crystal structure. The fluorine doping has increased the carrier density to the order of $10^{20}/cm^3$. After optimising the electrical properties in this manner, surface plasmon resonance has been obtained in the spray coated FTO films with air as dielectric using prism geometry.

Conclusions: The electrical properties of the FTO thin films were successfully modified and established plasmonic properties with low loss in NIR region. The development of such material for plasmonic application will lead to the invention of various plasmonic devices with affordable cost.

Keywords: Fluorine doped tin oxide; Plasmonics; Spray coating; Thin films; X-ray diffraction; Hall measurement

11.13

STRUCTURAL AND LUMINESCENCE CHARACTERISTICS OF Ba^{2+} CO-DOPED BiOCl: Dy^{3+} NANOPHOSPHORS FOR DISPLAY AND FORENSIC APPLICATIONS

Ansu Sara Solomon, Prathibha Vasudevan*

*PG and Research Department of Physics, St. Thomas College, Kozhencherry, Pathanamthitta, Kerala, 689641, India. *Corresponding author. E-mail: prathibhavspap@gmal.com*

Background: Designing white light-emitting diodes (w-LEDs), which have sharp color emission with vivid hue and color-tunable illumination, has been the great interest to researchers all around the global community. Even though some remarkable development has been reported, BiOCl phosphors doped with rare earth ions still demand more strategies for their fulfillment as potential phosphors.

Method: A series of BiOCl: Dy^{3+}, xBa^{2+} phosphors were synthesized by relatively low-temperature solid-state reaction method. The raw materials selected are Bi_2O_3, NH_4Cl, Dy $(NO_3)_3.5H_2O$ and Ba $(NO_3)_2$ were taken in their stoichiometric ratio and mixed thoroughly. It is then heated at 400°C for 2 hours and grounded to fine powders for further characterization.

Results: The X-ray diffraction (XRD) patterns, Rietveld refinement, X-ray Photon spectroscopy (XPS), Fourier Transform Infrared Spectroscopy (FTIR), Raman analysis, Photoluminescence Analysis and Lifetime decay analysis provide clear structural and luminescent characteristics of BiOCl: Dy^{3+}, Ba^{2+} nanophosphor. This phosphor powder exhibited a flexible mark for the detection of level 1–3 details with high contrast of latent fingerprint (LFP) and Cheiloscopy for individual identification in forensic science.

Conclusion: Our results reveal that the developed nanophosphors (BiOCl: Dy^{3+}, Ba^{2+}) has potential practical application for forensic cases to solve crimes and as a valuable tool for law enforcement.

Keywords: Phosphors, Luminescence, XRD, XPS

11.14

THE INFLUENCE OF SIZE AND DIELECTRIC PROPERTIES OF METAL NANOSTRUCTURES ON THE PERFORMANCE OF PLASMONIC POLYMER SOLAR CELLS

Shamjid P

Department of Physics, Dayapuram Arts and Science College for Women, Calicut-673601, Kerala, India

Background: Polymer bulk heterojunction solar cells have attracted significant research interest due to their promising properties such as low cost, lightweight, low-temperature fabrication and mechanical flexibility. However, the power conversion efficiency of polymer solar cells is far below their inorganic counterparts. Achieving high efficiency in light absorption and charge carrier transport simultaneously is a crucial factor for improving the efficiency of solar cells. Metal nanostructures have been incorporated at various locations in solar cells for improving light absorption by utilizing the plasmonic effects of the metal nanostructures. Theoretical simulations based on the finite element method (FEM) and finite-difference-time-domain (FDTD) methods have been widely used to optimize the device parameters for achieving high absorption enhancement.

Method: In the present work, the effect of size, shape and dielectric properties of metal nanostructures on light absorption enhancement in polymer solar cells has been investigated using three-dimensional finite-difference-time-domain FDTD simulations. The nanostructures of various metals (Al, Cu, Au and Ag) were used for the investigation. Three-dimensional electromagnetic simulations were performed using commercially available FDTD software (Lumerical FDTD Solutions).

Results: The Ag nanostructures induced higher active layer absorption enhancement compared to other metal nanostructures due to the superior plasmonic properties of Ag nanostructures in the absorption range of the photoactive layer. An absorption enhancement of 28% was achieved by incorporating 75 nm sized Ag nanospheres.

Conclusions: Metal nanostructures of different size and composition have been explored as absorption enhancers in polymer solar cells. Simulation results revealed that Ag nanospheres are desirable compared to their Al, Cu and Au counterparts due to higher relative scattering and intense near-field in a broad wavelength range.

Keywords: Metal nanostructures, Plasmonic effect, Polymer solar cells, FDTD simulation

11.15

DEPENDENCE OF THE NATURE OF 1D IN DOPED ZNO NANORODS ON ITS SEED LAYER MORPHOLOGY

Devika Mahesh* and M.C. Santhosh Kumar

*Optoelectronic Materials and Devices Laboratory, Department of Physics, National Institute of Technology Tiruchirappalli, Tamil Nadu, India.*email: devikamahesh72@gmail.com*

Background: Zinc Oxide (ZnO) is a versatile candidate for various applications like photodiodes, solar cells, light emitting diodes, UV-visible photocatalyst due to its' wide energy band gap.

Doping ZnO with group III elements like Al, In and Ga improves its n-type electrical conductivity tremendously making the doped ZnO thin an ideal candidate for optoelectronic applications.

Method: The spray pyrolysis technique is adopted for the deposition of Indium doped Zinc Oxide (In:ZnO) seed layers at substrate temperatures 350 °C, 400 °C and 450 °C. 1D nanorods have been grown on these seed layers by Aqueous Chemical Growth (ACG) process, which a simple and versatile hydrothermal technique. The temperature of the solution was maintained at 90 °C and the indium doping percentage was fixed at 2.5at.%.

Results: The Scanning Electron Microscopy (SEM) and Atomic Force Microscopy (AFM) characterisations indicate that the surfaces of the seed layers are topped by nanopyramids of size in the range 123 nm to 380 nm. The growth of 1 D nanorods on the seed layer was confirmed by the SEM analysis. Enhanced visible luminescence has been observed for the 1 D nanorods grown on the seed layers, though the seed layers showed quenched emission characteristics.

Conclusions: The substrate temperature od seed layer deposition is found to be crucial factor in deciding seed layer morphology, which in turn determines the size and alignment of the 1D nanorods grown on these seed layers by the ACG technique.

Keywords: Zinc Oxide, 1D nanorods, Surface morphology, Alignment, Photoluminescence

11.16

WHY CHENDA IS THE MOST ROYAL DRUM?

[1]Nishanth P. and [2]K. M. Udayanandan

[1]Department of Physics, PRNSS College, Mattanur, Kerala- 670702
[2]Department of Physics, GAS College, Mathil, Kerala-670307

Background: The sound produced by drums in ensembles of Kerala cater great attention among the audience. When different patterns of strokes are played on drums in the ensembles, the audience appreciate them with hand gestures. The ensembles attract the audience over the years and the regular listeners never get bored. The most popular among the instruments in different ensembles and art forms is the Chenda. The drum is assumed to be above the ashtadasa vadhyams of Kerala.

Method: Different audio samples of most commonly played ashtadasa vadhyams of Kerala are studied with fractalyse software. The fractal dimensions of instruments are found and compared.

Results: Different sound samples showed good values for fractal dimension indicating the fractal nature of the sound produced by the instruments. Among the instruments, highest value of fractal dimension is observed for Chenda.

Conclusions: The study showed that high fractal character of the patterns of sound produced on Chenda is the reason for the curiosity generated among the audience. The greater ability of the drum to attract attention of the audience is the reason to consider the Chenda as the most royal drum.

Keywords: Musical instruments, Fractal, Percussion ensembles, Ashtadasa vadhyams

11.17

THERMODYNAMICS OF QUARK GLUON PLASMA

Reshma P. [1], **Suresh T.P.** [2] **and K. M. Udayanandan** [3]

[1]*Department of Physics, S. N. Polytechnic College, Kanhangad, Kerala -671315,*
[2]*Department of Physics, Govt. Brennen College, Thalassery Kerala- 670106,* [3]*Department of Physics, GAS College, Mathil, Payyannur, Kerala- 670307*

Background: The recreation of quark gluon plasma (QGP) the hottest and densest fluid, has taken the physics arena to a surprising world of peculiar matter phase. The experimental demonstration of this in large hadron collider (LHC) at extremely very high energy densities and temperature helped us to understand more about the field of strong interactions. Quantum Chromo Dynamics (QCD) a quantum theory related to these strong interactions seemed to be powerful in exploring quarks through their color charges and coupling. The different models like bag model, Cornell potential model, relativistic harmonic oscillator model, dynamical quasi particle model, strongly coupled QGP, strongly interacting QGP etc. gained an array of successes in the study and predictions of this QGP phase.

Method: In this paper we find the equation of state (EOS) of non-ideal QGP in deconfined phase and find the thermodynamic quantities using the Mayer's cluster expansion. For the study, the potential modelled by S. Mattiello and W. Cassing is considered and the interaction potential is taken as $U(r) = \left(\frac{\pi}{12} + \frac{C_2}{2N_cT}\right) e^{-m_D r}$, where r is the radial distance, C_2=0.9 GeV non-perturbing dimension 2 condensate, $m_D \approx 1.26$T is the Debye mass, T is the temperature and N_c is the number of colours.

Results: With the use of Mayer's ring diagrams and evaluation of the interaction potential in momentum space the EOS of the quark-antiquark plasma is obtained as $\frac{P}{T} = \kappa^2 T - \frac{{a_1}^2 \kappa^{\frac{\gamma}{2}} + a_1\sqrt{a_2}\,\kappa^{\frac{5}{2}} + a_2 \kappa^{\frac{3}{2}}}{24\pi\sqrt{a_1\kappa + \sqrt{2a_2}}}$, where P is the pressure, γ is the number of particle rings, κ is the inverse Debye length, $a_1 = \frac{\pi}{3}$ and $a_2 = \frac{4\pi C_2 m_D}{N_c T}$ the interaction parameters. Further calculations resulted in the formalism of equations for thermodynamic quantities entropy, energy density and specific heat at constant volume.

Conclusions: Cluster expansion method was found to be a powerful tool in finding the non -ideal equation of state of deconfined quark anti quark matter. The thermodynamic behavior of quark gluon plasma is examined using the Cassing potential and established by formulating expressions for pressure, entropy, energy density and specific heat. The variation of pressure and energy density with temperature shows that at high temperature it obeys Stefan-Boltzmann law whereas entropy and specific heat obeys T^3 law.

Keywords: Quark gluon plasma, Mayer's cluster expansion, Equation of state

11.18

STUDY OF GOLD NANOPARTICLES INCORPORATED IN POLYMER MATRIX FOR BIOSENSING APPLICATIONS

Sujitha. A.S, Dr. Diksha Painuly

CRDC, HLL Lifecare Limited, Akkulam, Sreekariyam PO, Thiruvananthapuram-695017

Background: In recent years, health care and cure have moved in the direction of a personalised strategy. It is crucial to develop highly specific sensors that can detect the pathogens' biomarkers. Recent studies shows that nanofibres can be used as an excellent platform for various biosensing applications.

Method: This work involves the synthesis of gold nanoparticles and synthesis of gold nanoparticle incorporated polyvinyl alcohol (PVA) fibres by the process of electrospinning. The effect of addition of gold nanoparticles in the PVA matrix was studied in terms of absorption, emission, vibrational, thermal and morphological analysis. These findings validate the use of gold nanoparticles integrated into polymer matrix for biosensing applications.

Results: The strong absorption band at 523 nm and photoluminescence emission band at 422 nm confirms the synthesis of gold nanoparticles of small size. Blue shift happens to the gold nanoparticles incorporated PVA matrix compared to bare PVA. Increase in intensity of photoluminescence emission is observed on addition of gold nanoparticles to PVA. The FTIR spectrum clearly demonstrates the presence of functional groups in the molecule and the possibility of formation of intramolecular hydrogen bonding, which confirms the stability of the complex. Considerable improvement in thermal stability is observed for the gold nanoparticles incorporated PVA fibres. Uniformity of fibres and embedment of gold nanoparticles into the PVA fibres are evident from the HRTEM analysis.

Conclusions: This work offers a simple and relatively economical process of electrospinning for the production of gold nanoparticles incorporated PVA nanofibres. The increase in photoluminescence on addition of gold nanoparticles can be used as an excellent key for various biosensing applications.

Keywords: Electrospinning, nanofibres, gold nanoparticles, photoluminescence, biosensing.

POSTER PRESENTATION

11.19

A PHOTOELECTROCHEMICAL CELL TYPE UV PHOTODETECTOR BASED ON ZnO AND CuO

Akhil M. Anand, R. Jayakrishnan

Photovoltaic Research Laboratory, Department of Physics, University of Kerala, Kariavattom-695581

Background: Ultraviolet (UV) photodetector has become a major study topic due to its potential use in a variety of sectors, including remote control, chemical analysis, water purification, flame detection, early missile plume detection, and secure space-to-space communications. Wide bandgap semiconductors like GaN, SiC, ZnO, and TiO2 can operate in visible-blind mode without the need for filters have been studied during the last decade for wide-spreading usage in photodetection, especially in the ultraviolet region

Method: Self-powered UV detector was fabricated based on ZnO and CuO nano particles. ZnO thin films were fabricated by spin coating ZnO nano structures on fluorine-doped tin oxide (FTO) glass substrate. Copper foil was chemically oxidised to produce CuO nanostructures. The active electrode (FTO/ZnO) and the counter electrode (CuO/Cu) were adhered together face to face with a sealing material. Finally, electrolyte was injected into the space between the top and counter electrodes. The device is illuminated with uv source(λ=355nm) with power 12μW/cm^2. The effective area of the UV detector was approximately 2.6 cm^2.

Results: This UV photodetector establishes a built-in potential due to its Fermi energy level difference between ZnO and CuO. The photodetector generates photocurrent without any external bias because of the internal potential, which separates the electron-hole pairs UV light produces. Under UV light exposure, a sizeable photocurrent response was seen.

Conclusions: Photoelectrochemical cell (PEC)-type self-powered UV-photodetectors based on ZnO and CuO nanomaterials were achieved by a simple method. The detector exhibits a high responsivity of 44.02 mA/W, with rise time and a decay time is 0.65 s and 1.48 s, respectively, as well as considerable spectral response under weak irradiation. The results suggest that ZnO and CuO are potential materials for high-performance PEC-type self-powered UV-photodetectors.

Keywords: ZnO, CuO, Photodetector

11.20

FRAGMENT CONFIGURATIONS IN THE TERNARY FISSION OF ^{238}U ISOTOPE

Anjana Dev & Sreejith Krishnan

PG Department of Physics, T K Madhava Memorial College
Nangiarkulangara, Haripad, Alappuzha 690513, Kerala

Introduction: Ternary Fission is a type of fission in which three fragments are emitted from the breakup of a radioactive nucleus, of which one of the fragments is very light compared to the main fragment. This unique and rare phenomenon was initially detected by Alvarez *et al.*in 1946. Ternary fission mainly has two types of configurations named equatorial and collinear configuration.

Method: The barrier penetrability and the relative yield of all favourable fragment combination can be calculated using the Unified Ternary Fission Model (UTFM) proposed by Santhosh *et al.,* Here, two different fragment configurations are considered, one is equatorial configuration in which the third particle is emitted in a direction perpendicular to the main fission fragment and the second one is collinear configuration in which the third fragment emitted along the same axis of main fission fragments.

Results: The fragment combinations obtained in the equatorial and collinear configuration are compared and found that the magnitude of relative yield is found to be highest for the equatorial configuration. The fragment combinations with the highest relative yield are found to be the same for equatorial and collinear configuration. Also, it is detected that the fragment combination with highest relative yield is possible in the presence of doubly magic and near doubly magic nucleus.

Conclusion: The presence of doubly magic and nearly doubly magic nucleus plays an important role for the most favourable fragment combination in the alpha accompanied ternary fission of ^{238}U isotope. For the alpha accompanied ternary fission since the magnitude of relative yield is

found to be high for equatorial configuration, the equatorial configuration dominates over the collinear configuration.

11.21

COPPER-DIFFUSED SILICON FOR MEMORY APPLICATIONS

Anjana. R and **K.B. Jinesh**

[1]Department of Physics, University of kerala, Kariavattom, kerala-695581, India
[2]Department of Physics, Indian Institute of Space Science and Technology (IIST), Valiamala, Thiruvananthapuram – 695547 ,kerala, India

Background: von Neumann bottleneck and ending era of Moore's law enhanced emergence of new technologies. An efficient way to overcome is by imitates how the human brain operates. So here we are trying to mimic some properties of biological neurons in Copper diffused Silicon devices.

Method: we take three type of doped silicon wafers as substrate(n type,p type, n++ type).Using thermal deposition system(Filunger TCS 0204 thermal coating system)thickness of 150nm Copper is deposited. Annealing was carried out in a tubular oven in vaccum atmosphere. The heating rate was set to 10 °C/min.It is annealed at 600^0c for one hour.

Result: We report the Copper diffusion and in effect filamental structure responsible for the resistive switching in silicon wafers(100).Material characterizations were done using STM, XPS, Raman, FE-SEM and X Ray Diffraction.P type Silicon wafers were only showing good neuromorphic characteristics(paired pulse facilitation (PPF) and Spike-time dependent plasticity (STDP) were measured).

Conclusion: Three type of Silicon wafers were showing resistive switching behaviour.In which P type wafers were showing good neuromorphic behaviour.Cu:Si is thereby concluded as a CMOS-compatible material for artificial intelligence applications.

Keywords: Resistive switching,Neuromorphic devices

11.22

INVESTIGATIONS ON THE SOLAR FLARE INDUCED EFFECTS ON MAR'S IONOSPHERE USING MAVEN OBSERVATIONS

Ashwini Ashokan and Aswathy R P

Department of Physics, University of Kerala, Thiruvananthapuram

Background: A solar flare is a sudden flash of increased brightness on the Sun, usually observed near its surface and in close proximity to a sunspot group. A solar flare occurs when magnetic energy that has built up in the solar atmosphere is suddenly released. At Mars, flare irradiance ionizes and heats the upper atmosphere similar to what occurs at Earth. The present analysis investigates the observations made by MAVEN of the response of the Mars upper atmosphere the X11 solar flare occurred on 19th October 2014 compared to a non- flare day.

Method: The X-ray irradiance data is deduced from the GOES satellite to assess the solar flare. Electron density of the Mars ionosphere are found using in situ measurements from MAVEN (Mars Atmosphere and Volatile Evolution) LPW. LPW makes measurements of the ionosphere every orbit near periapsis, which occurs at ~4.5 hr intervals. The electron density of Mar's atmosphere is analysed in conjunction with the X11 solar flare and compared with non-flare condition.

Results: The electron density of Mar's atmosphere is significantly enhanced in flare days with maximum magnitude of 4.25 x 10^4/cm^3 in the flare day (Fig.1, left panel) compared to the non-flare day (maximum magnitude – 3 x 10^4 /cm^3; Fig.1, right panel). The majority of ionization is observed to be occurring at lower altitudes. The solar flare intensity peaks at ~ 05:00 UT and subsequently the enhanced electron density at the Martian atmosphere is observed at ~06:06 UT as per the availability of the data. The peaking altitude is ~ 160 km. The observed enhanced density in the flare day can be attributed on the enhanced photo ionization rates. The electron temperature at the Martian ionosphere is observed to be reduced in association with the solar flare (magnitude ~3650 K). The H^+ ion density increases to 560 /cm^3 from 210 /cm^3. However the O^+ density decreases from 6000/ cm^3 to 3600/ cm^3.

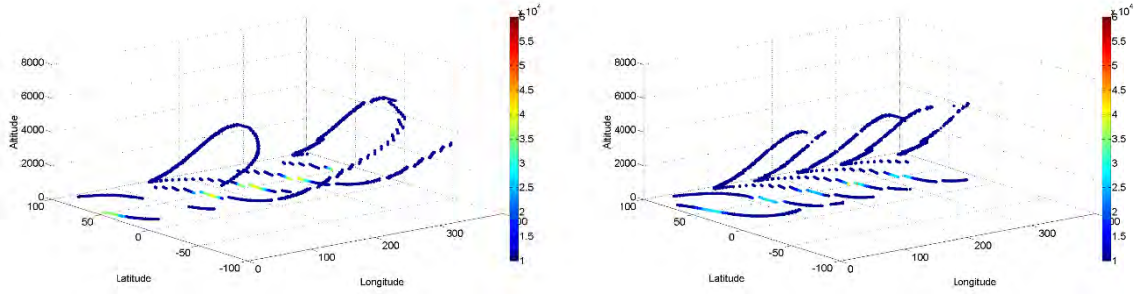

Fig.1: Latitude-longitude-altitude variation of electron density observed by MAVEN for the X11 flare day (left panel) and non-flare day (right panel)

Conclusions: The study reveals that the X- class solar flares can have a significant impact on the ionization density, temperature and composition of the Martian ionosphere.

Key words: Mars, Ionosphere, Solar flare

11.23

ROOM TEMPERATURE MAGNETOELECTRIC COUPLING STUDY OF $BaTiO_3$-$Ni_{0.5}Zn_{0.5}Fe_2O_4$ MULTIFERROIC COMPOSITES

[a]Dhanyaprabha K.C., [a]Bibin Jacob, [a]Manoj Mohan, [a]Hysen Thomas[*]

[a] Christian College, Chengannur, University of Kerala, India

Background: Multiferroic systems are those materials which possess more than one ferroic (anti-ferroic) order (ferroelectric, ferromagnetic or ferroelastic) in a single system. Composite magnetoelectric multiferroics are those systems artificially engineered by choosing suitable ferroelectric (non-magnetic) and ferromagnetic (non-ferroelectric) materials. Multiferroic

composites with Piezoelectric and spinal ferrite were extensively studied due to the high structural compatibility between the piezoelectric and spinal unit cells.

Method: The $BaTiO_3$ – $Ni_{0.5}Zn_{0.5}Fe_2O_4$ nanocomposites were prepared by solgel method followed by polyol method. The structural, morphological, magnetic, electric and magneto-electric properties of the systems were studied in detail.

Results: The structural analysis of the system was studied by XRD. The rietveld refinement performed using JANA 2006 software confirms the presence of phase pure $BaTiO_3$ and $Ni_{0.5}Zn_{0.5}Fe_2O_4$ phases in the composite. The mixed composite nature and crystallinity of composite was confirmed from HRTEM and SAED pattern. The multiferroic property of the composites are verified from the co existence of ferroelectric and ferromagnetic properties. The room temperature magnetoelectric coupling of 9.81 mV/(cm Oe) was observed for $BaTiO_3$ – $Ni_{0.5}Zn_{0.5}Fe_2O_4$ nanocomposites.

Conclusions: Magnetoelectric multiferroic $BaTiO_3$ – $Ni_{0.5}Zn_{0.5}Fe_2O_4$ composites was successfully synthesized by solgel method followed by polyol method. The structural and morphological analysis confirms the composite nature of the systems. The Room temperature ferroelectric and ferromagnetic characterization reveals the multiferroic nature of the system along with an adequate magnetoelectric coupling of 9.81 mV/(cm Oe). The coupling of electric and magnetic properties enables the systems for possible applications in magnetoelectric sensors.

Keywords: Multiferroic composites, JANA 2006, $BaTiO_3$ – $Ni_{0.5}Zn_{0.5}Fe_2O_4$, Magneto electric Coupling

11.24

EVOLUTION OF MARTIAN NEUTRAL ATMOSPHERE: ROLE OF SUN'S ACTIVITY

Ferna Farheen M K and Aswathy R P

Department of Physics, University of Kerala, Thiruvananthapuram

Background: The neutral atmosphere of Mars is abundant in CO2 and consists of other molecules such as O, N2, CO and Ar in trace amounts. They are important in the photochemistry and stability of the Martian atmosphere. The evolution of Martian atmospheric neutral species in conjunction with the activity of sun is not well addressed so far. The present study investigates this least explored aspect, considering the distinct solar activity conditions of the years 2016 and 2020 using the Neutral Gas and Ion Mass Spectrometer (NGIMS) of the Mars Atmosphere and Volatile Evolution Mission (MAVEN)

Method: The NGIMS on-board the MAVEN spacecraft is designed to characterize the neutral upper atmosphere and ionosphere of Mars and the solar wind input to this region of the atmosphere. The concentration of the Martian atmospheric neutral species (CO2, CO, N2, O and Ar) are analyzed for the distinct solar activity conditions as in 2016 (High Solar) and 2020 (Low Solar). The F10.7 index used to quantify the solar activity conditions.

Results: All the neutral species under our investigation (CO2, CO, N2, O and Ar) exhibit inverse association with the activity of sun in a systematic manner. The density profiles for the most abundant gas in Martian atmosphere, CO2, under distinct solar activity conditions are depicted in Fig.1. In 2016, where the F10.7 is 97 (relatively high solar), the average CO2 density corresponding to 160 km altitude is ~1.5 x 10^8 /cm^3 and is increased to ~ 3.5 x 10^8 /cm^3 as the

sun's activity reduces in 2020. The percentage increment (reduction) in the low (high) solar activity condition is 133% for CO2. Similarly, the variability in other neutral species are investigated. The negative correlation of the neutral species with the solar activity emphases the role of the solar driven radiation in the expansion of Martian atmosphere and subsequent escape of neutral species to the outer space.

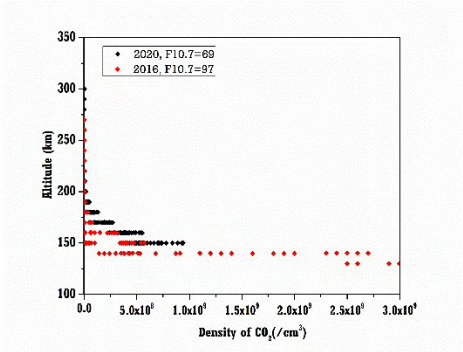

Fig.1: The density profiles for CO2 for 2020 (Orbit No: 10634) and 2016 (Orbit No: 2441)

Conclusion: The variability of the neutral species in the Martian atmosphere is investigated under distinct solar activity conditions and is quantified

Key words: Mars, Neutral atmosphere, Solar activity, F10.7

11.25

ECO-FRIENDLY, TRANSPARENT ULTRAVIOLET BLOCKING FILM BASED ON CARBON QUANTUM DOTS FUNCTIONALIZED WITH POLYVINYL ALCOHOL

Jasmine Jose, Vinoy Thomas*

**corresponding author: vinoythoma@gmail.com*
Centre for Functional Materials, Department of Physics, Christian College, Chengannur, Kerala- 689122, University of Kerala, India

Background: Excessive amount of ultraviolet (UV) radiation from the sun has intense negative impacts on human health and other biological systems. At the same time, UV radiation has wide applications in various fields such as medical, scientific research and so on. Thus, further study is needed to develop eco-friendly films that can shield against ultraviolet radiation in a selective way due to the increasing use of this radiation in medicine, other industrial and commercial applications. Fluorescent carbon quantum dots (CQD) are a class of nanostructured carbon materials that have gained widespread attention in recent years due to their properties such as their small-scale features (<10 nm), less-toxic nature, ease of synthesis, water dispersibility and excellent photoluminescence. Among various synthetic method, hydrothermal carbonization is considered a cost effective and efficient conversion technology to synthesize CQDs from different carbon rich materials. Owing to the excellent optical properties of CQD, it can be used as an excellent candidate for developing UV-blocking films. Even though earlier studies on UV protection have yielded encouraging results for UV protection, transparency of films at higher concentrations of UV active agents still poses a significant challenge. Transparent, eco-friendly, and versatile UV blocking films are now preferred due to the growing importance of

environmental concerns. Taking inspiration from these studies, herein we report an efficient, biodegradable film composed of carbon quantum dots (CQD) with excellent UV-blocking properties. Polyvinyl alcohol (PVA) is used as the matrix that disperses CQD prepared from biomass via hydrothermal treatment.

Method: The desired amount of distilled water was added to the 1 wt.% of cellulose, and then mixed well for 30 minutes to get the uniform suspension. Then the suspension was transferred into an autoclave and heated at 180 ℃ for 14 h. Then, the brown suspension was collected and centrifuged to obtain the CQD. The sample was labelled as CQD. For the synthesis of PVA film, 1 wt. % PVA in distilled water was taken and the film was labelled as PVA. For the fabrication of PVA-CQD films, 1 wt. % PVA was taken along with the desired amount of CQD. These sample was labelled as PVA-CQD. After suitable drying, the films were peeled out and kept for further study.

Results: The prepared CQDs are characterised using XRD, UV–Visible absorption spectroscopy and photoluminescence (PL) spectroscopy. The XRD results show diffraction peaks around 22^0 and 43^0. The corresponding planes are (0 0 2) and (1 0 0) respectively. The (1 0 0) plane is attributed to the graphitic core which suggested that the synthesised CQD has graphitic structure. The UV-Visible absorption spectrum of CQD displays absorption peaks at 225 nm and 275 nm, respectively. The peak at 225 nm is attributed to the $\pi - \pi^*$ transitions of C=O bonds in sp^2 hybrid regions. Also, the absorption peak at 275 nm is attributed to the CQD conjugation of C=C and C=O. Furthermore, the PL analysis reveals that the CQD has excitation independent emission in the blue region when exposed under UV irradiation. This observation suggesting fewer surface defects on the CQD and uniform size distribution. The UV-blocking ability of CQD as an UV absorbing agent is evaluated by developing film by dispersing CQD in PVA matrix. The UV-Visible absorbance study shows that a weak absorption around 275 nm is observable in the PVA film, whereas after the incorporation of CQD into it, the presence of a strong absorption peak at 270 nm and a weak absorption peak at 225 nm indicates the successful incorporation of CQD into the PVA matrix. The absorption peak at 275 nm in PVA film was attributed to the π–π* transitions of the charge transfer groups. To further evaluate the UV blocking efficiency of the film, UV-Visible absorption study in transmittance mode is used. The transmittance spectra revealed that these composite films efficiently absorb UV radiation while remaining transparent in the visible region. The addition of CQD to PVA could significantly increase the PVA film's ability to block UV light. The increased UV absorption of the films suggested that the PVA absorption is improved by the UV active CQD. The PVA-CQD film successfully blocked 98.1% of UV-C, 97.8% of UV-B, and 80 % of UV-A, with a visible light transmittance of 77%.

Conclusion: A green approach is adopted to synthesise CQD with graphitic structure via a hydrothermal method with water as the solvent using biomass as the precursor. The CQD exhibits excellent UV absorption and excitation independent photoluminescence in the blue region. Also, PVA is used as the matrix to fabricate UV blocking film by taking advantage of the excellent optical properties of CQD. Due to the excellent UV-shielding properties and visible transmittance, this film is expected to emerge as a new candidate among PVA-based UV-blocking materials Hence, this material would be suitable for sunglasses, UV-opaque optical filter films, UV-blocking covering for windows in buildings and automobiles, etc.

Keywords: Carbon quantum dots, hydrothermal approach, UV-blocking property

11.26

PERCOLATION OF EXTENDED OVERLAPPING SHAPES ON TWO-DIMENSIONAL SQUARE LATTICES

Jasna C K [1], V. Sasidevan [1]

Department of Physics, Cochin University of Science and Technology, Kochi-22,India

Background: Percolation is a statistical physics model that studies the connectivity of random and disordered media. It is a purely geometric phase transition characterized by the emergence of a spanning cluster in the system. The theory has been successfully applied to the study of many systems, natural, social, and technological. It has a remarkable impact on the study of the connectivity of systems. Discrete as well as continuum percolation models are studied. There are a lot of variants to standard percolation model. One of them is percolation of extended shapes like disc and squares on lattices. In this study relationship between discrete percolation and continuum percolation is analyzed.

Method: In this study, we explore a time dependent lattice percolation model which is a discrete model in two dimension. Through numerical simulation, we analyze the relationship between discrete percolation and continuum percolation. Percolation threshold is evaluated for the discrete model and study is extended to models of larger object sizes. Also a slight variation of the above model is done with redefined percolation criteria where object overlapping is necessary for percolation. Study is carried out on the convergence properties of discrete model and features of our model like multiple occupancy of sites is explored.

Results: For the time dependent discrete percolation model, we evaluated percolation thresholds. In the limit of large object size, model is found to converge to continuum percolation of disc problem. For model with redefined percolation criteria also the threshold values gradually approach to continuum percolation value. Multiple occupancy property is verified through calculation and simulation.

Conclusions: Percolation of extended overlapping shapes on a lattice is a model that helps us to understand the relationship between discrete and continuum percolation. Discrete percolation model is found to approach continuum model in the large object size limit. There are models that interpolates between discrete percolation and continuum percolation. Ours is one of them.

Keywords: Discrete percolation, Continuum percolation, Percolation threshold.

11.27

ZINC SULPHIDE-BASED LOW-COST PHOTODETECTOR BY SILAR METHOD

Jishad A Salam, R. Jayakrishnan

Photovoltaic Research Laboratory, Department of Physics,
University of Kerala, Karyavattom-695581

Background: Methods for the fabrication of thin films with well-controlled structures and properties are of great importance for the development of functional devices. SILAR, the Successive Ionic Layer Adsorption, and Reaction, is a simple, low-cost, and, arguably, the best method for developing semiconductor thin films for applications in photodetectors, quantum dot-

sensitized solar cells, etc. Due to its relative simplicity and low cost, this method has gained increasing interest in the scientific community.

Method: The Zinc sulphide (ZnS) thin films were fabricated via the dip SILAR process. Here, Zinc acetate and Sodium Sulfide (1:1) was prepared in distilled water and then coated on F: SnO2 (Fluorine doped tin oxide) film via 10 SILAR cycles. The film was vacuum annealed at 200℃ for 2hr and cooled naturally. The photodetector device structure is F: SnO_2/ZnS/Ag.

Results: The XRD pattern of ZnS exhibited mainly the reflection of the cubic phase. FESEM provides direct evidence of particle agglomerated surface morphology. The optical bandgap (3.0 eV) of the samples was determined by the Tauc plot. In the PL spectra, a broad blue emission peak with shoulders at 430 nm and 460 nm was observed in the sample. Light sensing and electrical parameters, including series resistance, photosensitivity, responsivity, and specific detectivity, were calculated.

Conclusion: A low-cost SILAR method was used to fabricate the photodetector device. A high-responsivity vacuum-annealed ZnS thin film photodetector was fabricated.

Keywords: Zinc sulphide, Photosensitivity, Photodetector

11.28

NICKEL SELENIDE NANOSTRUCTURES: A MATERIAL FOR NON-CONVENTIONAL ENERGY APPLICATIONS

T. Parvathy, **Ritu Rose Jaison** and **P.P.Pradyumnan**

Department of Physics, University of Calicut, Malappuram, Kerala, India, 673635

Background: Developing high-efficient materials with earth-abundant and low-toxicity components that have tunable optoelectronic properties is becoming a prominent trend for various fields like solar cell, sensors, thermoelectricity etc. Among transition metal chalcogenides, nickel selenide in particular has received a lot of attention in research investigations due to its exceptional semiconducting properties, such as great thermodynamic stability, superior optical and electronic transport properties.

Method: Nickel selenide nanoparticles were synthesized hydrothermally via reaction of Se powder with $NiCl_2.6H_2O$ in the presence of hydrazine hydrate ($N_2H_4.H_2O$) as reductant and NaOH as pH controller at 180^0C for 12 hrs. Nickel selenide compounds with different phase and structural characteristics were obtained by varying the molar ratio of the reactants and the reaction temperature.

Results: The formation mechanism of the nickel selenides has been investigated in detail by means of XRD, SEM, and AFM analysis. The morphology, phase structure, optical and electrical properties of Ni_xSe_y can be controlled by adjusting the Ni/Se molar ratio of the reactants and the reaction temperature. SEM and AFM studies shows that the effect of molar ratio and the reaction temperature have a significant effect on the morphology of grown phase. The optical properties of the Ni_xSe_y were studied and band gap lies in the range 1eV. Using Hall measurements, the conductivity variation of the nickel selenide series is studied.

Conclusion: This study offered a general, simple, and efficient technique for controlling the composition, phase structure, morphology, optical and electrical properties of nickel selenides that can be successfully implemented in energy harvesting applications.

Keywords: Nickel selenides, Atomic force microscopy (AFM), Scanning electron microscopy (SEM), Electrical Property, Hydrothermal synthesis

11.29

TRANSPORT CHARACTERISTICS OF A BROWNIAN PARTICLE IN A TILTED ROUGH POTENTIAL

Prathyusha S Nair[1], Ronald Benjamin[1]

*[1]Department of Physics, Cochin University of Science and Technology, Kochi 682022, India, * prathyushasnair@cusat.ac.in, rbenjamin@cusat.ac.in*

Background: The randomly moving Brownian particles can achieve unidirectional motion by rectifying the fluctuations acting on them from their environment. The particles encounter a rough environment in almost all physical, chemical, and biological systems. The transport process happening in the presence of these landscapes will be affected by the rugged/rough behavior. The roughness in energy landscapes acts as a hindrance to transport, but optimizing the parameter regime of the system can enhance the transport of particles. This work concentrates on how the diffusion and transport properties of an overdamped Brownian particle are affected by roughness.

Methods: In this work, we consider an over-damped Brownian particle in a tilted rough potential driven by Gaussian white noise. We numerically simulate the system and investigate the variation of the transport properties (current, effective diffusion coefficient, Peclet number, etc.) with various system parameters.

Results: We find that the diffusion of the particle is enhanced by the amplitude of roughness after a critical value of tilting force at low temperatures. The roughness does not have any significant effect on diffusion at high temperatures. But at all temperature ranges, the particle current is reduced as we increase the roughness.

Conclusion: This work affirms that the diffusion of the particle increases with roughness at a specific range of tilting force and low temperatures. And roughness reduces the particle transport in the chosen parameter regime. By choosing optimum values for the parameters we expect that roughness improves the transport coherence.

Keywords: Brownian particle, roughness, diffusion, particle current, transport properties, Langevin equation.

11.30

SOIL QUALITY ASSESSMENT AND GIS BASED MAPPING IN POST FLOOD SOILS OF *KOLE* LANDS OF KERALA

Safnathmol P and Rajalekshmi K

Dept. of Soil Science and Agricultural Chemistry, College of Agriculture, Vellanikkara, Kerala Agricultural University, Thrissur, Kerala, India.

Background: The flood occurred in August, 2018 caused great damage to the soil environment of *kole* lands. This demands a site-specific investigation in the flood affected areas of *kole* lands in order to put forward post flood management strategies.

Method: Hundred georeferenced composite soil samples were collected from seven block panchayats of AEU 6 and were analysed for different physical, chemical and biological quality indicators. Thematic maps were prepared using ArcGIS package.

Results: The highest mean soil quality index was recorded in Mullassery block panchayat and the lowest mean was in Cherppu block panchayat. Relative soil quality index varied from 25.93 to 72.22 per cent.

Conclusions: Drastic changes in soil environment had occurred with a greater number of soil samples from block panchayats fall in both low and medium soil quality.

Keywords: Soil quality, Kole lands, Principal component analysis, GIS, Post flood

11.31

MULTI WAVELENGTH INVESTIGATION OF THE STAR FORMATIONACTIVITY TOWARDS THE GALACTIC CLOUD G13.89-0.47

[1]Sangeetha K K & [2]Dr. V S Veena

[1]University of Kerala Kariavtatom Campus Trivandrum Kerala
[2]Post-Doctoral Fellow, Max Planck Institute of Radioastronomy

Background: It is still unclear how the physical processes that lead to the formation and evolution of massive stars work. Despite the fact that there are countless research and surveysthat have examined the chemistry and physical conditions of a large sample of high mass star forming regions The main advantage of studying individual regions is that, unlike large surveys that only glance at a few general characteristics of these regions, it allows one tofully understand the various aspects of a given region, such as the star formation activity, physical characteristics, chemistry, kinematics, etc. We use multiwavelength observations from infrared to radio wavelengths to comprehend many aspects of massive star formation since our goal is to understand the star formation activity.

Method: We start our study with warm dust emission towards this region because IRDCs have been found to be dark structures against nebulous mid-infrared emission. We analyze YSO population and its distribution across the cloud and finally the distribution of ionized gas emission is analyzed to identify the locations of star-forming flurries. we have constructed a ratio map of [4.5 μm /3.6 μm]. The [4.5]/ [3.6] ratio map towards the source. To locate YSO sources we employed the [5.8]- [8.0] versus [3.6]- [4.5] color-color diagram for the sources detected in all IRAC bands. To get an idea about massive stars around the region, G13.89-0.47 we used radio continuum image from NVSS survey.

Results: From the mid infrared maps, we could see the bright emission at the centre surrounded by dark patches in 3.6and 4.5 μm image clearly; and those dark patches represents infraredcloud. Moreover, there are more point sources can be found in 3.6 and 4.5 μm as they are shorter wavelengths and hence represents emission from warmer dust and from stellar photosphere of main sequence stars instead of 5.8 and 8.0 from which only warmer dust emission can be seen. There is flux ratio excess towards the centre of the region. Themorphology is arc like structure. So, this could indicate the presence of protostellar outflows. Also, we can infer that the [4.5]/ [3.6] ratio is ∼1.5 or larger for jets and outflows, whereas outside this region infrared average flux ratio is in the range of 1 like stellar sources. Here among the spitzer

source G13.89-0.47, we find that 414 sources are detected in all four IRAC bands. from the color–color diagram, a total of 56 YSO candidates are detected. Of these, 23 are Class I sources, 16 are Class II sources, and 17 are reddened Class I /II sources. Lyman continuum photon rate shows that the region contains a B0.5 Star.

Conclusion: In this work we have investigated the star formation activity in the region G13.89-0.47 located at a distance of 1.9 kpc. Here we used different data sets obtained from various archives as well as the techniques used to study star formation in the region. Data associated with study collected from spitzer space telescope and NVSS survey. Here we haveused continuum archival data at infrared and radio bands. As a continuation of the thesis work, we intend to use spectral line data to investigate the structure and kinematics of the molecular cloud associated with this region and to extend our study into a large region.

Keywords: Color-color diagram, mid infrared emission, spitzer data, lymann continuum photon rate

11.32

STRUCTURAL AND CHARACTERISTIC STUDY OF PURE AND SAMARIUM DOPED ZINC SULPHIDE

Sarath S Pillai[a], Vishnu PV[a], Jincemon Cyriac[b], Renju Ravi[a], Sreelatha[a], Archana L S[c]

[a]Department of Physics, Sreenarayana College, Chengannur, [b]Marian College Kuttikkanam (Autonomous), Kuttikkanam, Peermade, Idukki, Kerala, 685531, [c]Department of Physics, Govt. college for women, University of Kerala, Thiruvananthapuram, Kerala, 695014

ZnS is one of the first found group compound semiconductor and has a broad variety of applications in LEDs, Luminescence devices, Optical Sensors, Nanodevices etc. Sulphide is a chemically stable and technologically better alternative than its Chalcogenides. Hence it is a favourite host material with unique physical and chemical properties like enhanced surface to volume ratio, quantum size effect, surface and volume effect, high optical absorption, thermal resistance, chemical activity and low melting point. To modify the properties of semiconductors, they are introduced into doping.

Stoichiometric amounts of precursors were weighted and the compound is stirred using magnetic stirrer and centrifugated. The mixed product was air dried. The process of mixing and drying was repeated 3 times to get a homogeneous mixture. The dried mixture was then calcined in an electrical furnace (oven). The heating of the furnace was programmed at 50°C and kept it for 15 hours. This work is focussed to understand the optical characters of both pure and Samarium (Sm^{3+}) doped Zinc sulphide nanoparticles.

The samples of products were characterized by XRD, UV-Visible and Photoluminescence. XRD analysis confirms the hexagonal wurtzite structure of ZnS nanophosphor and the average crystallite size ranges from 46.83 nm to 46.16 nm for 0.005 and 0.01 Samarium doped ZnS. And for the undoped state the average crystallite size is 47.42 nm. UV-Visible spectrometer confirmed that there is a gradual increase in the absorption edge and this variation is also observed in bandgap too. The optical bandgap decreases with increase in doping concentration. For 0.005 Sm^{3+} doped ZnS, the bandgap energy is 3.48eV and for 0.01 Sm^{3+} doped ZnS, the bandgap energy reduces to 3.44eV. The difference is confirmed when we compare the bandgap energy of undoped Zinc sulphide (3.53eV) with the doped state. The Photoluminescence spectra of undoped ZnS

nanophosphor shows a strong emission peak at 466 nm. And this blue emission band may be originated from the reconstruction of the photogenerated hole with an electron occupying the sulphur vacancy. The photoluminescence spectra of Sm^{3+} doped Zinc sulphide ranges from 425 nm to 650 nm. The variation in the emission intensity in both samples is ascribed to the variation of average crystallite size with doping concentration. The emission intensity decreases after doping.

11.33

POSTULATES OF QUANTUM MECHANICS AND INCOMPATIBLE MEASUREMENTS

Sarathlal S,

University of Kerala Kariavattom Campus, Thiruvananthapuram

Background: Since almost a century ago, the perplexing characteristics of quantum measurements have sparked lively debates among scientists. This produced a number of intriguing research findings, but it took some time before fundamental ideas in quantum measurement theory, like the concepts of POVMs and joint measurability, emerged and gained widespread use.

Method: Here I learned about generalisation of postulates of quantum mechanics into mixed state. Here I mainly focused on half spin system. And measurement incompatibility, drawing attention to the links to information processing. Here I start with the general notion of joint measurability and discuss incompatiblility of measurements using postprocessing matrix in the case of 2 state system .

Results: we can show that if two measurements are compatible then we can find another measurement such that the old measurements are simply a postprocessing of new measurement.

Conclusions: it is possible to verify above result for a 2 state system

Keywords: Quantum mechanics, postulates of quantum mechanics , incompatibile measurements , POVM , post processing of measurements.

11.34

KINETIC ENERGY CALCULATION OF LONG-RANGE ALPHA PARTICLE IN THE TERNARY FISSION OF ^{238}U ISOTOPE

Seetha S Lekshmi & Sreejith Krishnan

PG Department of Physics, T K Madhava Memorial College, Nangiarkulangara, Haripad, Alappuzha Dist, Pin: 690513

Introduction: Ternary fission is the process in which a nucleus breaks into three fragments which cover a spectrum of events from a neutron accompanying the two main fission fragments, to the emission of three fragments of about equal masses. The third particle can be emitted in a direction perpendicular to the main fission fragments. In such case, if it is an alpha particle possess a kinetic energy of around 15 MeV.

Method: Using Unified Ternary Fission Model (UPFM), proposed by Santhosh et al., the barrier penetrability of all possible fragment combinations can be found out and hence the relative yield

can be computed. By using the formalism of Herbatch et al., and Frankel et al., the kinetic energy of long-range alpha particle can be calculated.

Results: The driving potential is calculated for all possible fragment combinations in the alpha accompanied ternary fission of ^{238}U isotope. The relative yield is calculated for the fragment combinations found in the cold reaction valley plot and hence the kinetic energy is calculated using the formalism of Herbatch and Frankel et al.,

Conclusions: The kinetic energy of long-range alpha particle is computed for the fragment combinations with the highest relative yield. The obtained results are found to be in good agreement with the experimental data of ternary fission of various isotopes.

11.35

FABRICATION AND CHARACTERIZATION OF 3D PHOTONIC CRYSTAL OPAL FILMS OF DIFFERENT POLYMER SPHERES: A COMPARATIVE STUDY

Sree Sanker S S[1], Subin Thomas[2], Dhanya P Jacob[3], Savitha Nalini[4] and K N Madhusoodanan[1]

[1] Department of Instrumentation, Cochin University of Science and Technology, Kerala,
[2] Department of Physics, St. Joseph's College, Moolamattom, Kerala, India
[3] Department of Physics, Cochin University of Science and Technology, Kerala, India
[4] Department of Physics, Sree Narayana College, Cherthala, Kerala, India

Background: Photonic crystals (PCs) have gained much attention because of their numerous applications in optical communication, sensing and optoelectronic devices. Due to their low cost, simple fabrication process, and adaptability for modification and functionalization, the colloidal photonic crystals (CPCs) have emerged as the most promising PCs. In the process of making CPCs, the most important task is the synthesis of size-controlled colloidal spheres.We present a comparative study of the fabrication and characterizations of PC opal films made using monodispersed poly(methyl methacrylate) (PMMA), Polystyrene (PS) and poly(styrene-methyl methacrylate-acrylic acid) (Poly(St-MMA-AA)) spheres.

Method: Monodispersed spheres of different polymer materials were synthesized via emulsifier-free emulsion polymerization and soap-seeded emulsion polymerization. The particle sizes have been controlled by varying the synthesis conditions. These polymer spheres were used in the self-assembly method to create 3D opal photonic crystal films.Various characterizations were performed on the fabricated PC opal films to investigate the morphology, mechanical stability and water affinity.

Results: The polymer sphere's size has been successfully controlled by varying the synthesis conditions. FESEM images showed that the synthesized spheres are of high monodispersity and spheres have self-assembled with proper packing to form opal film. The structural colour was evident for all the CPC opal films. Poly(St-MMA-AA) based opal film showed the best mechanical stability, whereas PMMA had the worst. Contact angle images reveal that the PS is hydrophobic, and the other two are hydrophilic.

Conclusions: This work presents a comparative study of the fabrication and characterization of different polymer spheres-based CPCs. Monodispersed polymer spheres of three various polymers have been fabricated, and their sizes have been successfully varied by changing the polymerization conditions. Several characterizations were carried out to investigate the behavior

of opal films.. The fabricated CPCs found applications including optical sensors, mask in lithography, structural colour patterns etc.

Keywords: Photonic crystal, Colloidal photonic crystal, Opal film, Polymerization, Monodisperse

11.36

STUDY OF CENTRAL INTENSITY RATIO OF EARLY TYPE GALAXIES HOSTING NUCLEAR STAR CLUSTERS

K. Sruthi[1] and C. D. Ravikumar[1]

[1]Department of Physics, University of Calicut, Malappuram-673635, India

Background: The properties of nuclear regions are thought to be linked to the formation history of galaxies. There are two known compact massive objects located in the very centre of galaxies, namely supermassive blackholes (SMBHs) and/or nuclear star clusters (NSCs). The formation and growth of NSCs, as well as their relation to massive black holes in their host galaxies, are crucial for understanding the evolution of galaxies and the physics shaping their central regions. In this study, we examine the relationship between NSCs, SMBHs, and host galaxy properties in the using the photometric parameter central intensity ratio (CIR). The CIR is found to contain information about the star formation near the central region of galaxies. Therefore it can be used as an ideal tool in studying galaxies hosting NSCs.

Method: We constructed a sample of 63 nearby early-type galaxies hosting NSCs based on the availability of *Spitzer*/IRAC 3.6μm observations adopted from literature. The sample includes 26 ellipticals and 37 lenticulars. CIR is computed at the centre of galaxy images using two concentric apertures of sizes 12 and 24 arcsec respectively.

Results: For faint, low mass, young, blue galaxies in the sample, the variation of CIR with mass of black hole suggests that nuclear star cluster mass increases with host galaxy mass. However, the evolution of nuclear star clusters appears complex in old, high-mass, and red galaxies without any apparent trends.

Conclusions: The positive trend shown by the low mass, young, blue galaxies suggests a simultaneous growth of NSCs and central black holes whereas as it is not possible to make a strong conclusion about red galaxies in the sample, because we do not observe any significant trend in CIR -M_{BH} relation. Our analysis supports the co-evolution of NSCs with their host galaxies reported in the literature, at least for dusty galaxies.

Keywords: Galaxies, photometry, central blackholes, nuclear star clusters

11.37

NEW ERA OF ENDOSCOPE LEDs VIA DOUBLE PEROVSKITE NANO PHOSPHORS

Veena V.P [1], **Shilpa C.K**[1], **Jasira S.V**[1], **Nissamudeen K.M**[1]

[1]School of Pure and applied Physics, Kannur University, Payyanur Campus, Edat, Kannur, Kerala, India – 670327, veenavp@kannuruniv.ac.in, nisamkm@kannuruniv.ac.in

Background: Xenon arc lamps used in endoscopic LEDs and biological imaging techniques suffer plasma oscillations and thermal runaway, leading to instability. At the same time, the UV

radiations emitted by them are prone to skin and causes eye injury. These lamps are costly and need a replacement after every 500hrs of usage. Recently, white emitting LED source with lifetime about 50,000hrs is replacing conventional arc lamps. But the major drawback is that they lack the violet component in the visible spectrum, which is unavoidable in determining certain diseases like lesions, patterns of colonic mucosa, and adenoma (polyp) tumors. So, an ideal white emitting source having violet spectral line is a necessity, which in turn enhances human welfare.

Method: Perovskite nano phosphor $La_{1.97}Dy_{0.02}Li_{0.01}MgTiO_6$ is synthesized by molten salt assisted solid state reaction method. Using X-ray diffractometer, the crystal structure and phase of the sample is investigated. The morphology, crystallinity, and shape were investigated using FE-SEM. The Photoluminescence studies are carried out using Flurolog, Horiba. All readings are taken at room temperature.

Results: The violet emission is crucial in detecting certain infirmities, which is absent in existing WLEDs. $La_{1.97}Dy_{0.02}Li_{0.01}MgTiO_6$ is one among the group with Violet-Blue-Yellow-Red emission, which gives luminescence intensity 2-3 times higher than traditional lighting sources. The photoluminescence studies under 351 nm show emission peaks at 388 nm ($^4F_{7/2} \rightarrow {}^6H_{15/2}$), 480 nm ($^4F_{9/2} \rightarrow {}^6H_{15/2}$), 574 nm ($^4F_{9/2} \rightarrow {}^6H_{13/2}$), and 670 nm ($^4F_{9/2} \rightarrow {}^6H_{11/2}$) respectively. The CIE coordinates are x = 0.325 and y = 0.322 with color temperature (CCT) 5902 K, very close to ideal white light, which is vital in choosing the right light source for endoscopic applications.

Conclusion: The light source plays a vital role in disease identification and examination. Good illumination is a major requisite in endoscopic examinations, as the lux level is below the threshold value, the image gets distorted resulting inaccurate results. This work focus on the synthesis and characterization of potential white emitting phosphor $La_{1.97}Dy_{0.02}Li_{0.01}MgTiO_6$ for endoscope LEDs.

Keywords: Perovskite, White light emitting diode, Endoscope

11.38

ZINC OXIDE NANOGRAINS ON CARBON CLOTH AS A FLEXIBLE PLATFORM FOR HYDROXYCHLOROQUINE DETECTION

Allen Joseph Anthuvan [a, b], Thangavelu Kokulnathan [b], Tzyy-Jiann Wang [b,*]

Nanotech Division, Accubits Invent Pvt. Ltd, Trivandrum 695 592, Kerala, India
Department of Electro-Optical Engineering, National Taipei University of Technology, Taipei 10608, Taiwan

Pharmaceutical pollution that imposes a health threat worldwide is making accurate and rapid detection crucial to prevent adverse effects. Herein, binder-free zinc oxide nanograins on carbon cloth (ZnO NGs@CC) have been synthesized hydrothermally and employed to fabricate a flexible electrochemical sensor for the quantification of hydroxychloroquine (HCQ) that is typical pharmaceutical pollution. The characteristics of ZnO NGs@CC were investigated by various in-depth electron microscopic, spectroscopic and electroanalytical approaches. Compared with the pristine CC platform, the ZnO NGs@CC platform exhibits superior electrochemical performance in detecting HCQ with a large oxidation current at a low over-potential of + 0.92 V with respect to the Ag/AgCl (Sat. KCl) reference electrode. With the support of desirable characteristics, the fabricated ZnO NGs@CCbased electrochemical sensor for HCQ detection displays good performances in terms of wide sensing range (0.5–116 μM), low detection limit (0.09 μM), high sensitivity (0.279 μA μM- 1 cm-2), and strong selectivity. By the resulting 3D hierarchical

nanoarchitecture, ZnO NGs@CC has progressive structural advantages that led to its excellent electrochemical performance in sensing applications. Furthermore, the electrochemical sensor is employed to detect HCQ in biological and environmental samples and also achieves good recovery rates. Thus, the designed ZnO NGs@CC demonstrates admirable electrochemical activity toward HCQ real-time monitoring and would be an excellent electrochemical platform for HCQ sensing

Keywords: Metal oxide, Carbonaceous materials, Flexible electrode, Electrocatalyst, Hydroxychloroquine, COVID-19

11.39

FABRICATION OF OPTICALLY ENHANCED NANOCRYSTALLINE Y- TYPE HEXAGONAL FERRITES $ACoFe_6O_{11}$ (A =Ba and Ca)

Amba Prasad [a], Manju S. John [a], Fergy John[a*]

[a]Department of Physics, St Gregorios College, Kottarakara 691531
**Corresponding author: fergyphd@gmail.com*

In this work, we introduce a study on nanocrystalline Y –type hexagonal ferrites **$ACoFe_6O_{11}$ (A=Ba, Ca),** which is successfully synthesized by modified auto –ignition combustion method. The easiness of preparation procedure without any calcination makes the method an edge over other synthesis methods. The nitrates of the corresponding metal were employed as the precursor along with nitric acid as fuel during the experimental procedure. It is noteworthy that the present work is a first experimental investigation on the structural and optical properties of the nanocrystalline Y-type hexagonal ferrites. X-Ray Diffraction analysis and Fourier Transform Infrared analysis is done for the confirmation of phase formation and phase purity of the prepared sample respectively. The XRD reveal that both the samples exhibit trigonal structure having space group $R3^{-}m$ with following unit cell parameters, a = 5.89 Aº and c= 44.02 Aº for $BaCoFe_6O_{11}$ and a = 5.9 Aº and c = 43.74 Aº for. The crystalline size derived from full width half maximum (FWHM) using the Scherrer formula is 10nm and 9nm for $BaCoFe_6O_{11}$ and $CaCoFe_6O_{11}$ respectively. The particle size confirmation of the as synthesized sample is carried out by analysing modified Scherrer equation method. Furthermore, FT-IR spectra of the as prepared samples displays, corresponding bands near 1425 cm^{-1} and 800-860 cm^{-1}, which indicates the characteristic of Ba-O stretching mode and Ca-O-Ca vibration mode that confirms the formation of the compounds. UV-vis spectroscopical analysis and photoluminescence are employed to investigate the optical nature of the material. The optical band gap energy is calculated using Tauc's plot and is obtained as 1.94 eV for $BaCoFe_6O_{11}$ and 1.84eV for $CaCoFe_6O_{11}$ respectively. The d-d transition of the Co2+ ion causes photoluminescence emission peaks in the visible range. The strong emission in the visible range, as well as the band gap energy values confirms the samples applicability in optoelectronic devices.

11.40

STRUCTURAL ANALYSIS OF CUO NPS USING RIETVELD REFINEMENT AND ANTIBACTERIAL EFFICIENCY

Chithra B and Sheeba N H

M E S College, Ponnani, University of Calicut
Nawras P S M E S Asmabi College

Background: Hugo Rietveld's crystal structure profile fitting known as the Rietveld Refinement is a well-known tool for profile fitting and microstructural analysis. The Rietveld method which is a rarely used technique refines user-selected parameters to reduce the divergence between a model based on the predicted crystal structure (calculated data) and an experimental parameter (observed data). The TEM analysis and SEM analysis employ techniques to investigate morphology variations of as-synthesised nanoparticles. Metal oxide nanoparticles have been reported to be used as anti-bacterial agents. These materials' inherent biological activities rely on a number of elements, including the metal used, particle size, structure, and surface area.

Method: The CuO Nanoparticles are prepared by coprecipitation method using Copper (II) Sulphate Pentahydrate solution and sodium Hydroxide as precursors. Copper (II) Sulphate Pentahydrate 0.5 M is dissolved in distilled water. After complete dissolution of copper sulphate 1M of Sodium Hydroxide solution is added under control stirring, drop by drop touching the walls of the vessels. The reaction is allowed to proceed for 2 hrs. and the solution is kept overnight to settle, the supernatant solution is then discarded carefully. The precipitate is washed several times with distilled water. For optimization, the washed sample is annealed at 80º C for different time duration of 3 Hr (CuO:1), 4 Hr (CuO:2) and for 6 Hr (CuO:3).

Results: The peaks in the XRD patterns of CuO-NPs compared with the standard ICDD (00-048-1548) values affirms monoclinic phase of CuO (tenorite) for the lattice. The intensities and positions of peaks of the sample heated for 4Hr is in good agreement with that of reported values. From Rietveld refinement of X-ray diffraction pattern of the CuO nanoparticles, well indexed peaks with a pure monoclinic symmetry unit cell with space group C2/c is obtained and lattice parameters a, b and c have been calculated with accuracy from Rietveld refinement. From SEM and TEM analysis it is noted that the particles are spherically distributed and well-aligned, with a nearly homogeneous, well-defined crystal structure. Additionally, agglomerations tended to occur more frequently. The optical band gap energy of ($\mathbf{E_g}$) of the obtained CuO nanoparticles is calculated from the Tauc's relation. It may be attributed to the quantum confinement effect brought on by the reduction in crystallite size of the nanoparticles. The antibacterial activity of the CuO nanomaterial is determined by using disc diffusion method against Gram positive and Gram-negative bacteria. Gram-negative bacterial strains are showing more sensitivity than gram-positive because of their membrane structure.

Conclusion: In the present study, optimised sample of CuO nanoparticles with monoclinic structure are synthesized by coprecipitation method. The crystallite size from XRD is determined to be ~18 nm that indicates nanostructure for as-prepared particles. The Rietveld refinement confirmed the development of a single monoclinic structure of CuO and provides refined values of lattice parameters a, b and c. SEM of CuO NPs exhibit gradual evolution of surface morphology with annealing time and TEM analysis of optimized sample CuO:2 illustrates surface with spherically distributed particles. The disc diffusion assay for anti-bacterial activity study indicates the sensitivity of CuO nanoparticles for combating pathogenic microorganisms.

Keywords: Rietveld refinement, antibacterial, SEM, TEM

11.41

A STUDY ON THE STRUCTURAL, OPTICAL, DIELECTRIC AND MAGNETOELECTRIC PROPERTIES OF $Bi_{(1-x)}Dy_xFeO_3$ (x = 0.01) MULTIFERROIC SYSTEM

Jincemon Cyriac [a*], Sunny Mathew [a], L R Sriramachandru [a], Jisty Ann Jiji [a], Nandakumar Kalarikkal [b], P.M.G. Nambissan [c], Saji Augustine [d]

[a] Department of Physics, Marian college Kuttikkanam (Autonomous), Kuttikkanam, Peerumade, Idukky, Kerala, 685531, [b] International and Inter University Centre for Nanoscience and Nanotechnology, School of Pure and Applied Physics, Mahatma Gandhi University, Kottayam, Kerala,686560, [c]Applied Nuclear Physics Division, Saha Institute of Nuclear Physics, Kolkata, 700064, [d]Department of Physics, Deva Matha College, Kuravilangad, Kottayam, Kerala, 686633

Multiferroics are defined as materials that exhibit more than one of the ferroic properties in the same phase. Bismuth Ferrite, single phase multiferroic system with rhombohedral distorted perovskite structure. The nanosized $BiFeO_3$ multiferroic system doped with Dy^{3+} ($Bi_{(1-x)}Dy_xFeO_3$) (x = 0.01) has been prepared by sol-gel method using PVA as a chelating agent. To study different properties X-ray diffraction method, UV-Vis spectroscopy, dielectric spectroscopy, magnetoelectric coupling, and positron annihilation spectroscopy is used. The XRD result confirms the structural transformation from rhombohedrally distorted perovskite structure to orthorhombic structure by Dy doping. The UV-Vis spectroscopy confirms the decrease in band gap energy by doping. It enhanced the dielectric and magnetoelectric properties of the sample at x = 0.01 in $Bi_{(1-x)}Dy_xFeO_3$. The Dy^{3+} doping increases the oxygen vacancies in the sample and it enhanced the switching properties of the materials.

12 –SCIENTIFIC AND SOCIAL RESPONSIBILITY

ORAL PRESENTATION

12.01

AI BASED DECISION SUPPORT SYSTEM FOR LANDSLIDE HAZARD MITIGATION WITH SOCIETAL PERSPECTIVE

A. L. Achu[a*], Girish Gopinath[a]

*[a]Department of Climate Variability and Aquatic Ecosystems, Kerala University of Fisheries and Ocean Studies (KUFOS), Kochi-682 508, Kerala, India. *achu.geomatics@gmail.com*

Landslides are the most frequent geological hazards affecting the mountainous regions across the world. Kerala is one of states which is frequently affected landslides during Indian summer monsoons. The rugged terrain, intense spells of heavy rainfall and anthropogenic slope modifications together make the Western Ghats of Kerala vulnerable to the occurrence of landslides. The aim of the present study is to model landslide susceptibility of southern Kerala using deep learning model. A total 1907 landslide events were collected from GSI-Bhukosh database and field works conducted during 2019 and 2020 and the dataset is randomly divided into 70-30% for model training and validation. Thereafter, nine landslide conditioning factors such as lithology, soil texture, land use/ land cover, slope angle, slope aspect, distance from roads, distance from streams, distance from lineaments and topographic wetness index are selected for modelling. The present study developed a Deep neural network with 9×50×50×50×2 architecture, i.e., nine nodes in input layer and 50 nodes each in three hidden layers and two nodes in output layer. The resultant probability values were in range between 0-0.99 which is further reclassified into five categories such as least susceptibility area, low susceptibility area, moderate susceptibility area, high susceptibility area and extreme susceptibility area. About 78.64% of the study area falling under least susceptibility followed by 8.55% in low susceptibility, 7.73% in moderate susceptibility, 1.39 percentage in high susceptibility and 3.69% in extreme susceptibility. Besides the proposed model is validated with ROC-AUC values. And the model obtained 91% accuracy in training section (AUC=0.91) and 90% accuracy in testing sections shows the ability of DNN in classifying landslides and non-landslides correctly. Finally, the model is made open-source web enabled using ArcGIS online geodata platform. The online version is free access and anyone can access using the link provided using a smart phone. Besides using their GPS location in the phone instant decision making is possible even for layman.

12.02

RECENT LANDSLIDES IN KERALA - AN ECOLOGICAL PERSPECTIVE

Achu VR*, Navya Mohan, Higgins Robert[1] and Preetha TS

Department of Botany, University College, Thiruvananthapuram- 695034, Kerala, India
[1]Department of Geography, University College, Thiruvananthapuram- 695034, Kerala, India
**Department of Botany, University of Kerala, Kariavattom, Thiruvananthapuram- 695581, Kerala, India*

Background: Kerala has been facing extreme weather events in the past few years. The massive drought in 2015 was followed by the Okhi cyclone in 2017. Massive floods have occurred in 2018

and 2019, along with landslides. Several factors like quarrying, razing hills for constructions, large-scale road construction and expansion in the mountains and mono-crop cultivations are the turning contributing factors in the landslides along with incessant rains of high magnitude. This work highlights the landslide proneness of the study areas such as Puthumala, Kavalappara, Pettimudi and Koottickal and validation of the major conditioning factors by mapping of different factors in these zones using ArcGIS 10.3.1 Software. This work brought forward the key measures to alleviate and exclude the intimidating ascendancy of landslides in these ecologically sensitive zones.

Method: The study intends to analyse the land use pattern with respect to the change in vegetation and a comparative analysis of the land slide affected areas such as Puthumala, Kavalappara, Pettimudi and Koottickal and validation of the major conditioning factors by mapping of different factors in these zones. The maps were generated using ArcGIS 10.3.1 Software. Geomorphology maps were prepared using LANDSAT8 operational land imaging and Survey of India Toposheet 1:50,000 (Toposheet no:58 A/2,58 A/3,58 A/6,58 A/7,58 B/16,58 F/3,58 F/4,58 C/14).

Results: From the analysis conducted, it was very clear that the landslide sites selected for the study are a part of the ecologically sensitive Western Ghats and they were on the list of areas vulnerable to landslides. Heavy rainfall triggered thousands of landslides in Kerala during 2018-2021. The study revealed that quarries, vertically cut slopes, inappropriate building construction, destruction of natural streams, change in land use pattern, especially the conversion of natural vegetation to plantations and deforestation have accelerated the landslide disasters in the study areas. Extremely heavy rainfall coupled with land use patterns including construction are the major causal factors of recent landslides in Kerala.

Conclusion: Landslides are the most dangerous natural disasters in the hilly and mountainous areas all over the world. It is high time to frame clear policies on proper land management as well as water conservation and utilisation. There must be greater attention to avoid change in land utilisation patterns and avoid initiation of large-scale projects with substantial environmental implications. It is high time to focus on “living in harmony with nature” to accomplish “Only One earth” the main theme of World Environment Day 2022 as well as the key recommendation of Stockholm Conference that was proposed fifty years back.

Key words: Landslides, Kerala, Puthumala, Kavalappara, Pettimudi, Koottickal, LANDSAT8 operational land imaging, Survey of India Toposheet

12.03

SCOPE OF SCIENCE, TECHNOLOGY AND INNOVATION (STI) ON IMPROVING THE LIVELIHOOD POTENTIAL OF *KANNADIPPAYA*

Anjana N., Pranav K., A. V. Raghu, M. Amruth, Syam Viswanath*

*KSCSTE- Kerala Forest Research Institute, Peechi 680653, (*Correspondence mail: syam.viswanath@gmail.com)*

Background: *Kannadippaya* is a unique bamboo mat and a tribal handicraft of Kerala woven by *Muthuvan, Mannan, Malayan, Oorali* and *Kadar* communities. The study assesses the potential for integrating science, technology and innovation elements into a traditional craft and its resource base to improve the livelihood of the community who possess traditional skills and knowledge.

Method: Social research methods such as informal and focus group discussions, participant observation, rapid rural appraisals and deployment of a structured questionnaire survey were carried out to collect information on the choice of species, time of collection, method of collection, method of weaving and the common use of Kannadippaya. Based on the gathered information SWOT, STI and institutional solutions were analyzed.

Results: Teinostachyum wightii (Munro) Bedd., is the preferred species for weaving Kannadippaya. Lack of raw material availability, financial and physical capital, predictable income-generating opportunities and proper marketing channels are the major challenges identified. Mechanisation, raw material supply augmentation, innovations in products and designs, trainings, branding through GI, and improvement of resource base will ensure the survival of the traditional cultural expression of Kannadippaya weaving.

Conclusion: The younger generation of tribal communities has less interest in Kannadippaya making the skills foreign to them. Proper intervention in the form of science, technology and innovation will ensure the survival of the skill of Kannadippaya weaving and enable it as a livelihood for people in the community.

Keywords: Bamboo, *Kannadippaya*, tribal handicraft, *Teinostachyum wightii, Ochlandra,*

12.04

ARTIFICIAL INTELLIGENCE-GUIDED EDUCATIONAL TOOL FOR AUTOMATIC STORY GENERATION FROM KEYWORDS

Godwin George[#] and Rajeev Rajan*

*[#]College of Engineering, Trivandrum, *Government Engineering College, Barton Hill*

Background: Keywords to story generation is a complex problem in artificial intelligence because it requires a highly powered GPU, the sentence needs good semantic connections, and the generated stories must be grammatically and logically correct. The existing models need high-performing machines, which makes it difficult for users to generate a story from keywords. We aim to develop a system capable of getting stories from keywords.

Method: FAISS-based approach is utilized effectively for story generation from keywords. FLAIR framework is used for name entity recognition in the story generation process. A full-stack web app using Python (anvil platform) is developed for story generation based on the proposed model.

Results: Thus, the proposed method reports a top-1 rate of 70%, better than the other model with method-2(FAISS) 50% and baseline method-1 (40%).

Conclusions: We can see that our system can meet the primary objective to generate stories from keywords. The system can generate stories in milliseconds related to key words contextually in less GPU specification devices. Very interesting results are also seen while generating multiple scenarios. The user ratings show the performance of our system is good and which can satisfy the user's needs that can't be met by existing techniques.

Keywords: Story generation, Search, FAISS, NER, FLAIR, Sentence transformers, natural language processing

12.05

AN OPEN FRAMEWORK FOR THE DEVELOPMENT OF AUTOMATIC SPEECH RECOGNITION SYSTEM FOR MALAYALAM

Kavya Manohar[1], Dr. Rajeev Rajan[2] and Dr. A. R. Jayan[3]

[1]College of Engineering Trivandrum, Thiruvananthapuram,[2]Goverment Engineering College, Bartonhill, Thiruvananthapuram, [3]Government Engineering College, Thrissur

Background: Speech is a natural form of communication between humans. As human machine interactions are becoming commonplace day by day, it is important to enable the machines to take spoken inputs in the language of the people. In this paper we present an open framework for the development of automatic speech recognition (ASR) system for Malayalam language.

Methods: We rely on openly available Malayalam speech corpora collected and curated by academic institutions, industries and non-profit organizations to train our acoustic model. The text corpora collected from Malayalam Wikipedia contents along with the transcripts of speech from speech corpora were used to train the language model. To prepare the largest openly available pronunciation dictionary for Malayalam, we have developed a finite state transducer based grapheme to phoneme conversion system named *Mlphon.* Acoustic model that learns to map acoustic features to Malayalam phonemes is trained with time delay neural networks (TDNN) using Kaldi speech recognition toolkit. Statistical n-gram language model that learns probability of word sequences from the text corpus is built using SRILM toolkit. Combining the acoustic model, the language model and the pronunciation dictionary we build the ASR system for Malayalam.

Results: The developed model is tested for its quality in terms of word error rate (WER) on test datasets. Out of vocabulary (OOV) words refers to those words in the test dataset that are not present in the pronunciation dictionary and hence cannot be recovered by the ASR. Our ASR model performs well on a test set that has fewer than 1% OOV words with a WER of 10% . Test datasets with 8% and 36% of OOV words have resulted in a WER of 31% and 85% respectively.

Conclusions: The ASR system developed is made available as an open public resource which can be integrated with numerous applications including automatic transcription of meetings; speech based typing, interactive voice response systems etc. We follow the open source development method with permissive licensing so that the framework may be reused by anyone for improving the current model. The entire source code is made available in this repository. The resultant model can be demonstrated during the presentation of this work.

Keywords: Automatic Speech Recognition, Language Technology, Malayalam, Open Technological Solutions

12.06

EXPOSURE OF PYRIPROXYFEN TO THE LARVAE OF *AEDES ALBOPICTUS* (SKUSE) ALTERS THE LEVEL OF STORAGE PROTEIN

Anjana Lokanathan M. K.[1], Kannan Vadakkadath Meethal[2]

Division of Biochemistry and Molecular Biology, Department of Zoology, University of Calicut

Background: Mosquito borne diseases are posing an enormous risk to human population worldwide. Different strategies are employed in order to control mosquitoes including use of

conventional insecticides. Major risks are the development of resistance by mosquitoes against insecticides and environmental health hazards. In the present study we examined protein profile changes, in particular the storage protein, hexamerin accompanying treatment with Pyriproxyfen, a juvenile hormone analogue insecticide, to the early third and fourth instar larvae of *Aedes albopictus*.

Methods: Early third and fourth instar larvae treated with different concentrations of pyriproxyfen and after 24 and 48 hours of exposure, LC50 was determined. LC_{50}, LC_{20}, and LC_{10} taken as sub lethal concentration was exposed to third instar larvae and protein profile changes studied using SDS PAGE. The band intensity was quantified using Gel Documentation.

Results: It is found that 24 hours LC_{50} for Pyriproxyfen against early third and fourth instar larvae of *Aedes albopictus* was 2.23±0.06 and 2.37±0.10 µg/ml respectively and treatment with sub-lethal concentration (LC_{50}, LC_{20}, and LC_{10}) resulted in a high intensity storage protein band in test when compared to the control. Storage proteins are the most abundant proteins in the larvae and range in molecular weights about 83kDa. The study of alteration in storage protein on exposure to pyriproxyfen will be helpful in understanding their role in the toxicity and resistance to the insecticide.

Keywords: *Aedes albopictus*, pyriproxyfen, storage proteins, hexamerins

12.07

RESISTIVITY ANISOTROPY: PRELIMINARY OBSERVATIONS FROM THE HARD ROCK AQUIFERS OF CENTRAL KERALA, SOUTH INDIA

Anu R

Junior Geophysicist, District Office, Ground Water Department, Alappuzha - 688003

Background: The chief source of water for people dwelling in the Mid Lands and High Lands of Kerala is groundwater occurring in the weathered zone, discontinuous fractures, joints and lithological contacts of the hard rocks, which is extracted through borewells. Dry borewells result not only in the dearth of drinking water and monetary loss to the stakeholders but often leads to protests against drilling. Resistivity sounding is commonly employed for groundwater prospecting in Kerala. It is observed that there is directional dependence of electrical resistivity in the hard rocks of Kerala and this resistivity anisotropy also contributes to improper well siting. Thus, a detailed scientific study on electrical resistivity variations is the required.

Method: Vertical Electrical Sounding (VES) data the Midland and High Lands of Ernakulam District in the state of Kerala were considered for this study. Existing data on yielding bore wells in the locality were also relied on.

Results: It was observed that even if vertical electrical sounding data in a particular direction of electrode lay out did not suggest any promising result, a change in the direction of resistivity survey led to the indication of fractures. These sites were later drilled resulting in borewells of moderate to high yield.

Conclusions: This work establishes the presence of directional dependence of electrical resistivity (resistivity anisotropy) in the hard rock aquifers of Central Kerala. Anisotropy is not just limited to biotite gneiss but observed in charnockites too. A proper demarcation of region-wise resistivity anisotropy direction and electrical anisotropy parameters will be beneficial to the society in the

long run, not just in terms of accessibility to potable water but for better management of groundwater resources.

Keywords: Resistivity anisotropy, Borewell siting, Hard rock aquifers, 1D (one-dimensional) electrical resistivity technique

12.08

DESIGN AND DEVELOPMENT OF TRANSDERMAL DRUG DELIVERY DEVICE FOR PAINLESS ADMINISTRATION OF INSULIN

Dr. Shiny Velayudhan

Department of Biomaterials Science and Technology, Biomedical Technology wing, Sree Chitra Tirunal Institute for Medical Sciences and Technology, Trivandrum

Diabetes, a glucose metabolic condition, is a serious chronic disease and a major public health issue. Insulin is one of the hormones that regulate blood glucose levels, and its products are essential for most diabetics. In the future, introducing microneedles (MNs) to insulin delivery could pave the way for non-invasively modifying glucose levels in diabetic patients, as they are painless, easy to handle, and do not require any power source. This study reports the fabrication and characterization of insulin loaded polymeric MNs using mild moulding conditions. Mild moulding method were used to avoid downsides, such as chemical solvents, heat, or UV light irradiation, which not only maintains insulin bioactivity and but also cut costs if mass production of drug-loaded MNs becomes a reality. Morphological analysis of the fabricated MNs showed that they were pyramidal in shape with sharp and slender tips, enabling them to penetrate easily through the skin. The needles formed were mechanical strong and sturdy and underwent little deformation when applied over the skin models. *In vitro* drug release profiles showed that the embedded insulin easily released and followed a first order release profile. The released insulin maintained its bioactivity even after storage of the insulin loaded MNs over 12 months at 4°C. The histology of rabbit skins (ex-vivo) to which the MNs were applied showed that MNs easily penetrated to the dermis. This study thus showed that the insulin loaded polymeric MNs could be fabricated using milder moulding conditions. As a painless and minimally invasive method of self-administration, MNs is very promising to replace subcutaneous injection of insulin for type I diabetes treatment, the possibility of using MNs to replace subcutaneous insulin injections in the treatment of type I diabetes seems very promising.

POSTER PRESENTATION

12.09

GENDER SENSITIVITY AMONG HIGH SCHOOL STUDENTS IN THODUPUZHA : AN INTERROGATION INTO AWARENESS REGARDING GENDER IN STUDENT LIFE

Kavitha Manohar

CPAS College of Teacher Education, Thodupuzha

Background: Kerala is top in human development indicators compared to other Indian states in infant mortality, maternal mortality, life expectancy, sex ratio and many others. The Kerala model is widely appreciated in the media with the tag line-"what Kerala thinks today is what India thinks tomorrow" recently during the first wave of Covid 19 outbreak. But does progressive picture in

these indices reflect personal life in micro observation, is a question. Here the researcher explores whether the rosy picture of gender equality in the public sphere is that much colourful when viewed in close quarters from student perspectives. The current study tries to analyse how far the gender sensitivity is taking place among high school students.

Method: The study deals with the area of "Sociology of Gender". It uses framework of feminist research methodology. The data collection was carried out by a convenient sampling method with a questionnaire as a tool, among high school students in Thodupuzha.

Result: The study found that awareness regarding the exact difference between sex and gender among high school students are not up to the level. How the student perceives homosexuality and transgenders was deeply discussed in this study. It revealed how the family and school act as socializing agents which is fostering gender stereotyping and gender segregated behaviour among students. How the term feminism is being misundesrtood is critically discussed in this study.

Conclusion: The inclusion of gender sensitivity in curriculum, teacher interactions in school, and activities in family and community are essential to have equality of all genders in society in the long run. Since, gender sensitivity as primary etiquette in progressive society, fundamental changes in the educational system are to be initiated in Kerala through which applauded gender indices become true in micro observation.

Keywords: Gender Sensitivity, High School Students, Gender Awareness, Student Life, Kerala

12.10

CHALLENGES AND PROSPECTS IN INDEGENOUS COMMUNITIES PRACTICING MEDICINAL PLANTS CULTIVATION: A CASESTUDY FROM ATTAPPADY VALLEY, KERALA, INDIA

R. Rakshitha[1], Amal Thankachan[1], M Amruth[2], T. K. Hrideek[3], A. V. Raghu[1],
[*]Corresponding author : dravraghu@gmail.com

[1]Extension and Training Division, [2]Sociology Department, KSCTE-Kerala Forest Research Institute, Peechi,
[3]State Medicinal Plant Board, Govt. of Kerala,

Background: This is a case study on Irula, Muduga and Kurumba communities involved in medicinal plant cultivation is carried out in the Attappadi valley of in Kerala.

Method: Participant observation, questionnaire survey and unstructured interviews and rapid rural appraisals were employed to gather information on various aspects of medicinal plant cultivation, harvest season, yield, marketing options and economics of the cultivation in 2 villages viz., Pudur and Sholayur Panchayaths.

Results: Among the drivers of medicinal plant cultivation are availability of cash subsidy schemes, lack of threats from wild animals raiding the crop and availability of land and suitability of species for low rainfall areas. However, the fluctuation in prices is affecting the farmer seriously. Since demand for medicinal plants is determined solely the companies and suppliers the option of selling it is the open market does not exist.

Conclusions: Empowering tribal communities as well as strategy for conservation and sustainable maintenance of natural populations are only possible by established supporting systems under the initiative of government, co-operatives or under the voluntary sector which are listed in the paper.

Keywords: Medicinal plants, Cultivation, Tribes, Farmers, Conservation

12.11

UNSCIENTIFIC WAY OF TEACHING OF PHYSICS AT HIGH SCHOOL LEVEL

K M Udayanandan, S N College, Keezhal Mukku, Vadagara
LinuKumar M C, Narayanalayam, Valapattanam, Kannur, 670010
udayananadan@gmail.com

Background: Many topics in Physics are presented in an unscientific way in both NCERT and SCERT books. Among the many, dispersion and scsttering are critically analysed in this paper

Method: The construction of Newton's disc based on Plancks theory in given. The different types of scattering are studied

Results: Construction of the Newtons disc is given as an application of dispersion in the text books, but the scientific way of construction is not adopted. It is given that the different colors must be of equal proportion. But in the figure it is not so. Molecular scattering is the reason for blue color of the sky. But in the books it is not mentioned and the books wrongly give an impression that Tyndall scattering is responsible for the blue color of the sky.

Conclusions: Actual physics behind Newtons disc and blue color of the sky are established. The lack of the development of scientific skills and an adequate exposition

of scientific concepts, in order to lay down a solid foundation is pointed out with examples. We hope this paper will help the teachers and students to understand the topics in detail.

Keywords: Molecular scattering, Newtons disc, Dispersion,

12.12

WOMEN EMPOWERMENT THROUGH CONSERVATION AND POPULARISATION OF MEDICINAL PLANTS

M Navas*, T K Hrideek, O L Pius and K J Dantas

State Medicinal Plants Board, Shornur Road, Thiruvampady P O,
Thrissur District, Kerala Pin-680022

Background: The role of medicinal plants in health care management is highly appreciated since long back. Around 2500 years ago Hippocrates first espoused the philosophy of "food as medicine". India, one of the mega diversity countries of the world has the history of practicing this theory in every nook and corner, as kitchen gardens. Revitalization of that great culture is a herculean task, though traditional food recipes using these food/medicinal plants has been enjoying renaissance among the consumers all over the world. Plants used for food and medicine from the courtyards are a nostalgic feeling for every people in the country, especially for Keralites. Considering these, State Medicinal Plants Board (SMPB) is promoting conservation and cultivation of medicinal plants with people's participation in households, aimed to produce quality plant materials for home remedies as well as for the Herbal Drug industry. In this background SMPB formulated a project entitled "Grihachaithanyam", a flagship project targeted to plant One Curry Leaf plant (*Murraya koenigii* (L.) Spreng.) and One Neem Tree (*Azadirachta indica* A.Juss.) in each household of Kerala.

Method: As a pilot level, in the first year implemented the program in one panchayath each in all 14 districts of Kerala. In the second year implemented the project in 471 Gramapanchayaths and

finally extended to all 941 Gramapanchayaths of Kerala. Seedlings were procured from Kerala Forest Research Institute in the first phase and later seedlings were raised locally, by generating rural employment involving women work force of Mahatma Gandhi National Rural Employment Guarantee Scheme (MNREGS) in each Panchayath, where they established nursery for the seedling production. Seedlings were distributed to each household with the involvement of elected members of respective Wards. Quality seeds of Curry leaf and Neem were procured from authentic sources and supplied to the MNREGS workers by SMPB.

Results: 10 lakhs Curry leaf plant (*Murraya koenigii*) and 19 lakhs Neem Tree (*Azadirachta indica*) seedlings were produced and distributed in 941 Gramapanchayaths of Kerala by generating around 25000 man days of rural employment and distributed more than 150 lakhs rupees as wages to the women beneficiaries. An average of 50 rural women were benefitted from each panchayath.

Conclusions: The main objective of SMPB is to encourage cultivation and conservation of medicinal plants and its sustainable management across the state. With a view to this 19 lakhs Neem Tree (*Azadirachta indica*) and 10 lakhs Curry leaf plant (*Murraya koenigii*) seedlings were produced and distributed by SMPB. Thus SMPB ensured at least one pesticide free, quality leafy vegetable/medicinal plant in each household of Kerala. This model can be replicated for selected medicinal/food plants in the state with people's participation. Thus SMPB is channelizing the medicinal plant resources in various ways for conservation, sustainable utilisation and upliftment and livelihood enhancement of the rural and tribal/marginalised people of Kerala.

Keywords: Curry Leaf, Grihachaithanyam, MNREGS, Neem, Women empowerment.

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