KERALA SCIENCE CONGRESS

32nd KERALA SCIENCE CONGRESS

25-27th January 2020

Yuvakshetra Institute of Management Studies, Mundur, Palakkad

Focal Theme: "Science & Technology for Climate Change Resilience & Adaptation"

Abstracts

KERALA STATE COUNCIL FOR SCIENCE TECHNOLOGY AND ENVIRONMENT
Sasthra Bhavan, Pattom, Thiruvananthapuram.

32nd KERALA SCIENCE CONGRESS - ABSTRACTS

Focal Theme
"SCIENCE & TECHNOLOGY FOR CLIMATE CHANGE RESILIENCE & ADAPTATION"

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PINARAYI VIJAYAN
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MESSAGE

It is my pleasure to learn that that the Kerala State Council for Science, Technology and Environment is holding the 32nd session of the Kerala Science Congress at Palakkad, that too with the focal theme as "Science& Technology for Climate Change Resilience & Adaptation" as it has critical significance in the context of extreme events that the State of Kerala faced during the last two years. Palakkad, the place chosen for the event is also significant due to its geographical position that has a strategic role in Kerala. Palakkad is also known as the 'Granary of Kerala' and as many as eight rivers originates from the hills here, which also includes the largest one, Bharathapuzha.

Our States is endowed with rich natural resources *viz.,* forests, wetlands, coastal or marine entities and several other geological assets. It's our responsibility to protect these natural treasures and KSCSTE is committed to do it with other line departments. In this context, I am happy to know that the 32nd Kerala Science Congress addresses the issues that have affected our fragile ecology and landscapes.

The Government of Kerala has given deserving thrust to promote its Research & Development programmes through liberal support to KSCSTE in solving many prevailing issues in the State including climate change issues thereby catalysing the Government's efforts to bring positive changes in the society. Kerala is known for high literacy, skilled human resources, knowledge driven society and intellectual faculties. The collaborative efforts involving all the scientific community in universities and research institutions, etc. would result in building resilience and adaptations to face any such hard situations.

I congratulate the KSCSTE in bringing the young researchers, academicians and scientists together every year through Kerala Science Congress to share their knowledge and experience for encouraging technological and innovative programmes for the State and also to keep up the scientific temperament.

I wish all success to the KSCSTE and 32nd Kerala Science Congress.

Pinarayi Vijayan

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Kerala State Council for Science, Technology and Environment

FOREWORD

The Kerala Science Congress (KSC) is an annual event of the Kerala State Council for Science, Technology and Environment (KSCSTE) which provides a platform for scientists, researchers and students to get together, present, discuss and disseminate their research. The KSCSTE has been organising this event continuously for the 31 years. The 32nd edition of the event, KSC 2020, is being held at Yuvakshetra Institute of Management Studies, Mundoor, Palakkad during25-27, January 2020with a focus on a theme of contemporary relevance "Science & Technology for Climate Change Resilience & Adaptation.

The repeated extreme rainfall events in the Kerala State and associated floods as well as landslides in the last two years had severe impacts on the socio-physical aspects, health sector, educational sector, agricultural sector and other livelihood means and infrastructure in the State. In this context, the focal theme of the KSC 2020 is highly relevant. The state also experiences the other extreme of the climate change in terms of drought and low water availability. It would be interesting to learn from a team of eminent scientists from across the country, who would deliberate on different perspectives of climate change in terms of the science of climate change, adaptation and policy and prediction.

The Science Congress will also have presentations of papers by researchers and students in 12 different subject areas which include Agriculture & Food Sciences, Biotechnology, Chemical Sciences, Earth & Planetary Sciences, Engineering & Technology, Environmental Science, Forestry & Wildlife Fisheries & Veterinary Sciences, Health Sciences, Life Sciences, Mathematical and Statistical Sciences, Physical Sciences and Scientific Social Responsibility.

An important feature of the Kerala Science Congress is the delivery of Commemorative Lectures in memory of some of the great scientists and visionaries of Kerala by eminent scientists. In order to facilitate interaction with scientific community, the Children's Science Congress is also planned as part of the KSC 2020. This would be a potential opportunity for the budding scientists to show case their scientific talents and ensure that the future of our State is in good hands.

An interactive session for the Post-Graduate Students with eminent scientists and academicians is a special session in Kerala Science Congress.The National Science Exhibition, which is conducted concurrently for four days has participation frommajor research institutes and industries across the Country, and provides a unique opportunity for the general public to view and understand the progress in various areas of science and technology.

I present this Book of Abstracts the 32nd Kerala Science Congress to the scientific community with great pleasure.. I take this opportunity to thank all the contributors for their participation in the KSC 2020. The efforts put in by the Chairmen and experts in reviewing and selecting the papers for presentation is highly appreciated.I would like to place on record my sincere thanks to all the institutions who are involved in organising this event. The organising team of the KSC 2020 consisting of various task based committee's warrants special mention.

I wish the 32nd Kerala Science Congress all success.

Prof. K. P. Sudheer
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Contents

01- AGRICULTURE & FOOD SCIENCE

01-01

GENOTYPIC SCREENING AND *IN VITRO* MASS MULTIPLICATION OF SUPERIOR *Anthuriumandreanum*Linden HYBRIDS

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Background: The growing floriculture creates a greater demand for anthurium flowers in the domestic as well as international markets making it a remunerative agri-business sector in the country. Anthurium has very high genetic potential due to its heterozygous nature. There is ample scope in hybridization programmes by harnessing its variability, incorporated with effective selection and multiplication of superior hybrids. The way towards supply of healthy planting material is through *in vitro* multiplication of these developed superior hybrids therby establishing a strong stand in the floriculture market.
Method: Genotypic variability analysis of 20*Anthuriumandreanum*Linden hybrids were done in the present study followed by screening of the genotypes for commercial characters. The genetic parameters such as GCV, PCV, heritability and genetic advance were also studied. Genotypes were also selected based on yield attributing characters after correlation and path analysis. The superior hybrids were carry forward for standardizing the protocol for efficient mass multiplication through organogenesis.
Results: Evaluation of genetic parameters followed by screening based on commercial characters resulted in the selection of two hybrid genotypes i.e. Pompon Red (PR) X Honeymoon Red (HR) andHoneymoon Red (HR) X Liver Red (LR), with superior flower yield attributing traits and qualitative characters. These hybrids were used for*in vitro* mass multiplication studies. Genotypic differences were evident during *in vitro* mass multiplication studies of these hybrids. Modified half strength MS medium supplemented with 200 mg L^{-1} NH_4NO_3 + 1.0 mg L^{-1} BA + 0.5 mg L^{-1} 2,4 D + 30 g L^{-1} sucrose + 6.0 g L^{-1} agar was the most suitable for callus induction and callus multiplication while shoot initiation, proliferation of shoot and root were the highest and faster in the same basal medium supplemented with 0.5 mg L^{-1} BA. Large scale multiplication of the superior hybrids and profit generation can be achieved through the tissue culture protocol that was standardized in the present study. The promising commercially superior anthurium hybrids identified in the study can be used in further crop improvement programmes.
Conclusions: This work was successful in evaluating and selection of commercially superior anthurium hybrid genotypes. For ensuring the supply of disease free and adequate planting materials, a low cost *in vitro* mass multiplication protocol was developed for the superior hybrids, which will thereby help in faster establishment of these hybrids in the floriculture market.
Keywords: Anthurium, flower yield, organogenesis, mass multiplication.

01-02

ORGANIC NANO NPK FORMULATIONS - A BOON FOR ORGANIC CULTIVATION OF VEGETABLES

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Background: Nanotechnology, one of the frontier technologies of present day science has immense potential in bringing about appreciable improvements in agriculture sector. Studies regarding utilization of nanotechnology

in organic farming are still much limited and less explored. Research works for understanding the potential of organic nano NPK formulations will start the ball rolling for an era of enlighted and sustainable organic agriculture. The present investigation entitled "Organic nano NPK formulations- A boon for organic cultivation of vegetables" was carried under the Department of Soil Science and Agricultural Chemistry, College of Agriculture, Vellayani.

Method: First part was characterization study was done using zeta sizer analyzer, SEM, surface area analyzer and ICP. The field experiment on okra was done once again confirmatory results.The field studies were carried out in a lattice design with 16 treatments and 3 replications. Treatments consisted of soil application of granular nano NPK at 3 levels (12.5 kg ha^{-1}, 25 kg ha^{-1} and 50 kg ha^{-1}) with and without FYM, foliar application of liquid nano NPK at 2 levels (0.2% and 0.4%) with and without FYM and combined application of granular and liquid nano NPK formulations with and without FYM.

Results: Characterization of physical, physico-chemical and biochemical properties of nano NPK formulations were estimated. The particle size of granular and liquid nano NPK formulations were 83.20 nm and 71.79 nm, respectively. The surface area of granular nano NPK formulation was 138.95 m^2 g^{-1}. The analyzed sample were verified its stability under the field conditions. Growth and yield attributes of okra *viz.,* plant height, LAI, DMP, fruit length, fruit girth, number of fruits per plant, average fruit weight andtotal fruit yieldwere significantly influenced by the soil and foliar applications of organic nano NPK formulations. Treatment that received FYM + soil application of granular nano NPK formulation 12.5 kg ha^{-1} along with foliar application of liquid nano NPK formulation 0.4 per cent was found to be the best with respect to yield and yield attributes of okra.

Conclusions: From the study it was concluded that combined application of granular organic nano NPK at 12.5 kg ha^{-1} with foliar application of liquid nano NPK 0.4 per cent at biweekly intervals can substitute conventional fertilizers for sustainable crop production and healthy environment.

Keywords: Organic nano NPK formulations, characterization, okra and yield

01-03

CHARACTERISATION OF *Ralstoniasolanacearum* (Smith) *Yabuuchi et al.* INFECTING SOLANACEOUS VEGETABLES IN RELATION TO PHYSICO-CHEMICAL AND BIOLOGICAL PROPERTIES OF SOIL

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Background: *Ralstoniasolanacearum,* the causal agent of vascular wilt disease of crop plants is ranked as the second most important bacterial pathogen in the world next to *Pseudomonas syringae*. The pathogen is highly diverse and soil borne, its survival is influenced by physico-chemical and biological properties of soil. Hence an understanding of the pathogen as well as physico-chemical and biological properties of soil influencing the disease could aid in adopting appropriate preventive and management measures against the disease.

Method: Themethod involved isolation and characterisation of *Ralstoniasolanacearum*(Smith)Yabuuchi *et al.* infecting solanaceous vegetables from four different agro ecological units (AEUs) of Kerala *viz.,* Northern central laterite (NCL), Marayur hills (MH), Southern laterite (SL) and Palakkad central plains (PCP) and evaluation of soil physico-chemical and biological properties influencing the disease.

Results: Per cent incidence (PDI) of bacterial wilt in different locations ranged from 20 to 88 per cent. A total of eight isolates were collected, purified andcharacterised by cultural, morphological and molecular characterisation.Theisolates of the pathogen were further categorized into race 1 and race 3 and biovarsII, III and IIIA. A significantly higher soil pH, organic carbon, available K, Ca and Fe content and soil microflora in rhizosphere soil of healthy plant compared to diseased and a significant positive correlation was observed between PDI and water holding capacity and bulk density whereas soil pH and available Ca content exhibited a negative correlation with PDI. Multiple regression analysis indicated that 96.8 per cent variation in the bacterial wilt incidence is explained by soil pH and available Ca content in the rhizosphere soil.

Conclusion: The study revealed the influence of soil factors on bacterial wilt disease incidence, population of *R. solanacearum* and pathogen variability. Hence, manipulation of soil factors can play a major role in integrated management of the disease.

Keywords: Bacterial wilt,*Ralstoniasolanacearum,* races, biovars, soil physico-chemical and biological properties.

01-04

ENRICHMENT OF *PSEUDOMONASFLUORESCENS*WITH CHITIN FOR ENHANCING PLANT PROTECTION EFFICIENCY

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Background: *Pseudomonasfluorescens*is a potentialbiocontrol agent which suppress plant diseases and enhance plant growth.Chitin and chitosan are known to have eliciting activities leading to a variety of defense responses in host plants in response to microbial infections, including the accumulation of phytoalexins, pathogen-related proteins and proteinase inhibitors, lignin synthesis and callose formation. The present study was conducted to combine the beneficial effect of *P fluorscens* and chitin and there by enhancing the plant protection efficiency for the management of banana diseases.

Method: Colloidal chitin (chitosan) was prepared by acid hydrolysis method. *P fluorescens*grown in King's B medium enriched with different concentration of chitin (0.5,1.0,1.5,and 2.0 %) was used for the evaluation of the plant protection property. Chitin enriched *P fluorescens* was evaluated against the banana post harvest fungi *Colletotricum muse*, fusarium wilt fungi *Fusariumoxysporum*f.sp*cubense,* rhizome rot causing bacteria *Pectobacteriumcarotovorum*andantifeedant property against *Spodoptertalitura*the leaf eating caterpillar.

Results: In the *in vitro* study of Chitin enriched *P.fluoroscens*(CPF) against *Colletotrichummusae*, the CPF with 2 % chitin was found to be the most effective treatment and it showed 54.95 per cent reduction over control. In the present study the antifungal activity showed positive correlation with concentration of chitin. In the *in vitro* evaluation of CPF against *Fusariumoxysporumsp.cubense,* the trend of fungal inhibition of CPF was similar to that observed for *C. musae.* CPF with 2% chitin*was* the most effective treatment against *F. oxysporum* f sp. *cubense*.

The impact of CPF on the growth of *Pectobacteriumcarotovorum* was analysed in double layer assay method. Application of CPF on the surface of the top layer produced a clear growth halo was observed under UV light which indicates the inhibition of *P carotovorum*. The increasing concentration of CPF showed an increase in the diameter of the growth halo.

The CPF showed inhibitory property against *Spodopteralitura.* Among the different concentration of CPF, 1-1.5% showed the minimum damage of the leaf and 58.91 per cent reduction over control.

Conclusion: The study includes evaluation of antifungal properties of chitin enriched *P. fluorescens* against *Colletotrichummusae*, *Fusariumoxysporum f sp. Cubensi,* antibacterialproperties against*Pectobacteriumcarotovorum* and antifeedant property against *Spodopteralitura*. The CPF treatments were more effective than *P. fluorescens* for the inhibition of pathogens/ pest. The highest chitin concentration used in the study (2%) was found to be the best treatment and existence of positive correlation between inhibitory property and concentration of chitin in CPF was observed in the case of fungal and bacterial pathogens. Chitin concentration of 1-1.5 % showed more antifeedant property than 2% against *Spodopteralitura*.

Keywords: Chitin, *Pseudomonas fluoroscens,* antimicrobial property, antibacterial effect, antifeedant property

01-05

PYRAMIDING OF THREE BACTERIAL BLIGHT RESISTANCE GENES INTO RICE CULTIVARS OF KERALA USING MARKER ASSISTED SELECTION

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Background: Bacterial blight (BB), caused by *Xanthomonasoryzae*pv.*oryzae* (*Xoo*) is one of the most destructive diseases active in the major rice growing countries of Asia. The present study focused on gene pyramiding of *xa*13*, Xa*21and *xa*5 against BLB into the popular rice cultivar of Kerala *viz*., Prathyasa and Aiswarya through marker assisted backcross breeding (MABB).
Methods: The BC_2F_1 plants obtained from intermated backcrossed lines with three gene combinations having more than 50% homozygosity with the recurrent parent were advanced through pedigree method to produce BC_2F_2.The percent of recurrent genome recovered in individual BC_2F_2 plants was calculated from the background selection using 50 SSR markers spread in the twelve chromosomes and specific to the recurrent parents.
Results: Marker assisted foreground selection coupled with stringent phenotypic selection and background analysis was carried out for hastening recovery of recurrent parent phenome and genome. The individuals were screened for genes *xa13*, *Xa21* and *xa5* using functional markers xa13pro, pTA248, and *xa5*FM respectively. From the BC_2F_1 plants obtained from intermated backcrossed lines with three gene combinations having more than 50% homozygosity with the recurrent parent were advanced through pedigree method to produce BC_2F_2. The percent of recurrent genome recovered in individual BC_2F_2 plants was calculated from the background selection using 44 and 53 SSR markers spread in the twelve chromosomes specific to Aiswarya and Prathyasa respectively.
Conclusions: The BC_2F_2 plants identified with three gene combinations having more than 80 % homozygosity with the recurrent parent can be advanced to produce superior BLB resistant lines either by selection in BC_2F_3 generation or backcrossing with the recurrent parent for maximizing recurrent parent genome in the progeny.
Keywords: Bacterial leaf blight, Rice, Foreground and background selection, Markers.

01-06

SEED INVIGOURATION FOR BETTER ESTABLISHMENT AND YIELD ENHANCEMENT IN CLIMATE RESILIENT GRAIN COW PEA(*Vignaunguiculata*L. Walp)

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Background: Theclimate resilient crops, pulses arethe most important food crops after cereals, being the cheapest and quickest means to augment protein production in developing countries. Seed priming and pelleting with micronutrients are the two simple inexpensive seed invigouration strategies for better establishment and increased yield.
Method: The research work comprised of one pot culture experiment and a field experiment which were carried out at Coconut Research Station, Balaramapuram. Pot culture experiment was laid out with six pelleting treatments, sixpriming treatments and a control. Treatments which showed fast, uniform synchronous emergence with high vigour index were selected as the two best seed pelleting and priming treatments for field experimentation. The field experiment was conducted during *Rabi* 2018. The treatments comprised of seed pelleting with borax 50 and 100 mg kg^{-1} seed; seed priming with $ZnSO_4$ 0.025 and 0.05 per cent for 4h; seed pelleting with borax 50 and 100 mg kg^{-1} seed + *Trichodermaviride*seed treatment 10 g kg^{-1} seed and seed

priming with $ZnSO_4$ 0.025 and 0.05 per cent for 4h + *Trichodermaviride*seed treatment 10 g kg^{-1} seed and a control.

Results: Results revealed that seed priming with $ZnSO_4$ 0.05 per cent for 4h recorded faster germination, the highest dry matter production at harvest, leaf area index, total chlorophyll content, fresh and dry weight of nodules, pods per plant, pod weight per plant, seed yield ha^{-1} and harvest index.

Conclusion: Considering the growth, physiological parameters, nodulation, yield attributes and yield, seed priming with $ZnSO_4$ 0.05 per cent for 4h along with recommended dose of FYM (20 t ha^{-1}), lime (250 kg ha^{-1}) and NPK (20:30:10 kg ha^{-1}) could be recommended for better plant establishment and higher yield in grain cowpea.

Key words: Seed invigouration, grain cowpea, nodulation, yield

01-07

DEVELOPMENT AND STORAGE STUDIES OF OSMO DEHYDRATED RED BANANA (*Musa* spp.)

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Background: Banana (*Musa* spp.) is an important tropical fruit crop and is well known for its high nutritional value, being rich in starch, sugars, vitamins and minerals. Red Banana is known for its characteristic flavour and colour and belongs to *Musa* AAA group. In India processing of banana is less than 2% and there is a vast potential for processing (Kumar *et al*., 2002). It could be processed into different products *viz*. powder, chips, fig etc. Processing of banana into diverse products with longer shelf life has been proposed as a way of absorbing seasonal surpluses and reducing postharvest losses thus increasing and stabilizing farmer's income. Osmotic dehydration of red banana was carried out on the basis of themass transfer kinetics.

Method: During osmotic dehydration of red banana, three different shapes (ring, round and chunks), three different concentration levels (40°B, 60°B and 80°B) of osmotic agentsucrosewas used at threedifferent levels of immersion time (60 minutes, 120 minutes and 180 minutes). The samples to solution ratiowere maintained at 1:1 w/w for all the experiments. Red banana slices were immersed in osmotic solution having 0.1% citric acid, 0.1% KMS and 0.2% ascorbic acid.The osmosed red banana slices were finally dehydrated in a cabinet drier at 50°C till the product attained a moisture content of 17($\pm$1)%and analysed for biochemical, physical and sensory quality parameters.

Results: Biochemical characters *viz*., TSS, total sugar and reducing sugar increased with increase in osmotic concentration and immersion time whereas acidity, ascorbic acid, antioxidant activity and carotenoid content decreased with increase in osmotic concentration and immersion time.The physical characters *viz.,* yield, rehydration ratio, browning index and textural quality of osmo dehydrated red banana were recorded and observed the highest yield (31.75%) was for osmo dehydrated red banana chunks at 80°Brix and 180 minutes immersion time and it was 30.37% and 29.58% for ring and round sliced osmo dehydrated red banana respectively.Sensory evaluationofosmo dehydrated red banana ring, round and chunk shaped slices were conducted and kruskalwallis test confirmed significant difference among the treatments for sensory attributes. Based on the biochemical, physical and sensory analysis, three best treatments; one from each shape *viz.,*osmo dehydrated red banana ring at 80°Brix, 180 min; round slices of osmo dehydrated red banana at 80°Brix, 180 min and osmo dehydrated red banana chunks at 80°Brix, 180 min were selected for storage studies.For biochemical characters *viz.,* TSS, total sugar, reducing sugar, acidity, ascorbic acid, carotenoid content and antioxidant activity were analysed and found increase in TSS, total sugar andreducing sugar where as acidity,

vitamin C, antioxidant activity and carotenoid content decreased. Sensory analysis revealed that all the three osmo dehydrated red banana treatments were safe and acceptable throughout the storage period and among all the three shapes, osmo dehydrated red banana rings recorded the highest acceptance followed by round shaped osmo dehydrated red banana and red banana chunks.Sensory qualities of the product decreased slightly with the advancement of storage period and no microbial growth was found till the end of storage.

Conclusions: Process variables were standardised for the development of osmo dehydrated red banana. Based on biochemical, physical and sensory parameters, osmo dehydrated red banana rings, round slices and chunks could be developed with osmotic solution concentration of 80°Brix for an immersion time of 180 minutes and the storage stability studies revealed that osmo dehydrated red banana packed in 200 gauge polypropylene could be stored for four months at room temperature.

01-08

METARHABDITIS RAINAI- A NOVEL ENTOMOPATHOGENIC NEMATODE EFFECTIVE AGAINST TERMITES, APHIDS, TOBACCO CATERPILLAR AND PSEUDOSTEM WEEVIL

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Background: Naturally occurring entomopathogens are important biotic factors for suppressing the population of insects. Exploitation of the mutualistic association of entomopathogenic nematodes (EPN) belonging to families Steinernematidae and Heterorhabditidae with insect pathogenic bacteria in the genera *Photorhabdus/ Xenorhabdus* is gaining momentum.Crop yield losses due to biotic factors like insect-pests, diseases, weeds, nematodes and rodents range from 15-25 per cent in India, among which 60-70 per cent loss is due to insect pests which are of great concern. Hence the present study was conducted to isolate and evaluate the pathogenicity of indigenous entomopathogenic nematodes against selected insect pests.

Method: Native isolates of entomopathogenic nematodes isolated from soil by using *Corcyra cephalonica* larvae as trap insect were used for the study. Active infective juveniles (IJs) were multiplied in *C. cephalonica* larvae and stored in tissue culture flasks kept in BOD incubator at 15ºC. Four levels of native isolate (10,50,100 and 200 IJ) were inoculated in petriplates containing test insects *viz*., termites, aphids, tobacco caterpillar and banana pseudostem weevil. The experiment is conducted in completely randomized design with four replications. Mortality of termites was recorded at 24, 36, 48, 60 and 72 hours after treatment. Chemical check and Control was also maintained in the experiment. The corrected mortality percentage was worked out using Abbott's formula. The native isolates were identified using morphological and morphometric characters. The most potent isolate was subjected to molecular characterization.

Results: AnativeEPNisolateobtainedfromMylom**,**Kottarakara(Kollam)identifiedas*Metarhabditisrainai*proved to be the most potent strain. This is the first report of *M. rainai*fromIndia.In case of termites and aphids, *M. rainai*showed maximum mortality (cent per cent) with 100 and 200 IJs at 48 HAT and effect of this native isolate was statistically on par with the chemicals. 200 IJs of *M. rainai* showed a mortality of 80.52 and 99.35 per cent at 60 and 72 HAT respectively in tobacco caterpillar.Among the test insects, the pseudostem weevil grubs recorded the least mortality percentage when treated with *M. rainai*. 100 and 200 IJs of *M. rainai* recorded 47.49 and 62.66 per cent mortality at 72 HAT.

Conclusion: This work clearly infers the biocontrol potential of the native isolate *M. rainai* for the control of termites, aphids, tobacco caterpillar and pseudostemweevil.*M. rainai*can be recommended in IPM programmes without any harmful effect on the environment. An effort needs to be directed towards formulating the strain so as to improve its efficiency and shelf life.

Keywords: Entomopathogenic Nematodes (EPN), Termites, Aphids, Tobacco caterpillar, Pseudostem weevil, Infective Juveniles (IJs), Mortality

01-09

MOLECULAR MARKER AIDED SELECTION FOR NOVEL TRAITS IN KOMADAN COCONUT PALMS FOR PRODUCING QUALITY SEEDLINGS

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Background: Komadan is a local coconut off-type, popular in the erstwhile central Travancore area of Kerala associated with the family history of an old TharavaducalledKomattu house. Komadan was superior to WCT in morphological characters of the palm including nut and copra characters. Coconut is a perennial crop and so the assurance of quality of the planting material is highly essential. Molecular markers are useful for locating the specific characters even in the seedling stage. Identification of specific markers for novel komadan traits helps in early identification of the true komadan traits.
Method: The experiment on "Molecular marker aided selection for novel traits in Komadan coconut palms for producing quality seedlings" was conducted at College of Agriculture, Vellayani with objectives to identify the molecular marker for detection of Komadan mother palms and development of SCAR marker from highly reproducible RAPD marker and validation of this marker in komadansegregants. The study consisted of ten KomadanPalms and ten West Coast Tall (WCT) Palms characterized by using 20 RAPD primers and 18 SSR primers. The good quality genomic DNA was amplified by using RAPD and SSR primers.
Results: Out of the twenty RAPD primers screened OPC20, OPP3, OPP2, OPP5, OPA5 and OPD3 produced amplicons specific to Komadan and among the eighteen SSR primers screened primers CNZ1, CNZ10, CNZ43, CAC10 and CnCirH4 produced specific marker to distinguish Komadan from other types. Among the RAPD markers OPC 20 gave more reliable reproducible amplicon specific to komadan palms in the bulked line analysis. This product was eluted and sequenced for developing SCAR marker. Out of 161 Komadansegregants screened the total of 86 genotypes showed expected product size of which 17 from Komadan x CGD cross, 27 from Komadan x WCT cross, 15 from WCT x Komadan cross and 27 from Komadanselfing.
Conclusion: The RAPD markers like OPC20, OPP3, OPP2, OPP5, OPA5 and OPD3 and the SSR markers CNZ1, CNZ10, CNZ43, CAC10 and CnCirH4 can be used for screening of true to type komadan palms. More reliable reproducible RAPD marker OPC 20 can be used for development of SCAR marker which gives sequence specific characterization in Komadansegregants.
Keywords: Komadan, WCT, RAPD markers, SSR markers, SCAR marker, true to type, segregants

01-10

TECHNOLOGICAL CHARACTERIZATION OF *W.cibaria* DMA18 ISOLATED FROM TENDER COCONUT WATER

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Background: Microbial exopolysaccharide (EPS) are reported to have health benefits as well as technological advantages in food products. Exopolysaccharides (EPSs) are high-molecular-weight polymers that are composed of sugar residues and secreted by microorganisms into the surrounding environment .In addition to the health benefits ,these antioxidants have the potential to delay the onset of food discoloration and deterioration, thereby playing a role in shelf life extension and food preservation .This study technologically characterized and determined the antioxidant potential of a lactic acid bacteria from tender coconut water .
Method:*W.cibaria* DMA18 was isolated from tender coconut water.Technological characterization was done by assessing rate of acid production and ability to produce flavour compounds by utilising citrate (Kempler and McKay,1980).Safety evaluation was done by checking gelatine liquefaction potential ,haemolytic pattern (Harrigan ,1998) and antibiogram(Bauer *et al*.,1966) Theanti-oxidant ability of the isolate and its crude EPS

extract were measured by ABTS assay described by Re *et al.,(*1999)
Result: The isolate was confirmed as *W.cibaria* by 16SrRNA sequencing and sequence is deposited in NCBI with accession number MH782084. *W.cibaria*DMA18 was found to be a non-haemolytic non gelatine liquefier. The antibiogram of DMA18 revealed that it was sensitive to most of the antibiotics tested but resistant to Vancomycin.HorrelElliker test graded the culture as a slow starter.The ability to ferment citrate signifies the flavour production potential. The isolate(6µl) and EPS(0.016mg)extract showed a scavenging effect of 28.5% and 31.5% respectively.
Conclusion:Theobservations demonstrated that *W.cibaria* DMA has ample scope to be industrially exploited.
Key words:*W.cibaria* DMA 18,exopolysaccharide, antioxidant ,ABTS

01-11

EFFECT OF *KUNAPAJALA,* AN ORGANIC LIQUID MANUREON YIELD AND SOIL HEALTH OF BHINDI *(Abelmoschusesculentus*L. Moench.)

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Kunapajala is fermented liquid organic manure mentioned in Vrikshayurvedha and now a days popular among farmers. Two types of *Kunapajala, viz*; herbal and non-herbal getting pace. A field experiment was conducted to evaluate the soil and foliar efficacy of 2% and 5% herbal and non- herbal *Kunapajala* on plant growth by using bhindi as a test crop.Soil and foliar application of 2% and 5% herbal and non- herbal *Kunapajala* along with 50% N as FYM was compared with Panchagavya, Fish amino acid and inorganic fertilizers.Foliar application of 5% non-herbal *Kunapajala*(T_{13}) recorded the highest growth and yield number of fruits per plant (25.5), length and girth of fruits and yield (20.78 t ha^{-1}) of bhindi. The soil analysis revealed that application of non- herbal *Kunapajala* improved the soil health in terms of soil chemical and biological properties. The highest NPK contents were observed in T_{13}. Treatment T_{13} recorded highest mean values for all macronutrients, micronutrients and enzymatic activity and soil microbial count. The foliar application of 2% or 5% non-herbal *Kunapajala* can reduce the dose of FYM to half without sacrificing the yield. Present study confirmed that *Kunapajala* is a promising, eco-friendly, innovative and low-cost plant stimulant for sustainable crop production and safe agroecosystem.

01-12

CARBON SEQUESTRATION POTENTIAL OF HYBRID NAPIER

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Background: Fodder grasses have a role in carbon sequestration and they produce huge biomass by capturing atmospheric carbon dioxide. The mitigation potential of improved grassland and cropland management is about 1350–1450 million tonnes CO_2 equivalents per year.Hybrid napier is a popular fodder grass among dairy farmers all over Kerala because of its high yield potential, quality and adaptability to tropical conditions.
Method: The experiment was conducted to assess the influence of growing conditions such as open and coconut garden on growth and soil carbon sequestration potential of hybrid napier. The composite soil samples were drawn from 0-15 cm depth from experimental area and bulk density and organic carbon content of soil were analysed by standard analytical methods. The soil carbon sequestration was calculated in terms of increase in carbon stock in soil. SCSP = SOC x BD x T, Where SCSP-Soil Carbon Sequestration Potential(t ha^{-1}), SOC-Soil organic carbon (%), BD-Bulk Density (Mg m^{-3}), T-Thickness of surface layer (cm).
Results: Soil organic carbon was significantly higher in open area (1.06 %) than in coconut garden (0.96%).

The increase in soil carbon sequestration was 21.05 per cent in open area compared to coconut garden (25% shade).This increase in SOC might be due to the higher growth and yield of hybrid napier which sequestered atmospheric CO_2 in to the plants and in turn returns the organic carbon in to the soil.
Conclusion: From the results of the study , it can be concluded that cultivation of fodder crops like hybrid napier provides an excellent opportunity to accumulate CO_2 from atmosphere helping to mitigate climate change along with year round production of fodder and income generation to farmers.
Keywords: Carbon sequestration, Hybrid Napier, Soil organic carbon

01-13

SYNERGISM IN DEFENSE AND GROWTH: THE ROOT ENDOPHYTIC FUNGUS *PIRIFORMOSPORAINDICA*CONFERS ENHANCED TOLERANCE TO *FUSARIUM* WILT IN BANANA WITH INCREASED GROWTH

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Background: Banana is a major fruit crop of Kerala which is severely affected by ***Fusarium* wilt (Panama wilt)** leads to extensive yield loss and is difficult to manage. Beneficial root-colonizing endophytic basidiomycete fungus, *Piriformosporaindica* results in enhanced plant growth and yield in addition to conferring resistance/tolerance to (a)biotic stress in crop plants. Present study elucidates the role of *P. indica* against *Fusarium*wilt in banana.
Method: Work deals with standardization of the co-cultivation of *P. indica* with major TC banana varieties and optimum stage of TC plants for priming of *P. indica*, evaluation of the primed banana seedlings against *Fusariumoxysporum* f. sp. *cubense* (*Foc*), compatibility study of *P. indica* with commonly used pesticides in banana cultivation and mass multiplication of *P. indica* in organic substrate.
Result:*P. indica* root colonization in TC banana plantlets enhanced the root and shoot biomass, thus promotes growth and establishment of the plantlets in the field. *P. indica*-colonized or -primed TC plants produced more number of leaves with increased leaf area. *P. indica* could successfully antagonize the most virulent isolate of *Foc*through antibiosis, lysis, coiling and overgrowth. *P. indica*-colonized/-primed seedlings could tolerate/inhibit the infection of the Fusarium wilt pathogen successfully, thus helps in the establishment of the primed plantlets in the field. Pot culture experiments demonstrated cent per cent protection of the plants from *Foc.P.indica* is compatible with most of the insecticides and also standardized the mass multiplication of *P. indica*in organic substrates with more than one year shelf life.
Conclusion: The present study demonstrated that the root endophytic fungus *P. indica*conferred enhanced tolerance to *Fusarium* wilt in banana with increased growth.
Keywords: *Piriformosporaindica, Fusariumoxysporum* f.sp. *cubense* (*Foc*), Growth promotion
Acknowledgement: *Kerala State Council for Science, Technology and Environment (KSCSTE) for funding the project and Kerala Agricultural University for providing facilities.*

01-14

ALLELOPATHIC EFFECT OF *WEDELIATRILOBATA L* AGAINST COMMON RICE VARIETIES IN KERALA

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Background: Allelopathy is a biological phenomenon where one plant inhibits the growth of another. Some allelopathic plants can be used to control weeds by producing allelochemicals since it affect morphology,

physiology and biochemistry of other plants. The proposed work utilized the allelopathic activity of the highly invasive creeping plant, *Wedeliatrilobata L.*, against rice varieties and an attempt was made to isolate responsible allelocompounds from the petroleum ether extract of leaves.

Method: The present study focused on the determination of possible allelopathic effect of six commonly used varieties of rice (*Oryza sativa*) found in two different regions of Kerala (Jaya, MattaTriveni and Akshaya from Palakkad region and Dhanya, Bhagya and Triveni from Kayamkulam region) against the aqueous leaf extract of wedelia (25%, 50% and 75%) by petridish bioassay. The parameters such as shoot length, root length, fresh weight and dry weight were analyzed.A one-way analysis of variance (ANOVA) was performed using IBM SPSS Statistics, Version 20) to compare means according to Least Significant Difference (LSD) at a 0.05 level of probability.

Result: The germinated rice seedling of the selected varieties was significantly inhibited by the allelopathic effect of aqueous extract of wedeliawhich was much more pronounced at higher concentrations. Among the varieties, MattaTriveni from Palakkad and Triveni from Kayamkulam have found to be highly inhibited. The LC-MS-MS analysis of the Petroleum ether extract of wedelia leaf powder revealed that the allelopathic potential of *W. trilobata* is due to the presence of diterpene and coumarin derivatives along with sesquiterpene lactones.

Conclusion: The future prospects of the present study suggested a promising tool for the controlling of O.rufipoganby *W.trilobata L.*, The allelopathic compounds isolated from wedelia can be used as natural herbicide and they are less disruptive to the ecosystem.

Keywords:*Oryza sativa*, *Wedeliatrilobata L.,*allelopathy, allelochemicals, herbicides

01-15

IDENTIFICATION OF NOVEL PROTEASE INHIBITOR FROM THE SEEDS OF *HIBISCUS ACETOSELLA*AGAINST THE LARVAL GUT PROTEASES OF *SPODOPTERA LITURA* FABRICIUS

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Background: Pest menace and its control is an integral part of any agricultural practices. Apart from their booming health hazards, extensive use of chemical pesticides have led to the development of resistance in the pests against a wide variety of pesticides and insecticides. Plant protease inhibitors (PIs) are the natural defensive mechanisms in the plants which are being exploited for pest control. Unlike the conventional chemical control methods which are designed to kill the insects that feed, plant PIs rather retard their development which do no endeavour any selection pressure. Thus minimises the chance of resistance development against the PIs. Moreover the PIs are more target specific.Since it is much safer method of pest control, identification and purification of novel protease inhibitors is beneficial.

Method: In this work protease inhibitory activity of the seed extract of *Hibiscus acetocella* was checked using protease inhibition assay where azocasein was used as substrate.The total proteinase activity was assessed by incubating 5µl of crude gut extract with a final concentration of 11.48µg/µl azocasein as substrate in 100 mM bicarbonate buffer, pH 9.0 at 37°C for 30 minutes in a total volume of 20.2µl. After incubation, the reaction was stopped by adding 80 µl of 5% Trichloro acetic acid (TCA) , centrifuged at 10,000g for 10 minutes and 50 µl of the supernatant from each tube was mixed with 150 µl of 50mM NaOH. Proteolytic activity was measured at 440nm in a Microplate reader. All assays were done in triplicate.

The protein nature of the inhibitor was confirmed by proteinase K treatment. For this 90µl of plant extract incubated with 2.3µg of Proteinase K at 56°C overnight followed by heat inactivation of the Proteinase K enzyme by heating the mixture at 96°C for 5 minutes. Appropriate controls were maintained

Purification of the inhibitor was done by subjecting the 50% ammonium sulphate fraction (fraction with highest inhibition) to ion exchange chromatography using Source Q (cation exchanger) 5ml column in a

Biorad NGC Quest Plus FPLC system .The fractions were eluted with a gradient of 25mM Tris buffer with 500 mMNaCl(pH 8.1) with a flow rate of 0.5 ml min^{-1}.Peak fractions from the column were checked for the protease inhibition pooled and concentrated using amicon UF-3kDa membrane.The purity of the inhibitor was checked by running SDS PAGE. The ion exchange purified and concentrated product was subjected for final purification with trypsin affinity chromatography.

Results:

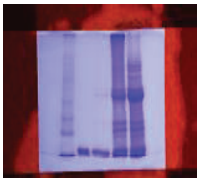

Fig 1: SDS PAGE (Reducing 10%) profile of the purification steps
Lane 1. Protein marker
Lane 2. Purified inhibitor
Lane 3. Elute from SourceQ column
Lane 4. 50% ammonium sulphate fraction
Lane 5.Crude seed extract of *Hibiscus acetosella*

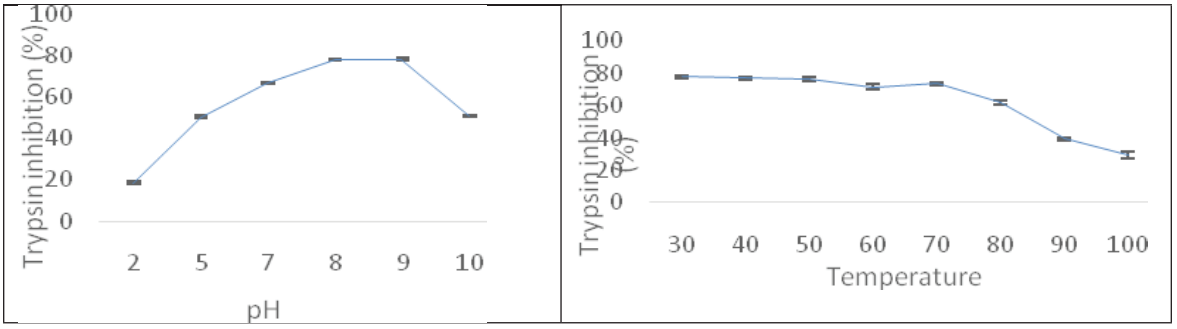

Fig 4: pH stability of purified HAPIFig 3: Thermal stability of purified HAPI

Conclusion: The protease inhibitor purified from *Hibiscus acetosella*is of 25kDa in size (Fig 1). It exhibited 65% of stability between pH 5.0 and 10.0 (Fig 2) and maximum stability at 40°C. After 70°C the stability of the inhibitor began to decline gradually (Fig 3). It inhibited the gut protease activity of *S.litura*upto an extent of 84.61±0.97%. The percentage inhibition of the inhibitor increased significantly with each purification step. The activity of the purified fractions were evaluated using azocasein. The specific activity achieved was 600 fold more than that of crude extract with a yield of 2.2 µg/g seed.

Keywords:*Hibiscus acetosella*, gut protease inhibitor, *Spodopteralitura.*

01-16

SUITABILITY OF DIFFERENT CROPS UNDER HYDROPONICS FODDER PRODUCTION SYSTEM

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Background: In India, especially Kerala, as the gap between the demand and supply of green fodder is becoming wide, researchers and farmers are in search of an alternative fodder or fodder production method. In this juncture, hydroponics fodder production emerged as a promising technology for green fodder production.

Method: The experiment was aimed to identify suitable fodder crops from ten crops *viz.*, rice, barley, maize, wheat, sorghum, bajra, ragi, cowpea, horse gram and green gram. The crops were grown in a low cost hydroponics structure made of pvc pipes with 2m x 1.3m x 1.8m length, breadth and height with four shelves and automatic sprinkler irrigation system. The seeds were soaked in 0.1 percent sodium hypochlorite for 12 hours, and tied in gunny bag and kept for germination for 24 hours. The seeds were then transferred to trays

following a seed rate of 200 g ft^{-2} (2.15 kg cm^{-2}). The total yield of green fodder was recorded at harvest and it was sampled for proximate analysis.

Results: Among the crops, maize recorded highest B:C (2.51) ratio and net income. Considering yield and quality, green gram recorded significantly superior GFY (10.17 kg kg^{-1}seed), protein content (20.97 %), lowest values for fibre and ash, and a B:C ratio more than 1.0.

Conclusion: Considering growth parameters, yield attributes, quality and economics, maize and green gram were found to be the best among the ten crops grown in hydroponics fodder production system.

Key words: hydroponics, fodder, maize, low cost hydroponics system

01-17

SEVERITY, HOST RANGE AND MANAGEMENT OF *COLLETOTRICHUMGLOEOSPORIOIDES* CAUSING ANTHRACNOSE OF VEGETABLE COWPEA

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Background: Cowpea is a popular vegetable consumed in Kerala, but anthracnose caused by *Colletotrichumgloeosporioides* reduces the yield upto 60 per cent. Present study envisages tofind the most virulent strain of *C. gloeosporioides*, its host range, and management using new generation fungicides with high specificity and efficiency at low dosage.

Method: Thework deals with isolating the pathogen from different agro-ecological zones of Kerala, studying the symptomatology, screening the most virulent isolate by artificial inoculation, host range of the virulent isolate on vegetable crops, screening selected high yielding cowpea varieties to the disease and testing new generation fungicides for its management by poison food technique.

Results: The disease severity and Per cent disease Index (PDI) ranged from 16.67 to 51.33 % and 23.56 to 73.50% in different agro-ecological zones of Kerala. The pathogen produced greyish white colonies with hyaline and bullet shaped conidia. Cg1 isolate from Vellayani(Thiruvananthapuram) was the most virulent isolate and when tested on common vegetables, cucumber, tomato, chilli, amaranth, brinjal, bitter gourd, beans, winged bean and pumpkin developed typical symptoms of anthracnose. ArkaGarima, Lola, VellayaniJyothika and Githikaweresusceptible on artificial inoculation of the pathogen. A new generation combination fungicide, Trifloxystrobin 25% + Tebuconazole 50% at very low dosage recordedmaximum inhibition of the pathogen compared to other fungicides.

Conclusions: Anthracnose of vegetable cowpea caused by *C. gloeosporioides*ispresent in moderate to severe form in Kerala with a host range in cucumber, tomato, chilli, amaranth, brinjal, bitter gourd, beans, winged beanand pumpkin. New generation combination fungicide Trifloxystrobin 25% + Tebuconazole50% is effective for its management.

Keywords:*C. gloeosporioides*, screening, host range, varietal evaluation, new generation fungicides

Funding: Kerala Agricultural University and Jawaharlal Nehru Memorial Fund

01-18

IN VITRO ROOTING OF BANANA MUSA (AA) 'KADALI' THROUGH *IN VITRO* MALE BUD CULTURE

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Male buds of banana can be used as a potential explant for*in vitro* shoot regeneration.The present investigation was undertaken to study the effect of different concentrations of sucrose and IBA on rooting in Kadali variety

of banana. The shoots which are developed on Murashige and Skoog medium (full MS and half MS) was inoculated on same medium supplemented with combinations of sucrose (1.5 % and 3.0%) with IBA (1.0, 2.0, 3.0 and 4.0 mgL^{-1}). With regard to different treatments, results revealed that banana cv. Kadali recorded minimum number of days for root initiation and produced higher number of roots in full MS medium with 3 per cent sucrose and IBA 1.0 mgL^{-1}. The longest root was observed in the combination of half MS with 1.5 per cent sucrose and IBA 3.0 mgL^{-1} and 3.0 per cent sucrose and IBA 1.0 mgL^{-1} under full MS. Well rooted plants were hardened after potting in pro trays containing 1:1 (v/v) sterilized coco peat and vermiculite. After one month of planting out, 90 per cent of the plants were found to survive.

01-19

SEWAGE SLUDGE COMPOST AS A GROWTH MEDIUM FOR MARIGOLD

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Background: The massive volume of municipal sewage sludge generated in the sewage treatment plant Muttathara, Thiruvananathapuramaffects the functioning of the treatment plant and is recognized as "a future waste problem". Thereis an urgent need to develop environmentally and economically acceptable novel approaches for the safe disposal and better utilization of sewage sludge.The best option is to use this sludge for crop production.The study will open a new frontier for utilization of sewage sludge generated at sewage treatment plant Muttathara.
Method: This work deals with the preparation of different sewage sludge composts using sewage sludge, bulking agents, heavy metal adsorbent and liming materials for 60 days. Prepared composts were analysed for primary nutrients and the suitability of the compost for growing medium were analysed by using marigold as a test crop.
Results: Sewage sludge generated from sewage treatment Muttathara was rich in plant nutrients. Composting of sewage sludge increased the nutrient content of sludge. Analysis of the initial and final growing media revealed that nutrient content decreased in the final growing media than the initial growing media. Compost prepared by using sewage sludge, sawdust, zeolite and flyash was found to be superior in plant growth and floral parameters.
Conclusion: Based on the findings it can be concluded that sewage sludge from sewage treatment plant Muttathara after composting with sawdust, zeolite and flyash for 60 days can be used as a component of growing medium for ornamentals (1:1 ratio mixed with potting mixture)
Keywords: Sewage sludge, compost, growth media, yield.

01-20

EFFECT OF BENZYL ADENINE (BA) ON *IN vitro* BUD PROLIFERATION IN IVYGOURD (*Cocciniagrandis* (L.) Voigt.) VARIETYSULABHA FROM NODAL EXPLANTS

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Background: The main problems associated with the cultivation of ivygourd include the shortage of seedling material from cuttings of mature stems and unrestricted exploitation by the pharmaceutical industries leading

to depletion of this valuable genotype. This limits the scope of commercial level cultivation of this crop.
Method: Shoot tips and nodal segments were taken as explant and were treated with 70% alcohol for 30 sec followed by surface sterilization using mercuric chloride 0.1 % for 3 minutes. Sterilized nodal explants of 1-2 cm length were inoculated in basal MS medium supplemented with BA(0.1- 1 mg L^{-1}) for bud proliferation and multiple shoot induction.
Results: MS + BA 1 mg L^{-1} was found to be significantly superior to all other treatments with respect to days for bud initiation (5.50 days), number of shoots per explant (1.75), shoot length (5.71 cm) and percentage of response (100 %).
Conclusions: We can establish a rapid and reproducible *invitro*regeneration system with less cost and high frequency survival success of regenerated plants through nodal explants of *C. grandis,* as an alternative to vegetative propagation through stem cuttings.

01-21

STUDY OF POSTHARVEST CROWN ROT OF BANANA IN KERALA AND THE PATHOGENS INCITING THE DISEASE.

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Background: Banana (*Musa* spp. L.) is the most important fruit crop in Kerala. Post-harvest diseases reduce the market value of bananas and cause huge losses of production intended for export. Crown rot of dehanded banana is a major threat causing losses during storage and marketing. Even though the infected fruits are safe for human consumption; the infection reduces its fruit quality, shelf life and marketability.
Method: Banana fruits of variety Robusta with typical crown rot symptoms were collected from the local markets of major banana growing districts of Kerala viz., Thiruvananathapuram, Alappuzha, Pathanamthitta, Palakkad and Wayanad. Diseased fruit specimens were brought to the lab and symptoms were studied. After the symptomatology studies, the diseased fruits were subjected to pathogen isolation. The pure cultures of the isolated fungi were subjected to pathogenicity tests and virulence rating.
Result: All the samples collected from different locations showed the incidence of crown rot. This indicates 100 per cent prevalence of crown rot in all the surveyed places and the crown rot incidence was higher during the summer and was found to be declining during the coldest months. Thirty two fungal isolates were obtained as pathogen and the morphological studies revealed that out of the 32 isolates obtained, ten were identified as *Lasiodiplodia* sp., eight as *Colletotrichum*sp., five as *Fusarium* sp., three as *Aspergillus* sp., two as *Cunninghamella* sp., two as *Verticillium* sp., one as *Penicillium* sp. and one as *Rhizopus* sp. In case of *Lasiodiplodia*sp.,rotting started at crown region and later covered whole fruit with fluffy mycelia. Oozing of liquid was also observed in the diseased fruits.
Conclusions: From this study, it could be interpreted that *Lasiodiplodia*sp. was the major pathogen and *Lasiodiplodiatheobromae*(Percent Disease Incidence 100 %) was the most virulent pathogen associated with postharvest crown rot disease of Robusta variety in Kerala.This calls for an urgent need to formulate an effective strategy for the management of postharvest crown rot of banana.
Keywords: Crown rot, postharvest disease, *Lasiodiplodia* sp., Banana

01-22

GENETIC VARIABILITY STUDIES FOR YIELD AND YIELD CONTRIBUTING TRAITS IN BLACK GRAM(*Vignamungo*(L.) Hepper)

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Background: Pulses are a wonderful gift of nature, also known as grain legumes, are the major source of protein in Asia and constitute an important supplement to the predominantly cereal-based diet (Sahoo and Jaiwal, 2008). Among pulses, urdbean is an important short duration legume cultivated over a wide range of agro-climatic conditions.It is well known that 50 g pulses/person /day should be consumed in addition to other sources of protein such as cereals, milk, meat and egg which is a very difficult task to achieve as the production and productivity of pulse crop including black gram is very low.
Methods: The experimental material comprised of 32 genotypes from different sources was evaluated during *rabi*2017–18 at Research and Education Farm, Department of Agril. Botany, College of Agriculture, Dapoli, Dist. Ratnagiri, Maharashtra state. The experiment was laid out in randomized block design (RBD) with three replications. A plot size of three rows each with a row length of 2.4 meter per replication with a spacing of 30 X 20 cm was adopted.
Results: The analysis of variance revealed significant differences among the genotypes for all the traits studied indicating the presence of genetic variability within the genotypes for the thirteen characters studied showing an ample scope for selection of desirable genotype from the present gene pool for increasing yield and productivity of black gram.
Conclusions: The characters such as seed yield per plant, plant height, number of pods per plant, number of clusters per plant, protein content and number of primary branches per plant showed wide range of variability; hence selections based on the traits could improve productivity in black gram directly.
Keywords: Variability, Mean, PCV, GCV, Heritability, Genetic advance

01-23

ASSOCIATION OF OKRA ENATION LEAF CURL VIRUS WITH BHINDI YELLOW VEIN MOSAIC DISEASE IN KERALA

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Background: Okra is a commercial vegetable crop in the Indian subcontinent and globally ranks first in production. Yellow vein mosaic disease of okra caused by a begomovirus complex has become major constraint for okra cultivation and production in the Indian subcontinent (Jose and Usha, 2003). Information regarding the different strains associated with the disease from different geographical regions would help to develop the strain specific diagnostics of the virus
Methods:A sampling survey was conducted in eleven different locations in Kerala. Transmission of the virus through seed, vector and grafting was carried out. The molecular detection and characterization of the virus was carried out through DNA isolation from symptomatic leaves and PCR amplification of the core coat protein gene of the virus using reported primers.
Results: The virus was transmitted through insect vector, *Bemisiatabaci*and also through grafting. The PCR amplification of the core coat protein gene of the virus yielded amplicons of expected band size of about 550 bp. Homology analysis of the sequences were carried out using the BLASTn program and revealed that the virus has 99-100 per cent sequence similarity with okra enation leaf curl virus.

Conclusion: The virus associated with bhendi yellow vein mosaic disease in Kerala is identified as okra enation leaf curl virus which is transmitted through grafting as well as insect vector, *Bemisiatabaci.*

Keywords: Bhendi, Yellow vein mosaic disease, Okra enation leaf curl virus, PCR

01-24

GROWTH AND YIELD ENHANCEMENT IN BANANA CV. NENDRAN (MUSA AAB) THROUGH MICRONUTRIENT MIXTURE APPLICATION

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Background: Banana is a high nutrient requiring crop. It requires a continuous supply of nutrients at proper growth stages for enhanced yield and productivity. The unscientific crop management practices being adopted by farmers led to poor utilization of nutrients and thereby resulted in low productivity. Due to low organic matter in the soil, introduction of high yielding cultivators and fast growing tissue culture plants, deficiency of micronutrients has become a major problem in banana cultivation.

Method: Thetrial was conducted in Kollam district during 2016-17, for assessing the effect of foliar and soil application of micronutrient mixtures in banana for yield enhancement. Different treatments tried under the trial were T_1-Farmers practice , T_2-(recommended dose of fertilizers as per POP along with Sampoorna KAU multimix applied at the rate of 10 gl^{-1} at 2,4, 6 and 8 months after planting}) and T_3- (recommended dose of fertilizers as per POP along with Ayar applied at the rate of 100 g per plant at 2 and 4 months after planting).

Results: Soil application of ayarapplied at the rate of 100 g per plant at 2 and 4 months after planting along with recommended dose of fertilizers as per POP resulted in highest yield (40 t/ha) , benefit cost ratio (1.61) and less pest and disease incidence in banana variety Nendran . The highest psuedostemheight and functional leaf number at 2MAP, 4MAP and 6 map was reported from Ayar followed by foliar application of Sampoorna KAU multimix applied at the rate of 10 gl^{-1} at 2,4, 6 and 8 months after planting and lowest in farmer's practice. The earliest bunch emergence was also noted in Ayar applied banana. Crop duration was more in farmers practice and lowest in ayar application. Number of hands $bunch^{-1}$ was more in ayar application followed by Sampoornaapplication and lowest in farmer practice.

Conclusions: It was concluded from the study that micronutrient application is essential for attaining higher yield in banana.Soil application of ayarapplied at the rate of 100 g per plant at 2 and 4 months after planting along with recommended dose of fertilizers as per POP resulted in highest yield (40 t/ha) , benefit cost ratio (1.61) and less pest and disease incidence in banana variety Nendran .

Keywords: Banana, Micronutrient,Deficiency,Ayar,Sampoorna

01-25

INFLUENCE OF ORGANIC MANURE SEED PELLETING ON YIELD AND NUTRIENT UPTAKE OF RICE

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Background: Seed pelleting is a technique of seed encapsulation with inert materials to change their size and shape.Seed pelleting aid in rigorous application of nutrients, accelerate germination and seedling emergence which is beneficial over conventional dibbling method. Organic manure seed pelleting method is gaining popularity among farmers but only few works have been done on seed pelleting of rice using organic manures. The study entitled'Influence of organic manure seed pelleting on yield and nutrient uptake of rice', variety Uma, was carried out in the Department of Soil Science and Agricultural Chemistry, College of Agriculture,

Vellayani.

Method:A pot culture experiment was carried out in Completely Randomized Design (CRD) with eight treatments and four replications. Treatments consisted of seed pellets prepared with combination of FYM, *Azospirillum* and Phosphobacteria (T_2), vermicompost, *Azospirillum* and Phosphobacteria (T_3), bioslurry flakes, *Azospirillum* and Phosphobacteria (T_4), charcoal, *Azospirillum* and Phosphobacteria (T_5), fly ash, *Azospirillum* and Phosphobacteria (T_6), pongamia leaf powder, *Azospirillum* and Phosphobacteria (T_7), bioslurry, plant extracts, *Azospirillum* and Phosphobacteria (T_8: Farmer practice). Seeds alone without pelleting was used as control (T_1).Carrier based inoculum of *Azospirillum* and Phosphobacteria were used at the rate of 5 g kg^{-1} and fenugreek paste was added at the rate of 25 g kg^{-1} as adhesive.

Results: The highest grain and strawyieldwererecorded by the treatment vermicompost, *Azospirillum* and Phosphobacteria. Regarding the uptake of nutrients, the treatment vermicompost, *Azospirillum* and Phosphobacteria registered the highest uptake of N, K, Ca, S, Zn, Cu, B and Si in grain and shoot.P uptake in grain was highest in the treatment bioslurry flakes, *Azospirillum* and Phosphobacteria while the treatment vermicompost, *Azospirillum* and Phosphobacteria had the maximum uptake in shoot.

Conclusion: From the study, it was concluded that organic manure seed pelleting using vermicompost, *Azospirillum* and Phosphobacteria significantly increased the yield and nutrient uptake.

Key words: organic manure, nutrient, seed pelleting, uptake, yield

01-26

READY TO USE PONGAMIA OIL SOAP: A BIORATIONAL INSECTICIDE FOR CONTROLLING OKRA SHOOT AND FRUIT BORER

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Background: Pongamia oil soap is a ready to use botanical product made of pongamia oil which contains active flavonoids like karanjin and pongamolwhich possess insecticidal properties. It has antifeedent properties similar to neem*oil* and act against a number of insect pests. Pongamiaoilisalso safe to humans and other mammals.

Method: A field study was carried out in the instructional farm, College of Agriculture, Padannakkad for two seasons (rabi and summer) during 2018 – 2019 with four replications and seven treatments in Randomized Block Design. Pongamia oil soap at 0.6, 1 and 2 per cent were applied once at vegetative stage, 30 DAS and twice at reproductive stage, 55 and 80 DAS along with a standard check (Quinalphos 25 EC @ 0.05%), neem oil soap 0.6 %, soap solution 0.5%and control. Damage symptoms caused by okra shoot and fruit borer, *Eariasvitella*were observed at one day prior to and 7 and 14 DAA.

Result: In the present study highest concentration of pongamia oil soap (2 %) proved to be the best treatment with only 6.7 and 12.5 % of fruit damage and 12.6 and 13.13 % of shoot damageduringrabi and summer season respectively. However quinalphos 0.05 per cent (standard check) treated plot showed the maximum reduction with only 4.79 and 8.04 per cent of fruit damage and 9.58 and 5.10 per cent of shoot damage. It was followed by pongamia oil soap 1 per cent. Neem oil soap and pongamia oil soap at 0.6 per cent gave statistically similar results indicating similar insecticidal properties of pongamia oil with that of neem oil. Soap solution 0.5 per cent showed results which was statistically similar to control stating that the reduction in fruit damage is completely due to the insecticidal properties of pongamia oil. The effectiveness of the soap declined seven days after the spray application. Reduction in fruit and shoot damage by pongamia oil soap applicationmay be due to its insecticidal properties on larval stages and feeding deterrency. Pongamia oil soap 2 per cent proved its efficacy against *E. vitella*resulting in highest marketable fruit yield after the standard check.

Conclusion: Application of pongamia oil soap 2 per cent proved effective in reducing the damage symptoms caused by okra shoot and fruit borer which helped in procuring higher marketable yield and found to be an ideal biorational insecticide.

Keywords: Pongamia oil soap, okra shoot and fruit borer, marketable yield, biorational insecticide

01-27

SPATIAL VARIATION OF SOIL FERTILITY FOR PRECISION AGRICULTURE IN THE AGRO ECOLOGICAL UNITS OF THRISSUR DISTRICT KERALA

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Background: To deal with the global and regional controversies including food security, climate change, land degradation, biodiversity loss, water resource management and ecosystems health, detailed accurate spatial soil information is urgently demanded. The present study suggested that the geostatistical model can directly displayed the spatial variability of soil properties in Thrissur district and will help farmers and decision makers for improving site - specific nutrient management in precision agriculture.
Method: Exploratory Spatial Data Analysis (ESDA) using ArcGIS 10.2.2 was used to portray the spatial structure of the soil properties of 600 georeffered soil samples such as pH, EC, OC, N, P, K and micronutrients such as Cu, Fe, Mn, Zn and B. The semivariogram modeling in ordinary kriging was used to the quantification of spatial dependence of the selected soil properties based on the values of Relative Nugget Effect % (RNE %).
Results: The semivariogram best fit model was selected for all the above soil properties on accordance with the goodness of fit (r^2) values. Gaussian model for pH, Zn, B and Mn; exponential model for OC, K and Fe; circular model for P and Cu; spherical model for N; and model stable for EC.
Conclusion: The values of RNE % proclaimed moderate spatial dependence of all the soil properties except K, B and Zn, where K and B conveyed strong spatial dependence and Zn indicated weak spatial dependence. The moderate and weak spatial dependence recommends for developing site - specific nutrient management taking into account various stochastic factors (fertilization, soil erosion, management practices etc.) Strong spatial dependence of K and B need uniform management in the study area as it was affected by the structural factors (climate, parent material, topography etc.) only.
Keywords: Precision agriculture, spatial variation, spatial dependence, site – specific nutrient management

01-28

CHARACTER ASSOCIATION STUDIES AND PATH COEFFICIENT ANALYSIS IN HORSEGRAM GENOTYPES

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Background: Horsegram[*Macrotylomauniflorum* (Lam.) Verdc.], an underutilized and hardy pulse crop of the semi-arid tropics,plays a vital role in eradicating malnutrition, maintaining nutritional security and generating income for the rural poor owing to its exceptional nutritional profile, drought-resistance and general hardiness. The popularity and productivity of this crop can be increased by evolving high yielding varieties, for which knowledge of association of yield with other characters will be of immense help.
Method: Fifteen genotypes of horsegram were taken for the study and were raised in beds with a spacing of 30 x 25 cm. Each genotype was considered as an individual treatment. Correlation coefficients were worked out for 14 different quantitative characters using Falconer formula and path coefficient separated the correlation coefficients into direct and indirect effects of component characters on yield using a method developed by Wright.
Results: Seed yield plant^{-1} was found to be significantly and positively correlated with number of primary branches plant^{-1}, number of secondary branches plant^{-1}, nodes plant^{-1}, pods plant^{-1}, seeds pod^{-1} and 100-seed weight both at genotypic and phenotypic levels. Path coefficient analysis revealed that number of pods plant^{-1},

seeds pod^{-1}, nodes plant^{-1}, 100-seed weight, days to maturity and number of primary branches plant^{-1} were the primary yield contributing characters due to their high direct effect on seed yield plant^{-1}.

Conclusions: Based on these results obtained, it would be easier for the plant breeder to evolve efficient breeding strategies so that the useful associations could be effectively exploited for the development of a superior variety.

Keywords: Genotypic correlation, Path analysis, Seed yield, Quantitative characters

01-29

INSECTCIDAL ACTIVITY OF LYSINIBACILLUS SPHAERICUS AGAINST BANANA PSEUDOSTEM WEEVIL(BPW)ODOIPORUS LONGICOLLIS OLIV.

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Background: Bananapseudostem weevil (BPW) *Odoiporuslongicollis*(Olivier)(Coleoptera:Curculionidae) is a noxious pest of Banana (Musa sp.). Farmers use chemical pesticides against this pest like carbofuran they will cause harmful effects to agriculture and also carcinogenic to humans.The present study aims to find out the insecticidal activity of *Lysinibacillussphaericus,*a diazotrophicendophyteisolated from rice plant, against the pseudostem borer.The culture supernatant showed potential insecticidal activity. The culture supernatant was subjected to mass spectroscopic analysis like FTIR,GC-MS to find out the active fraction of the metabolite with potential insecticidal activity. SEM analysis of dead remains of grubs clearly showed **Method:**Evaluation of insecticidal activity of the Lysinibacillus strain against odoiporuslongicollis by direct exposure methods,Supernatant and pellet activity.Extraction of crude metabolites from the strain for the analysis of presence of compounds in it. **Results**:The bacterial strain showed high percentage of mortality in the supernatant activity than the pellet activity.Different compounds extracted through FT-IR and GC-MS. **Conclusions:** The *Lysinibacillussphaericus* showed activity against banana pseudostem weevil (BPW) *Odoiporuslongicollis*Oliv.So it can be used as an effective insecticidal agent against the pseudo stem borer.The activity of the bacteria is may be due to the metabolic compounds produced from it.From the results of SEM,FTIR and GC-MS it is clear that the activity against the target pest.Further studies are needed for the application of this strain in agriculture fields.

Keywords: Biopesticide, *Lysinibacillussphaericus,* banana pseudostem weevil, biocontrol,*Odoiporuslongicollisoliv*

01-30

PHYSIOLOGICAL CHANGES IN AEROBIC RICE VARIETIES IN RESPONSE TO ELEVATED TEMPERATURE

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Background: Global mean surface air temperature increased by about 0.5 ºC in the 20thcentury and may further increase by 1.5 to 4.5 ºC in this century.It is reported that the grain yield will decline by 10 percent with an increase of 1ºC in minimum temperature (Peng*et al*., 2004).Cultivation of high temperature-tolerant varieties is one of the most effective counter measures to maintain high productivity and stability of rice under anticipated climate change.

Methods:A pot culture experiment was conducted with four different varieties and high temperature stress

imposed at different stages of crop growth. The design was factorial CRD with sixteen treatment combinations and three replications. The treatments included were four aerobic rice varieties, 'Swarnaprabha', 'Sharada' (MAS 946-1), 'Vaishak', 'MDU-6' and high temperature stress was imposed at different growth stages of rice plant, from tillering to panicle initiation, panicle initiation to flowering and flowering to maturity. 'No stress' control was also included for each variety.

Results: The variety Vaishak produced higher grain yield (13.81g/hill) compared to other varieties when stress was imposed at sensitive stage (flowering to maturity). The performance of this variety was superior under ambient condition also. Also the varietyVaishakh showed high values of soluble protein, nitrate reductaseacitivity, proline, and SOD under high temperature compared to other varieties, which explains its tolerance to high temperature

Conclusions: This study revealed that the variety Vaishak produced higher yield and physiological parameter which showed tolerance to elevated temperature.

Keywords: Elevated temperature, Aerobic, Rice, Yield, Physiology

01-31

INTEGRATED WEED MANAGEMENT IN BUSH TYPE VEGETABLE COWPEA *Vignaunguiculata*subsp. *unguiculata (L.) verdcourt)*

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Back ground: Cowpea is one of the most important leguminous vegetable crop grown in Kerala.Because of the slow initial growth and wider spacing, weed infestation is severe in bush type vegetable cowpea. The crop is infested by a variety of weeds species right from germination to harvest. Presence of weeds causes severe yield loss and also intensifies the disease and pest problems by serving as alternate host. Manual method is the most common method of weed control followed in vegetable cowpea. Non-availability of labour at right time, hike in wage rate and aberrant weather conditions limits its efficacy. In order to reduce the dependency on human labour for weeding it is essential to develop an integrated approach involving both chemical and non-chemical methods. Hence the present study is formulated.

Materials and method: Field experiment was conducted during *Kharif* 2019 (June to September 2019) at Coconut Research Station, Balaramapuram in Factorial Randomized Block Design with seed bed preparation as first factor and weed management practices as second factor in three replications. Seed bed preparation comprised of stale seed bed (s_1) and no stale seed bed (s_2) and weed management comprised of eight treatments *viz*., dried banana leaves @ 10 t ha^{-1} (w_1), dried banana leaves @ 10 t ha^{-1}fbimazethapyr 50 g ha^{-1} at 25 DAS (w_2), dried banana leaves @ 10 t ha^{-1} *fb*quizalofop p-ethyl 50 g ha^{-1} (w_3), post emergence application of imazethapyr at 15 DAS (w_4), preemergence application of diclosulam 12.5 g ha^{-1}*fb*quizalofop p ethyl 50 g ha^{-1} (w_5), preemergence application of diclosulam 12.5 g ha^{-1}fb hand weeding at 25 DAS, hand weeding twice at 20 and 40 DAS and weedy check.The variety used for the experiment was Bhagyalakshmyand spacing adopted was 30 cm x 15 cm. Seed rate adopted was 25 kg ha^{-1}. Lime was applied @ 250 kg ha^{-1}. Crop was fertilized with FYM @ 20 t ha^{-1}and N:P:K @ 20:30: 10 kg ha^{-1}. Dried banana leaves placed between the rows @ 10 t ha^{-1} on five DAS (days after sowing). Herbicides were applied as per the treatment using a flood jet nozzle. The spray fluid adopted was 500 L ha^{-1}. Weed count and weed density were recorded at 45 DAS. Pod yield was recorded and expressed in kg ha^{-1}. Economics was worked out based on the prevailing market price of the inputs and price of the pods (₹ 20 kg $^{-1}$). All data were statistically analysedand the treatment means were compared at 5 percent probability level.

Results: Seed bed preparation and weed management practice had significant effect on total weed density, weed dry weight and weed control efficiency. Stale seed bed recorded significantly lower weed density, dry weight and higher weed control efficiency, higher pod yield, economic returns and B:C ratio than normal

seed bed preparation (farmer practice). Adoption of weed management practices resulted in yield increase of 38.99 to 58.97 per cent. Among the weed management practices, mulching with dried banana leaf @ 10 t ha^{-1}fbquizalofop p-ethyl recorded the lowest weed density, dry weight and the highest pod yield, gross returns and B: C ratio and it was statistically comparable with mulching with dried banana leaf @ 10 t ha^{-1}*fb* post emergence application of imazethapyr 50 g ha^{-1} at 25 DAS. Mulching with banana leaf alone recorded higher grain yield than herbicide treatments and hand weeding treatment. Interaction between seed bed preparation and weed management practices was also found significant. The treatment combination, s_1w_3 (stale seed bed + mulching with dried banana leaf @10 t ha^{-1}*fb* post emergence of quizalofop p-ethyl 50 g ha^{-1} at 25 DAS) recorded the highest pod yield, gross returns, B:C ratio, and the lowest weed dry weight and weed density and the highest weed control efficiency.

Conclusion: The work establishes the effectiveness of banana leaf mulch in weed control in bush vegetable cowpea. Considering, the weed control efficiency, and economic returns, stale seed bed + mulching with dried banana leaf @ 10 t ha^{-1}fb post emergence application of quizalofop p ethyl or imazethapyr 50 g ha^{-1} can be adjudged the best treatments for higher yield in bush vegetable cowpea.

Key words: Dried banana leaf mulch, imazethapyr, stale seed bed,quizalofop p-ethyl

01-32

DIVERGENCE ANALYSIS OF CHINESE POTATO (*Solenostemonrotundifolius*(Poir) J.K. Morton) GENOTYPES COLLECTED FROM DIFFERENT LOCATIONS OF KERALA

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Coleus (*Solenostemonrotundifolius*(Poir) J.K. Morton), commonly known as Chinese potato, or 'poor man's potato' is a tropical multipurpose tuber crop species.D^2 analysis using a combined classification approach in respect of eight selected characters led to the discovery that the 30 genotypes studied could be grouped into ten clusters. The clustering specified that some genotypes belonging to the same locality got separated into different clusters and certain genotypes from different places got assembled in the same cluster. This leads to the conclusion that factors other than geographical diversity may be accountable for such clustering and that there was no parallelism between genetic diversity and geographic distribution.

Biological yield and average weight of tuber contributed maximum to the total divergence. The maximum cluster distance (2421.004) was observed between clusters IV and VIIand the minimum was recorded between cluster I and IX(199.084).Among the ten clustersconsiderable differences existed for all the characters under study. Cluster II had high mean value for tuber yield $plant^{-1}$(266.943), and harvest index (0.423). Cluster VI had highest number of tubers $plant^{-1}$(12.467). Cluster VII showed highest biological yield (1039.365). Cluster VIII had highest average tuber weight (33.18) and maximum plant height (85.13). Cluster IX exhibited least days to flowering (67.20). Cluster X recorded maximum tuber girth (13.17).

Divergence analysis is found to be a powerful tool in the hands of the plant breeder to assess the degree of dissimilarity among the genotypes and consequently to group them based on their phenotypic expression. The variability can be further expanded through induced mutation in representative samples taken from these clusters.

01-33

COMPARATIVE EFFICIENCY OF ORGANIC SOURCES IN REDUCING METHANE EMISSION FROM RICE FIELD

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Background: In the current scenario of climate change, wetland paddy fields act as major sources of greenhouse gases, especially methane (CH_4).The emission of greenhouse gases (GHG) results in a decrease in stored soil carbon and thus affects the process of soil carbon sequestration.
Method:A field experiment was conducted in rice crop to compare the efficiencies of various organic sources in curtailing the methane emission.The experiment was taken up at farmer's field in acidic sandy clay loam soil (Ultisol). The treatments consisted of organic sources like farmyard manure (FYM), *Artocarpus* sp. (ART) leaves, daincha (DNC), rice husk biochar (RHB) along with no organic manure (NOM). These were applied with inorganic nitrogen source, urea at different levels viz., 0, 35, 70 and 105 kg N ha^{-1} represented as N_0, N_1, N_2 and N_3 respectively. The gas samples from the experimental plots were collected using closed chamber method during *mundakan* season at three different stages of rice crop *viz*., active tillering, panicle initiation and near harvest. The samples were analysed for CH_4 content using gas chromatograph.
Results: The data revealed that at active tillering stage, the methane emission was maximum (15.30 mg m^{-2} hr^{-1}) from the plots with FYM as organic sourcewhile it was only 3.74 mg m^{-2} hr^{-1} in the plots with RHB. The rate of methane emission with biocharcould be curtailed to the tune of four times to that of FYM. Further in most of the cases, the emission rate decreased with higher doses of fertilizer. Among the three stages, maximum emission of methane was observed at panicle initiation stage from FYM treated plots(19.89 mg m^{-2} hr^{-1}). At near harvest stage, the methane emission was very meagre from all treatmental plots.
Conclusion: Biochar-amended soil showed reduced methane emission and hence low global warming potential (GWP) and this could be attributed to the biological stabilization of carbon and nitrogen in soil.
Keywords: Organic Sources, Methane Emission, Rice, Biochar

01-34

PERFORMANCE EVALUATION OF RICE VARIETIES AND THEIR RESPONSE TO ZINC NUTRITION IN UPLANDS

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Upland rice crops are grown in unbunded, unflooded field, where soil conditions in the root zone remain aerobic through most of the growing season. This system of rice cultivation which requires less water is an attractive, alternative which can be practiced successfully. Non availability of suitable upland varieties is the main drawback in the large-scale adoption of this system of rice cultivation in Kerala.Upland rice rhizosphere has aerobic condition. In aerobic system, iron oxidation by root released oxygen causes reduction in rhizospherepH. The reduced pH limits the release of zinc from highly insoluble fractions. Aerobic condition often accelerates organic matter oxidation, restricting zinc availability in soil solution. So, zinc management is an important factor in upland rice production systems. Hence the present study was formulated with an objective to the study the performance of different varieties and also to study the response of these varieties to zinc sulphate application.

The experiment was conducted during *Kharif* 2018 (May – August 2019) at Coconut Research Station, Balaramapuramin Factorial Randomized Block Design with varieties as first factor and zinc sulphate

application as second factor in three replication. Varieties used were Anna 4 (v_1), APO 1 (v_2), and Prathyasa (v_3) and the zinc sulphate application comprised of seed priming with ZnSO4 @ 2g kg $^{-1}$ seed (s_1), foliar application with $ZnSO_4$ @ 0.5 % at active tillering stage and panicle initiation stage (s_2), combination of s_1 and s_2 (s_3), soil application of $ZnSO_4$ @ 20 Kg ha $^{-1}$ (s_4), and control (without $ZnSO_4$ application) (s_5). The seeds were dibbled in a spacing of 20 cm × 10cm. Seed rate adopted was 80 kg ha^{-1}. Lime was applied @ 650 kg ha^{-1}. Crop was manured with FYM @ 5 t ha^{-1}and N:P: K @ 90:30:45 kg per ha(Suman, 2018). Nitrogen was applied in three equal splits, K in two equal splits and entire P as basal. The crop was raised purely under rainfed situation, if rain fall is not received for more than a week, then irrigation was given to field capacity. Productive tillers were recorded by placing a quadrate of size 0.25 m x 0.25 m from two spots in each treatment plot. Grains per panicles, sterility per cent and 1000 grain weight were recorded from ten randomly selected plots. Grain was recorded at 14 per cent moisture and straw yield individually harvested from each treatment plot, dried in sun and recorded the weight till a constant weight was obtained. Economics was worked out based on the prevailing price of input and market price of grain and straw. All data were statistically analysed except gross returns and B:C ratio. The treatment means were compared at 5 per cent probability level.

Results: Results revealed that both the varieties and zinc sulphate application have significant effect on yield attributes and grain yield of rice. Compared to Anna 4 and Apo 1, Prathyasa performed well under upland situation and recorded higher grain yield, gross returns and B: C ratio. Though Prathyasa recorded higher grain yield it was statistically comparable with Apo 1. Compared to control (zero Zn application), all the method of zinc sulphate application registered higher grain yield. Soil application of zinc sulphate @ 20 kg ha^{-1}recorded higher grain yield and it was statistically comparable with seed priming with zinc sulphate 2 g kg^{-1} seed + foliar nutrition of zinc sulphate 0.5 per cent at active tillering and panicle initiation stage. Interaction was also found significant, the treatment combination v_3s_3 recorded higher grain yield which was statistically comparable with v_3s_4. However, higher straw yield was recorded by the variety Apo 1 and because of that the gross returns and B:C ratio, v_2s_4 recorded the higher returns and B:C ratio.

Conclusion: It can be concluded from the study that Prathyasa or Apo I can be recommended with application of NPK @ 90:30:45 kg + soil application of zinc sulphate @ 20 kg ha^{-1} or seed priming with zinc sulphate 2 g kg^{-1} seed + foliar application of zinc sulphate 0.5 per cent at active tillering and panicle initiation stage.

Key words: Foliar application, Seed priming, Soil application, Varieties, Zinc sulphate, Upland rice

01-35

BROAD RANGE ANTIFUNGAL FEATURES OF SEED HARBORED ENDOPHYTIC BACTERIA ISOLATED FROM CULTIVATED RICE VARIETY OF KERALA

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Background: The ever increasing global population entails the need for uplifting agricultural productivity which is laden with hindrances such as crop nutritional deficiencies and diseases. Extensive use of chemical fertilizers and pesticides has already resulted in irreparable damage to the environment and human health. Here comes the importance of plant growth promoting microorganisms (PGPM) for establishing the environment friendly sustainable agriculture systems and as a promising alternative to harmful chemicals due to their natural mechanisms for plant growth promotion.Among various plant associated microorganisms, endophytes are very remarkable as they reside inside the plant tissues without causing any apparent harm to the host. They have multi-mechanistic features to promote plant growth and improve plant defense. They also produce of anti-herbivory compounds, support plant nutrient acquisition, and provide tolerance to biotic and abiotic stresses. Besides, they produce a plethora of secondary metabolites with potential application in medicine, agriculture, and industry. Many recent studies also supported the presence of indigenous endophytic bacteria in various plants and plant tissues. These unexplored organisms can have remarkable applications to enhance plant productivity. The remarkable features expected from seed endophytes have formed the basis of current

study.

Method: The study has designed and carried out to isolate seed endophytes from commonly and traditionally cultivated rice seeds. The isolated endophytes were investigated for its plant growth promotion (PGP) and antagonistic mechanisms against selected phytopathogens. Antifungal activity of isolated endophytes was tested against phytopathogenslike*Fusariumoxysporum, Pythiumaphanidermatum, Pythiummyriotylum, Phytophthorainfestans, Rhizoctoniasolanii,Colletotrichumacutatum*and*Sclerotiumrolfsii*by dual culture and also by well diffusion method using crude extract. Identification of potential isolate was done by 16s rRNA gene sequencing. The organism was furthertested for plant growth promotion in *Vignaunguiculata*seedlings and protection to*Sclerotiumrolfsii*was tested using whole rice kernals. GC-MS, LC-MS/MS analysis were done to identify the chemical basis of its antifungal activity.

Results: The isolated seed endophyte*Paenibacillus*sp.showed potential antifungal activity against all the tested phytopathogens. Antagonistic activity of the *Paenibacillus*sp.against plant pathogen *Sclerotiumrolfsii* in rice kernels also showed remarkable protective effect. *In planta*studies in *Vignaunguiculata*using*Paenibacillus*sp. showed increased root length of seedlings. Further GC-MS, LC-MS/MS analysis proved various metabolites as basis of its antifungal activity.

Conclusion: This is the first reporton the study of *Paenibacillus*sp.as a rice seed endophyte, from Jyothi red rice variety with broad spectrum of antifungal activity.So this rice seed endophyte obtained from the red rice variety used in Kerala can be a potential future option for the control of diversephytopathogens and also for plant growth promotion application.

Keywords: Endophyte, Rice Seed endophyte, *Paenibacillus*sp., Plant growth promotion and plant protection

01-36

TRANSITION TOWARDS ORGANIC FARMING–AN ANALYSIS OF POLICY, PROMOTIONAL INTERVENTIONS AND FIELD LEVEL SCENARIO IN KASARAGOD DISTRICT

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Background: Various interventions were implemented in Kasaragod district to promote organic farmingsubsequent to the declaration of the district as organic.A study was conducted to analysethe field level scenario of transition to organic farming in the district and the perspectives of stakeholders about the policy and programmeson organic farming.

Method: 215 farmers were selected for the study giving proportional representation to agro-ecological units and cropping systems prevalent in Kasaragod District. Data were also collected from selected agricultural officers, researchers and input dealers.

Results: Majority of farmers was not aware about the practices of organic farming even though most of them perceived that organic farming was practically feasible. A sizeable proportion of agricultural scientists, extension personnel and input dealers were apprehensive about the practical feasibility of complete conversion of farming in the district to organic mode. The envisaged group activities were not properly followed in majority of the clusters of organic farmers.Lack of availability of quality organic inputs and their high cost, lack of marketing facilities for organic produce and lack of extension support were the major constraints in adopting organic farming. Lack of clarity in policy and non-systematic formulation and implementation of promotional schemeson organic farming adversely affected the effectiveness of interventions.

Conclusion: Policy and programmes for promoting organic farming need to be revisited and an alternate framework has to be formulated for the organic farming innovation system for the optimal outcomes from the transition towards organic farming.

Key words: Organic farming, stakeholder perspectives, field level scenario

01-37

ROLE OF HORMONES AND INFLORESCENCE ARCHITECTURAL GENES IN INDUCING SPIKE BRANCHING TRAIT IN BLACK PEPPER

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Black pepper, the 'King of Spices' normally have non-branched spikes/inflorescence. A pepper type 'Thekken', a selection made by a keralitefarmer, exhibits profuse branching with more than 30 well developed branches bearing about 300 berries, is a trait of high economic value that can lead to increase in productionand hence won the National Innovation Award (2012).

In the present study we evaluated the role of auxin and cytokinin and the major floral architectural genes viz., *PINFORMED1* (*PIN1*) and *BREVIPEDICELLUS (BP)* in inducing the branching trait in Thekken.

The study revealed that in Thekken, the auxin (IAA) content was significantly lesser (1/4th) when compared to non-branched varieties, whereas, the totalcytokinin content was found increasing during a particular growth stage of inflorescence. Histological sections of inflorescence of Thekkenat this particular stage showed a prominent mass of meristamatic tissue which later grows out as branch. Differential expression analysis of the floral genes showed overexpression of *PINFORMED1* (14 fold) and *BREVIPEDICELLUS* (27 folds) in Thekken compared to non-branching varieties.

PIN1, being an auxin efflux carrier, its overexpression noticed in Thekken at transcriptome level correlated with the lower auxin content in the hormonal analysis. Overexpression of *BP* noticed in Thekken correlated with the increased cytokinin content and further correlated with the branch meristem initiated in the histological sections.

Hence, the differential expression of the floral genes as well as the differential levels of the hormones indicate their significant role in inducing the spike branching trait in Thekken.

01-38

DEVELOPMENT OF RECOMBINANT COAT PROTEIN FOR IMMUNODETECTION OF *Cucumber mosaic virus* INFECTING BANANA

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Background: Banana (*Musa* spp.) is infected by four well characterized plant viruses *viz*., *Bananabunchytop virus*, *Cucumber mosaic virus, Banana bract mosaic virus* and *Banana streak virus*. Among these viruses, *Cucumber mosaic virus*(CMV) causes devastating effect on tissue culture banana plants. The study entitled "Development of recombinant coat protein for immunodetection of *Cucumber mosaic virus* infecting banana" was carried out in Department of Biochemistry, Indian Institute of Science, Bangalore, Division of Plant Pathology, Banana Research Station, Kannara and Department of Plant Pathology, College of Horticulture, Vellanikkara, Thrissur during 2018- 2019. The present study was carried out to produce recombinant coat protein, which can be utilized later for producing high quality antiserum for the detection of CMV infecting banana.

Method: The CMV infected samples were collected and amplified the coat protein using CMV-CP specific primer. The amplified gene was later cloned in linear vector and confirmed the recombination through molecular sequencing. The CMV-CP amplicon was later subcloned to expression vector and the gene was induced using

specific concentration of IPTG. The expression of specific protein was confirmed through Western Blotting and DAC-ELISA.

Results: CMV infected samples were collected based on symptoms and all the samples were screened through direct antigen coating immunosorbent assay using commercially available CMV polyclonal antiserum. Sample KANC- 4, KANC- 2 and NDRNS- 4 were showed maximum absorbance at 405 nm and the same was elected for molecular detection using reverse transcriptase polymerase chain reaction with CMV- CP specific primer. The PCR product was purified and CMV- CP amplicon of isolate NDRNS- 4 was ligated to pGEM- T linear plasmid vector, later transformed to *Escherichia coli* DH5α cells. Positive clones were selected according to blue- white screening and confirmed by colony PCR, restriction digestion andby sequencing.

The vectors *viz*. pRSET- C and pET28a were selected for the expression of CMV- CP gene in *E. coli*. Coat protein specific forward (5' GGG GCT AGC ATG GAC AAA TCT GAA TCA ACC 3') and reverse (5' CCC GGA TCC TTA CTC TCC ATG GCG TTT AG 3') primers were designed along with recognition sites of restriction enzymes BamH1 and Nhe1.The annealing temperature of designed primer was standaized as 55°C using gradient PCR.CMV- CP gene was amplified at 750 bp using designed primer and high fidelity *Pfu* DNA polymerase enzyme. Both the expression vectors as well as amplicon were subjected to ligation and the recombination in expression plasmids (pRSET- C/ CMV- CP and pET28a/CMV- CP) were confirmed through PCR and sequencing. The pRSET-C/CMV- CP plasmid which showed maximum homology was selected for further studies.

The recombinant plasmid was transformed to *E. coli*BL21 (DE3)pLysS cells for the expression of CMV- CP gene and the expression of 25 KDa recombinant CMV coat protein was confirmed in 12% sodium dodecyl sulphate - polyacrylamide gel electrophoresis. Tris- NaCl buffer of pH 8.0 was selected for solubilizing the recombinant protein,usingExPASy - protein translation tool. The recombinant protein was further purified through Nitrilotriacetic acid column purification, in which the 6X histidine tagged recombinant protein was bound with agarose coated Nickel beads. Buffers containing imidazole were used for the elution of histidine tagged recombinant protein, since imidazole competes with histidine for the binding site in nickel beads. Each fraction*viz*.cell pellet, supernatant, flow through, wash and elution were collected and later observed in SDS-PAGE. Absence of 25 KDaprotein in cell pellet, implies that the recombinant coat protein is completely soluble in Tris- NaCl (pH 8.0) buffer.

Confirmation of recombinant coat protein was carried out through DAC- ELISA and Western blotting using commercially available polyclonal CMVantiserum.

Conclusions: Antiserum production is an essential pre- requisite for serological detection. In earlier periods, this was done using purified virus but it is usually a cumbersome procedure in terms of purity and concentration of the final preparation. Contamination of antigens with plant proteins or other viral proteins in the case of mixed infection and presence of inhibitory compounds are also the drawbacks of this method. The recombinant coat protein based antiserum is an efficient remedy for the above mentioned dilemma.Developing antiserum against local virus isolates will be useful for enhancing the efficacy of indexing and ultimately eliminating the virus from the tissue culture plants.

Keywords: Expression vector, *Cucumber mosaic virus*, recombinant coat protein, histidine tag.

01-39

GRASS-LEGUME MIXTURE FOR QUALITY FODDER PRODUCTION IN KERALA

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Background: A field experiment was conducted at AICRP on Forage Crops and Utilization, College of Agriculture, Vellayani, Thiruvananthapuram, Kerala during June 2016 to 2019 to find out the effect of grass-legume mixtures on fodder yield,qualityandeconomics of the system.

Method: The experiment was laid out in RBD with three replications, comprising of eight treatments. Treatments comprises T_1- BN hybrid sole, T_2-Guinea Grass sole, T_3-BN hybrid paired row+ fodder cowpea, T_4-BN hybrid paired row+desmanthes, T_5-BN hybrid+ Agase, T_6-Guinea Grass+ fodder cowpea, T_7- Guinea Grass+ desmanthes and T_8- Guinea Grass + Agase.
Results: The pooled data over three year's period showed that, grass legume mixture of hybrid napier cv. Suguna (paired row) with fodder cowpea has recorded the highest green fodder yield of 2036.78 q/ha and dry fodder yield of 503.29 q/ha which was significantly superior over rest of the forage cropping systems. Intercropping of BN hybrid+ Agase had recorded highest crude protein yield of 49.45 q/ha.Economics of the system revealed that variation in the cost of cultivation per hectare was recorded with different grass legume mixture. Highest cost (Rs. 315000ha^{-1}) was incurred when BN hybrid cultivated as a sole crop. Whereas intercropping guinea grass with agase had the lowest cost of cultivation (Rs. 240000 ha^{-1}) and highest Net monetary Return (Rs.355500 ha^{-1}) as well as Benefit Cost ratio (2.48).
Conclusion: Based on the findings of the three years study, it could be concluded that legume fodder mixture of hybrid napier cv. Suguna with fodder cowpea gave maximum green and dry fodder yieldand intercropping guinea grass with agase had the lowest cost of cultivation and highest Net monetary Return as well as Benefit Cost ratio.

01-40

ASSESSMENT OF TECHNOLOGICAL PROPERTIES OF FOUR STRAINS OF *L.fermentum*FOR USE AS FUNCTIONAL STARER CULTURES

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Background: Members of the genus *Lactobacillus* are widely employed as starter cultures, probiotics and as feed additives. Besides, they are also explored for their potential as functional starter cultures; starters that possess at least one inherent functional property. Asniche specific variations are observed in the metabolic profile and functional properties of microorganisms LAB isolates from different sources are potential options in the search for potentialfunctional starter cultures.
Method: This work compared four *Lactobacilusfermentum* strains (*Lactobacillus fermentum*DMA01, *Lactobacillus fermentum*FC01, *Lactobacillus fermentum*DMF18 and *Lactobacillus fermentum*FT01) isolated from different food materials (milk, curd, orange and tomato) for the following technological properties; proteolytic, lipolytic and amylolytic activities, acid and exopolysaccharide (EPS) production by growing them on different specific growth media and through HorrallElliker activity test and inoculation loop method.
Results: Isolate from milk (*Lactobacillus fermentum*DMA01) and orange (*Lactobacillus fermentum*DMF18) were found to be better acid producers than the one's from curd (*Lactobacillus fermentum*FC01) and tomato (*Lactobacillus fermentum*FT01). All the four strains showed proteolytic activity and none of them exhibited lipolytic or amylolytic activities. Only one isolate, the one from milk was found to produce exopolysaccharide.
Conclusions: Strain specific variations were observed in the technological properties of *L. fermentum* strains isolated from different food sources. One strain namely *Lactobacillus fermentum*DMA01 isolated from milk was found to be a better acid producer and was also found to be capable of EPS production. This observation underlines the possibility of exploring this strain as a good candidate for development as a novel functional starter culture.
Keywords:*L.fermentum,*HorralElliker activity test, Exopolysaccharide production, Congo red binding assay

01-41

IMPACT ASSESSMENT OF CLIMATE VARIABILITY IN BANANA (NENDRAN) CULTIVATION IN MAJOR BANANA GROWING DISTRICTS OF KERALA

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Climate change and its variability pose a major challenge to agriculture sector. The paper analyzes the imact of climate variability and their coping strategies to mitigate the effects of climate variability in banana(Nendran) cultivation in Palakkad and Thrissur districts in Kerala and is based on primary data collected from a sample of 120 farmers in Thrissur and Palakkad districts during the year 2016-17. Sixty banana *(Nendran)* growing farmers were selected randomly from Kodakara block in Thrissur district and Agali block in Palakkad district. Cobb Douglas production function was fitted to estimate the resource productivity in banana cultivation in both the districts. In Thrissur, area in hectares and bunch weight were found to influence total yield positively. Area in hectares in banana cultivation had an elasticity of 0.021 and bunch weight in banana cultivation had an elasticity of 1.075. Returns to scale for banana cultivation in Thrissur was 1.113 which is more than 1, which indicated increasing returns to scale. In Palakkad district, irrigation and bunch weight were found to influence total yield positively at five per cent level of significance. Irrigation in banana cultivation had an elasticity of 0.012 and bunch weight in banana cultivation had an elasticity of 0.77. Returns to scale for banana cultivation in Palakkad was 0.782 which is less than 1, which indicated decreasing returns to scale in Palakkad district. Sensitivity assessment for the three rainfall seasons showed that for kumbhavazha cultivation, summer rainfall was most important and the reduction in summer rainfall reduced the benefit cost ratio from 2.5 to 2.

02- BIOTECHNOLOGY

02-01

CYTOTOXIC, ANTIOXIDANT AND ANTIMICROBIAL ATTRIBUTES OF *Thespesia populnea* (L.) Soland ex correa

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Abstract: The explorations for new natural bio-active compounds are highly in demand due to their diverse action and reduced toxicity. The present study mainly focussed on the evaluation of the antiproliferative, antioxidant and antimicrobial potential of leaf extracts of *Thespesia populnea* (L.) Soland. The extraction was done by sequential extraction method based on the increasing polarity of solvents. The cytotoxic effect of chloroform extract (CHFE) were evaluated by MTT assay and showed a dose dependant response in 10 different cell lines of various site of origin. The chronic myelogenous leukemic cells (K562) were found to be more sensitive towards the CHFE treatment and their apoptotic effect were characterised by DNA fragmentation, scanning electron microscopy, nuclear staining methods, flow cytometric analysis, Annexin V FITC assay and caspase expression. The anti oxidant ability of the extracts were evaluated using DPPH radical scavenging assay. Here an attempt was also made toidentify the antimicrobial activity of leaf extracts of ***T.populnea***

against five clinicallyimportant microbes including both bacteria and fungi. Thus the study confirmed that the extracts of *T. populnea* exhibited a variety of biologically important activities likeantiproliferative, antioxidant and antimicrobial ability. So the medicinal plant *T. populnea* is a promising medical aid in therapeuticals and for herbal formulations.

Keywords: Antiproliferative, antioxidant, antimicrobial, apoptosis, CHFE.

02-02

INTERPRETING THE MECHANISM OF ACTION OF TRYPTANTHRIN, AN ANTI CANCER COMPOUND FROM *Wrightia tinctoria* AGAINST MALIGNANT MELANOMA

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Background: Traditional Indian medicine formulations against various skin ailments such as psoriasis, eczema and dermatitis use different parts of the plant *Wrightia tinctoria* as a main ingredient. Studies conducted in our lab have shown that DW-F5, an active fraction of dichloromethane extract of the leaves of *Wrightia tinctoria* exhibits exceptional cytotoxicity towards malignant melanoma both *in vitro* and *in vivo.* Further characterization has led to the identification of tryptanthrin as one of the active components of DW-F5.

Methods: MTT assay, Western blotting, Transfection, *In vivo* models

Results: Tryptanthrin, induces apoptosis in melanoma cell lines while being non-toxic towards normal immortalized melanocytes. The cytotoxicity of tryptanthrin in different melanoma cell lines were in concordance with the expression levels of lineage survival oncogene MITF, MIcrophthalmia associated Transcription Factor.MITF-M protein is the master regulator in melanoma progression. Tryptanthrin successfully inhibited the activation of MITF-M by inhibiting the phosphorylation at serine 73 residue. *In vivo* studies carried out in NOD-SCID mice showed that tryptanthrin causes significant tumor reduction and invasion.

Conclusion: Our *in vitro* and *in vivo* results indicate that tryptanthrin is a potential chemotherapeutic agent against malignant melanoma which mediates its anti-melanoma activity by inhibiting the activation of MITF-M, the master regulator of melanomagenesis and progression.

Keywords: Melanoma, Tryptanthrin, MITF-M

02-03

ASSESSMENT OF THE MITOGENIC POTENTIAL AND GLUCOSE UPTAKE ASSAY OF LLL: A NOVEL SEED LECTIN FROM *LEUCAENA LEUCOCEPHALA* (LAM) DE WIT.

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Background: Lectins are a specialized group of proteins with immense biological properties and applications. Research on lectins has gained momentum with the detailed investigations being carried out on lectins isolated from natural sources.

Method: This particular study describes the purification and characterization of a lectin from the seeds of *Leucaena leucocephala* a plant belonging to Fabaceae family mainly used for fodder and green manure. *Leucaena leucocephala* lectin (LLL) was purified by a two-step purification method involving DEAE- cellulose anion exchange chromatography and Sephadex G-75 size exclusion chromatography.

Results: The isolated lectin displayed a high haemagglutination titre upon treatment with rabbit erythrocytes. SDS-PAGE experimentally revealed the presence of three bands corresponding to 37, 27 and 20 kDa indicating the presence of isolectins. LLL was observed to possess mitogenic activity towards Peripheral blood mononuclear cells (PBMC).Glucose uptake studies indicated that *Leucaena leucocephala* seed lectin shows an

effect in stimulating glucose uptake at the tested concentration (300 µg/ml).

Conclusions: A new glucose specific lectin has been isolated from *Leucaenaleucocephala* seeds which exhibits mitogenic activity thereby triggering cell stimulation and division as evidenced by a high mitotic index. Since it binds to glucose with high specificity, it could be targeted towards the investigation of cell surface glycosylation changes associated with certain diseases. Hence the immense potential of *Leucaena leucocephala* lectin can be directed towards the area of diagnostics and cancer cell glycosylation studies.

Keywords:*Leucaena leucocephala* lectin, Haemagglutination, Glucose, Sephadex G-75, Mitogenic activity.

02-04

MOLECULAR CLONING AND CHARACTERIZATION OF VIRUS CAUSING LEAF CURL DISEASE OF *Capsicum* spp.

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Background: Even with chilli being one of the most the important spice crop in India, the farmers are not in a position to produce good quality chilli with high productivity due to various biotic problems like incidence of pest and diseases, abiotic and crop related problems. Among the different viral diseases, chilli leaf curl disease caused by *Chilli leaf curl virus* which is transmitted by whitefly (*Bemisia tabaci* G.) is one of the most important diseases, limiting the production of *Capsicum* spp. causing an yield loss of up to 100 per cent.

Method: The project initiated with purposive sampling surveys conducted in different locations of Thrissur district, Kerala to document the incidence and symptomatology of leaf curl disease on chilli plants. Molecular characterization of different virus isolates collected from various locations of Thrissur district were carried out by PCR amplification of viral coat protein gene using two *Begomovirus* specific degenerate (universal) primers, namely, AV494 / AC1048 and Deng 540 / 541. The sequence data obtained in the study were subjected to *in silico* analysis to assess the diversity of the isolates.

Results: Molecular characterization of the four virus isolates collected from various locations of Thrissur district *viz.,* VKA1 VKA2, KAR1 and KOD4 and two isolates *viz.,* VLNY1 and PKD1 collected from Vellayani, Thiruvanathapuram district and from Vithinasseri, Palakkad district, respectively were undertaken. The nucleotide BLAST (BLASTn) analysis revealed more than 90 per cent sequence identity with *Chilli leaf curl Vellanad virus* isolate (Accession No. NC038442.1) from Vellanad region of Thiruvanathapuram district, Kerala. The phylogenetic analysis revealed that, the isolates VKA2, KAR1 and KOD4 had very distinct sequence alignment when compared to other *Chilli leaf curl virus* isolates from India. The results indicated that, the three isolates *viz.,* VKA2, KAR1 and KOD4 could be new strains of *Chilli leaf curl virus* infecting chilli.

Conclusions: Three, possibly new strains of *Chilli leaf curl virus* infecting chilli have been identified and hence the study highlights the need for monitoring the emergence of new strains of plant viruses especially begomoviruses infecting solanaceous crops grown in Kerala. As this disease is one of the most important challenges to chilli cultivation, the information generated from the study could also be applied for the timely detection and effective disease management.

Keywords: Chilli, *Chilli leaf curl virus*, Begomovirus

02-05

ANTIMICROBIAL ACTIVITY OF PLANT EXTRACTS AGAINST FOUR BACTERIA CAUSING SKIN INFECTION

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Background: Treating bacterial infections with chemical agents such as antibiotics have a great negative impact on human health.The present study focus on the identification of potential natural alternative for the treatment of bacterial skin infection .
Method: The crude ethanol extracts of fifteen plant species used in the Kerala traditional for treating various childhood diseases were analyzed for their antimicrobial potential against four bacterial strains isolated from skin infection.
Result: The antibiotic susceptibility analysis through disc diffusion analysis showed that all these bacterial strains were resistant to at least two commercially available antibiotics. Eventhough all the extracts used in this study showed antimicrobial activity by well diffusion assay,*I.coccinea ,S.aromaticum, C.reticulata, M.pudica, A.bilimbi fruit, P.nigam, P.guajava A.indica, P.nigrum,* and *J. adhatoda* showed significant activity against the bacterial strains. The antimicrobial analysis of methanol, ethanol, acetone, Dimethyl sulfoxide (DMSO),chloroform and water extract of these selected plants revealed that methanol ,ethanol and acetone extract of *S.aromaticum*showed highest inhibitory activity against the strain *Staphylococcus aureus MLT13*, *Staphylococcus aures HS24* and *Streptococcus pyogenes AL1* respectively, while ethanol extract of *I.coccinea* leaf had highest inhibitory action against *Proteus vulgaris M11* strain and the minimum inhibitory concentration of the same were found to be 18.19µg/ µl ,*6.30* µg/µl ,*13.182* µg/µl and 10.96 µg/µl respectively.
Conclusions: The present study indicates the possibility of using *S.aromaticum and I.coccinea* for treating skin infection caused by *Staphylococcus, streptococcus and proteus* species and also give additional support for the use different plants in the treatment of bacterial infections.
Keywords: Plant extract,agar well diffusion,antimicrobial activity, solvent extraction,antibiotic susceptibility,minimum inhibitory concentration

02-06

ANTIBACTERIAL NATURAL RUBBER LATEX FORMULATION WITH MELANIN INTERCALATED ANIONIC CLAY FOR URINARY CATHETERS

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Background: Catheter associated urinary tract infections (CAUTI) are a major threat to the health of hospitalized patients. The bacterial colonization over the catheter surface leads to bacteruria and thereby subjecting the urinary tract of the patient to serious infections. The development of antibacterial formulations for antibacterial urinary catheters inorder to prevent such infections is a fascinating scientific and technological challenge.
Method: In this work we explores a new host – guest hybrid antibacterial system based on layered double hydroxides (LDH) hosting synthetic melanin which is synthesised by a simple coprecipitation followed by intercalation technique. This antibacterial system has been successfully incorporated in a standard natural rubber latex formulation for urinary catheters.

Results: The XRD, FT – IR, TGA and TEM analysis confirms the successful formation of typical hexagonal layers of LDH nanoparticles and the intercalation of melanin at the interlayer sites of LDH. The evaluation of antibacterial activity of the synthesized samples proved that the antibacterial activity of melanin is retained after being intercalated with LDH nanoparticles. The as synthesized antibacterial agent was successfully incorporated in natural rubber latex without affecting its stability and films were casted out of it.
Conclusion: This work throws light into a successful antibacterial formulation based on natural rubber latex for preventing urinary tract infections. This formulation can be utilized for the manufacture of urinary catheters with inherent antibacterial properties and thereby reducing the nosocomial infections to improve patients' care.
Key words: Layered double hydroxides, Antibacterial activity, Catheter associated urinary tract infections (CAUTI)

02-07

DEVELOPMENT OF ANTIBACTERIAL AGENTS FROM ENDOPHYTIC STREPTOMYCES FRADIAECQLW AND ITS EFFECT ON BIODETERIORATION OF COTTON CLOTHES

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Background: Textiles and garments are considered as the secondary skin of human and it represents the civilization, cultural and the financial boom of the country. The primary objective of this project is the prevention of microbial attack of clothes via developing natural antibacterial agents. Different artificial antimicrobial marketers are available, but due to fitness issues and environmental impacts now not secure to use for long.
Materials and methods: The current work targeted on the development of natural antibacterial agent from Endophyticactinobacteria, to manage biodeterioration. Initially well diffusion and agar over layer methods had been used for screening. Antibacterial finishing was carried out by using dip-dry and pad-dry method. AATCC 90, AATCC100, AATCC 60 assessments were later performed to verify the quality of finished fabric. Skin compatibility test was carried out to confirm that after wearing, skin is free from irritation. To enhance the durability of antibacterial retailers, it was micro encapsulated and proven with scanning electron mircroscopy. After preliminary morphological identification the usage of 16SrRNA sequencing the bioactive isolate was once deposited in the Genbank. Commercial reachable tricolsan used as control over the study.
Results: Endophyticactinobacteria isolated from distinctive medicinal plants and screened against pathogens. The isolate from *Cissusquadrangularis* leaf verified as most bioactive and named as CQLW. Clear area of inhibition observed in opposition to check pathogens. Different features of fabric together with aesthetic and structural have been validated and all effects have been better while comparing with that of control. AATCC 60 method concluded that besides mordant the antibacterial dealers can withstand up to 6 wash cycles and micro encapsulation more advantageous for the durability. Results of *in vitro* study using L929 revealed that there is no cytotoxic effect on skin. Bioactive isolate confirmed as *Streptomyces fradiae* and deposited in gen bank with accession number MH538952
Conclusion: This work established the development of natural antibacterial agents and its efficacy against pathogens. Results concluded that the extracted antibacterial agent is with top undertaking and can be used better than synthetic agents. Outcome of the study indicated clear possibility of developing eco-friendly antibacterial agents for protection of textile materials.
Keywords: Antibacterial agent, Aesthetic quality, Biodeterioration, Endophyticactinobacteria, Structural quality, *Streptomyces fradiae.*

02-08

ANALYSIS OF PROTEIN-LIGAND INTERACTION IN METHICILLIN-RESISTANT *Staphylococcus aureus* -an *in silico* approach

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Background: Methicillin resistant *Staphylococcus aureus*(MRSA) is a group of strains of *S. aureus* which are resistant to all β lactam antibiotic except newer cephalosporins having anti MRSA activity.MRSA is an important agent of healthcare-associated and community-acquired infections. MRSA has become a global epidemic in global healthcare today. Many natural compounds have been identified that show good anti MRSA activity from invitro stdudies This paper focus on analyzing the molecular interactions of 10 selected natural compounds isolated from various non microbial sources with three target proteins in MRSA through *in silico* studies
Method: Docking studies of 10 selected natural compounds and three proteins targets in MRSA involved in acquiring resistance has been carried out using docking software Autodock Vina 4.
Results: Docking studies shows that there is effective interaction between the ligands and target proteins based on the binding energy values.
Conclusion: The work proposes 6,6'Dihyroxythiobinupharidine ,Marinopyrrole and emodin as candidate lead compounds that will be effective against MRSA. These drug candidates can be further synthesized can be undertaken for clinical studies.

02-09

PHOTOCATALYIC DEGRADATION OF MALACHITE GREEN DYEUSING BIOSYNTHESIZED SILVER NANOPARTICLES

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Background: Malachite green is an aqueous tri-phenyl methane dye which is widely used in textile, leather and paper industries. The waste water generated from these industries contains a huge amount of refused dyes, and thus imparts constraint on the environment. Also malachite green is photostable and hence the use of engineered biocatalysts to enhance its degradation is quite promising. In biosynthesis, nanoparticles are synthesized using plant extracts as reducing agents. When metal nanoparticles absorb visible light of the solar spectrum, the surface electrons are excited to a higher energy state and these electrons will lead to the formation of free radical molecules which instigate photocatalytic dye degradation.
Methods: The work focused on biosynthesis of silver nanoparticles using an aqueous extract of *Cocos nucifera* mesocarp (Red spicata dwarf). The particles were optimized against synthesis parameters and characterized using UV-Vis Spectrophotometer, SEM and XRD. Synthesized particles were used as catalysts in degradation of malachite green dye. Role of bio active compounds on the surface of nanoparticles in photocatalytic degradation were confirmed using Fourier Transform Infrared Spectroscopy.
Results: Optimally biosynthesized silver nanoparticles were in the range of 45nm as confirmed by characterization studies. They exhibited solar photocatalytic activity in terms of degradation of malachite green dye and the FTIR analysis of the silver nanoparticles obtained after the degradation confirmed the role of the capping agents in photocatalysis.
Conclusion: Solar photocatalytic degradation of organic pollutants using silver nanoparticles synthesized

using an agro waste provides dual fold advantages of waste utilization and energy efficient treatment of large quantities of dye containing effluents using solar energy.

Keywords: Biosynthesis, Silver nanoparticles, *Cocos nucifera*, Malachite green, Photocatalytic

02-10

ESTIMATION OF SODIUM BENZOATE IN KASHAYA

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Background: The Ayurvedic medicinal system is deeply ingrained in Indian culture from Vedic times**.** As per the ancient texts, Ayurvedic drugs were always freshly prepared and used immediately by the patient. The increased use of Ayurvedic medicines today and its preparation as an over the counter (OTC) formulation saw the susceptibility of *Kashaya* (water decoctions) to microbial attack leading to the addition of chemical preservatives. The chemical preservatives commonly used today include benzoic acid, sodium benzoate and parabens. The use of chemical preservatives could lead to the development of several acute and chronic health problems including cancer. FDA regulations allow a maximum concentration of 0.1% Sodium benzoate in a formulation. Different studies showed that the level of preservatives added was seen to be 8-10 times higher than the Government permitted level. To ensure the quality and safety of Ayurvedic formulations, information on the amount of Sodium benzoate added in Ayurvedic formulations is important. This work envisages the estimation of Sodium benzoate in commercial samples of different Kashaya.

Method Five different commercial samples of each of the *Rasonadhi* and *Nayopayam* Kashaya were purchased from authorized Ayurvedic medicinal shops. Each bottle contains 200ml of Kashaya. The selection was based on the commercial demands and availability of the Kashaya in the market. The samples were labelled appropriately as RS1-RS5, and NP1-NP5 respectively.The bottles were checked for the expiry and proper sealing. Traditionally prepared *Rasonadhi* and *Nayopayam* samples without Sodium benzoate was kept as control. Preliminary qualitative analysis was done by ferric chloride and by modified Mohler's methods. Quantitative estimation was carried out by titrimetric method. Calculations were done as per the formula given in titrimetric method. The control samples did not show the presence of Sodium benzoate.

Results: All the Kashaya samples tested for the presence of added Sodium benzoate showed salmon colored precipitate of ferric benzoate on addition of 0.5 ferric chloride solution into residue obtained on acidification with HCl and extraction with diethyl ether. The modified Mohler's test was also positive in all the samples except traditionally prepared samples. Red brown rings of benzoic acid formed in all the commercial samples tested. On mixing the color diffused throughout the sample liquids and on heating a color change to greenish yellow were observed. The titrimetric estimation showed that the amount of sodium benzoate in all tested samples were above the FDA permitted limits (more than 0.1%).

Conclusions: Sodium benzoate is a common chemical preservative used to avoid spoilage of Ayurvedic formulations. This work showed that, most of the Ayurvedic Kashaya is preserved for a greater shelf life by the addition of Sodium benzoate. Also, the amount of added preservative Sodium benzoate in the commercial Kashaya samples were above the FDA approved limits. This results provide an insight in to the misuse of chemical preservatives in commercial Ayurvedic formulations. The safety and quality of medicinal products are of paramount importance. Thus the use of Sodium benzoate should be regulated and strict monitoring to be done to maintain the level below the permitted limit by FDA

Keywords: *Chemical preservative, Sodium benzoate, Kashaya, Ayurvedic formulation*

02-11

CHARACTERIZATION OF A LIPASE FROM A NEWLY ISOLATED *PSEUDOMONAS GUARICONESIS* FOR POTENTIAL INDUSTRIAL APPLICATIONS

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Background: Lipases are a class of versatile enzymes with a wide range of industrial applications. They can catalyze several reactions in nonaqueous medium for the biofuel industry, production of value added products such as esters, organic acids, food, beverage, cosmetics, textile and pharmaceutical industries. Castor oil as compared with other oils, used as inducers for lipase production are not appreciably hydrolyzed by lipase activity and is a rich source of ricinoleic acid which has got a variety of industrial potential. The lipase mediated hydrolysis of castor oil has got many attractive advantages over conventional hydrolysis technique.
Methods: This work explores the isolation and screening of a potent lipase producing strains capable of hydrolyzing castor oil .The enzyme production was confirmed using lipase assay and zymogram analysis. Various parameters affecting enzyme production were optimized through statistical design experiments. Stability and transesterification properties of the lipase were also checked for studying their potential industrial application. The fatty acid liberated after castor oil hydrolysis were identified using GCMS, H-NMR and HPLC.
Results: The lipase assay and zymogram analysis confirmed lipase activity in the culture filtrate which showed a maximum lipase activity within 24 h of fermentation and 220 /mL after the statistical design experiments. The lipase from *Pseudomonas guariconesis* was also found to be stable under alkaline conditions, metal ions, organic solvents, bleaching agents and commercial detergents which make them ideal candidates for detergent industry. It also showed efficient trans-esterification potential and production of ricinoleic acid was confirmed by GCMS, H-NMR and HPLC which needs further purification for industrial applications.
Conclusion: This work establishes the efficacy of *P. guariconesis* lipase as a potential enzyme for detergent applications, transesterification applications and also for the enzymatic hydrolysis castor oil for the production of a hydroxy acid ricinoleic acid with important industrial applications.
Keywords: Lipase, *Pseudomonas guariconesis*,castor oil, ricinoleic acid.

02-12

TARGETED POLYSACCHARIDE COATED IRON OXIDE NANOPARTICLES:A SMART NANOVECTOR FOR CANCER THERANOSTICS

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Background: Biopolymer based Iron oxide nanoparticles (IONPs) are deliberatedas upcoming theranostic agent. The current study focuses on the synthesis of folic acid and doxorubicin conjugated galactoxyloglucan (PST001) - iron oxide nanoparticles, their characterization,drug loading and theranostic applications like contrast agent in MRI and magnetic field mediated drug delivery.
Methods: Folic acid receptor targeting doxorubicin loaded PST coated IONPs (DOX@FAPIONPs) was synthesized and characterized by UV-Vis spectroscopy, FTIR, TEM and DLS. *In vitro* and *in vivo* therapeutic efficiency of the synthesized particles were analyzed. MRI efficiency of particles was monitored in xenograft mice model.
Results:DOX@FAPIONPs induced a statistically significant dose-dependent increase in cytotoxicity in folate positive cells compared to DOX treated cells. Studies in healthy mice showed the significantly lesser release of drug in the bloodstream and reduced accumulation of DOX@FAPIONPs in tissues compared to free drug.

DOX@FAPIONPs exhibited substantial contrastenhancement effect for T2-weighted MRI in HeLa- xenograft nude mice model. Tumor reduction experiments in DLA solid tumor models revealed enhanced anti-tumor activity, proving the efficacy of DOX@FAPIONPs as a promising drug delivery system as well.

Conclusion: In summary, we have successfully designed and prepared novel drug-loaded targeted iron oxide nanoparticles using PST001 as a toolfor theranostic management of cancer.

Keywords: Nanoparticles, Folic acid, Doxorubicin, MRI

02-13

ISOLATION AND IDENTIFICATION OF POTENT ANTICANCER COMPOUNDS FROM THE PLANT, *Corallocarpusepigaeus*

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Background: *Corallocarpusepigaeus* (Cucurbitaceae) is a plant widely used in traditional medicine for various illness and ailments. It is a climbing, monoecious plant found in the rain shadow regions of the Western Ghats. Although, the anti-proliferative property of this plant is reported, none of them has yet analyzed its anti-cancer potential in detail.The present study has explored the anticancer property of the plant, assessed the pharmacological safety of the purified active fraction from the tuber extract of the plant and chemically characterised the anticancer compoundisolated.

Method: Tubers of the plant were subjected to serial exhaustive extraction of compounds usingsolvents of increasing polarity. The tuber extracts and fractions were analyzed for its anticancer potential by cell viability assays. The cytotoxic mechanism exhibited by the active extract was analyzed by FACS and Western blot analysis. Toxicological evaluation of the active fraction by acute and chronic toxicity studies was carried out in *Swiss albino* mice.Isolation and characterization of the anti-cancer principle from the active fraction was done by TLC, column chromatography, NMR (^{13}C and ^{1}H) and Mass spectrometry.

Results: Ethyl acetate and methanolic extracts of the tuber of *C. epigaeus* exhibited potent anti-proliferative activity. Active fraction FFC from ethyl acetate tuber extract was found to be most effective against hepatocellular carcinoma and melanoma cell lines. The cytotoxic mechanism exhibited by FFC involves caspase dependent apoptosisin melanoma cells. Toxicological evaluation of the FFC fraction revealed the pharmacological safety of the compounds. Chemical characterization revealed, Cucurbitacin B as the major compound in the FFC fraction from ethyl acetate extract of the tuber. This is the first ever study reporting the presence of Cucurbitacin B in the plant *Corallocarpusepigaeus*. Preliminary chemical analysis of the methanolic extract of the tuber revealed the presence of a compound distinct from that of Cucurbitacin B, and is being characterised.

Conclusion: The plant *C. epigaeus* possess significant anticancer property. One of the potent anticancer compounds identified through chemical characterization is Cucurbitacin B. Studies are in progress to delineate the structure of other potent compounds with anticancer efficacy.

Keywords: Anticancer principle, *Corallocarpusepigaeus*, Cucurbitacin B

02-14

BANANA PEEL – GELATIN BASED BIOPLASTIC AND ITS OPTIMIZATION

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Background: Solid waste pollution caused due to the excessive use of petroleum derived plastics has become one of the paramount concerns of today. This calls for an urgent need to replace petroleum- based plastics with bioplastics. Many bioplastics like Starch-based bioplastics, microorganism-based bioplastics, milk-based bioplastics etc. have already addressed this problem before. But due to their excessive time consumption during synthesis, they have very low industrial significance. This project endeavours to study a novel method in the production of bioplastic using waste banana peels. For this purpose, various treatments using different plasticizers like glycerol and sorbitol were done. An appropriate proportion of corn-starch is also added in the production of bioplastic due to its various properties like large availability, low cost, renewability and biodegradability. When exposed to heat and mechanical treatment, corn starch also behaves like a thermoplastic in the presence of various plasticizers like glycerol and sorbitol. Food grade gelatine along with combinations of glycerol and sorbitol were used as plasticizers which in turn helped to increase the plasticity and decrease the viscosity of the bioplastic. In order to abet the process of film formation, HCl was used which helped in the hydrolysis of amylopectin present in the banana peels. The pH of the medium was neutralised using NaOH. The tensile and comprehensive strengths of the bioplastic obtained were tested using UTM. Various characteristics of the bioplastic were tested using several tests like Burning test and Water absorption test using ASTM standard methods. FTIR was used to determine the spectra of the bioplastic. Furthermore, to check the biodegradability of the bioplastic, degradation study was carried out for a period of 2 weeks. Thus, this study helped to infer that bioplastics made from banana peels can be considered as an industrially relevant, eco-friendly, promising biopolymer. Further research needs to be carried out to determine their durability and marketability.

Method: Banana peels were washed and cut into small pieces. Peels were dipped in acetic acid for 2-3 minutes. Peels were then boiled in distilled water for 30 minutes. The water was decanted from the beaker and the peels were now left to dry for about 30 minutes. After the peels were dried, they were pureed until a uniform fine paste is formed. To 5g of paste each, 0.6ml of 0.5N HCl, 0.6ml of 0.5N NaOH and 1.5ml of gelatine were added to the mixture. Various treatments such as adding different concentrations of plasticizers like glycerol, sorbitol and also corn starch were done. Then the mixture was stirred well. The bioplastic was then spread evenly onto the small petri plates covered with foil or parchment paper and baked at 120°C for about 30 minutes. It was allowed to cool and various tests like water absorption test, burning test, loading test using UTM, FTIR analysis and biodegradability test were done.

Result: Standardisation of the sample preparation protocol was done and UTM results yet to come.

Keywords: Bioplastic, Banana peel, Bio-degradation, cornstarch, gelatin, glycerol, plasticizer

02-15

INSILICOPREDICTION AND SYNERGISTIC ANTIBACTERIAL STUDY OF SYNTHETIC 4-AMINOCOUMARIN DERIVATIVES WITH DIFFERENT ANTIBIOTICS AGAINST METHICILLIN-RESISTANT *Staphylococcus aureus*

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Background: Rapidly increasing anti-bacterial resistance is one of the major life-threatening causes of public health. Coumarins are benzopyrene class of natural organic compounds exhibiting a diverse range of biological activities. Synthesis of new bioactive coumarin derivatives has become a hot area of research due to the interesting physicochemical properties and pharmacological relevance of these compounds. The mechanism of antibacterial action of aminocoumarin derivatives varies from other antibiotics by altering its target of action which results in a synergistic effect against multidrug-resistant *S.aureus.*
Method: Synthesis of some bioactive derivatives from 4-aminocoumarin and structural analysis using different spectroscopic methods. Screening of possible targets of *S.aureus* with high-affinity binding sites to newly synthesized compounds using the Glide module of Schrodinger 10.4.Determination of Minimum Inhibitory and Bactericidal Concentrationbyin-vitro susceptibility testing and synergistic antibacterial studyof 4-aminocoumarin derivatives with oxacillin and gentamicin against methicillin-resistant *S.aureus*.
Result: In this study, possible targets of *S.aureus* with high binding affinities were identified as DNA gyraseusing molecular docking methods. The in-vitro susceptibility testing reveals that the antibacterial effect of antibiotics was modulated by the synergistic action of synthetic aminocoumarin derivatives.
Conclusion: This work establishes the possible targets of *S.aureus* as well as different phenyl iodonium derivatives of 4-aminocoumarins which deserve further exploration to develop therapeutic agents that can modulate the effect of antibiotics on MRSA.
Keywords: Coumarin derivatives, Synergistic antibacterial effect, Methicillin-resistant

02-16

NANOSTRUCTURES BASED PROBES FABRICATION AND THEIR POTENTIOMETRIC SENSING APPLICATION

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Background: Highly selective and sensitive detection of various analytes such as biomolecules, heavy metals1, and other organic and inorganic pollutants is of great interest among researchers. Currently, analyte samples can be characterized by Atomic Absorption Spectroscopy (AAS), and Inductively-Coupled Plasma Mass Spectroscopy (ICM-PS). These analytical methods are well established, highly selective and sensitive but require high cost and sophisticated equipment under the supervision of advanced analysts. Potentiometric methods such as Cyclic Voltammetry (CV), Chronoamperometry (CA), and Square Wave Voltammetry (SWV), etc. are promising due to their high selectivity, sensitivity, portability, easy to use and economic viability. As the electrodes play the most essential part for sensitivity and selectivity, the aim is to utilize the capabilities of nanostructures, which provide high surface area of interactions for fabrication of electrodes.
Method: Present research deals with the synthesis of highly pure, large scale, economical nanostructures by electrochemical method using our own developed fully automated two-electrode electrochemical setup. Different variety of metal, metal oxide, multi-metal oxide nanostructures, and their dispersions were successfully achieved from a single platform of our two-electrode setup with easy operation and minimal requirements. Graphene oxide is prepared using a modified Hummer's method sensing the response of various analytes/contaminants via different Potentiometric detection methods such as Cyclic Voltammetry (CV),

Chronoamperometry (CA), and Square Wave Voltammetry (SWV).

Results: For each of the sample obtained, the morphology is studied using scanning electron microscopy, transmission electron microscopy and the structural investigation was carried out by measuring X-ray diffraction.Further, conjugation of the synthesized nanoparticles (NPs) with Graphene Oxide (GO) is done by EDC/NHS route.

Conclusions: It can be concluded that the electrochemical reduction method is a single step method to synthesize different metal, metal oxide and even multi metal oxide nanostructures. Our developed instrument can be used to conjugate carbon based nanostructures with inorganic nanostructures in a single step phasing out the use of different chemicals used in other methods such as EDC-NHS.The synthesized NPs/GO conjugate will be used for fabrication of highly sensitive electrodes and sensing the response of various analytes/contaminants via different Potentiometric detection methods such as Cyclic Voltammetry (CV), Chronoamperometry (CA), and Square Wave Voltammetry (SWV).

Keywords: Electrochemical, Nanoparticles, Potentiometric, Detection

02-17

SCREENING AND ISOLATION OF ANTIMICROBIAL PEPTIDES FROM 12 COMMON WILD PLANT LEAVES

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Background: The inventions of potent antibiotics have led to the development of multidrug resistant (MDR) microbial strains. These infections pose a major threat to general human health and as a consequence, development of alternatives that does not induce drug resistance came to be essential. Antibiotics from plant antimicrobial peptides (AMPs) permeabilizes microbial cell membranes, thus acting as effective antimicrobial agents.

Method: The work aims to develop plant AMPs as potential antibiotics against microbes, by isolating the AMPs from leaf extracts of plants. Crushed leaf extracts of twelve commonly known plantswere subjected to ammonium sulphate precipitation to isolate the proteins. Antimicrobial activity of the peptides was tested and the viable peptides were further purified and characterized through native PAGE.

Results: The crude leaf extracts were obtained using liquid nitrogen extraction method and the peptides were isolated via ammonium sulphate precipitation method. The isolates were screened for their antimicrobial activity, and the ones with commendable inhibition zones were purified and analyzed for their molecular weight.

Discussions: The plants that show narrow spectrum activity are ghaneri, shoeflower, chilli, touch-me-not, insulin, pepper and guava. The plants that show broad spectrum activity are mango, Indian lotus croton, crape jasmine and periwinkle. Best zones of inhibition were obtained in the following: Indian lotus croton, crape jasmine, mango and periwinkle.

Conclusions: This work proves the efficacy of AMPs from leaf extracts as a potential antimicrobial agent. Since the plant varieties chosen are widely grown and can be easily procured, this is a feasible method of developing AMPs as a solution to MDR organisms predominantly seen on infectious wounds.

Keywords: Antimicrobial peptides, liquid nitrogen, ammonium sulphate precipitation, native PAGE

03- CHEMICAL SCIENCES

03-01

A ONE-POT ACCESS TO POLYNUCLEAR DISPIROHETEROCYCLES INCORPORATING SPIROPYRROLIDINE OXINDOLES AND THIENO[2,3-b]INDOLES

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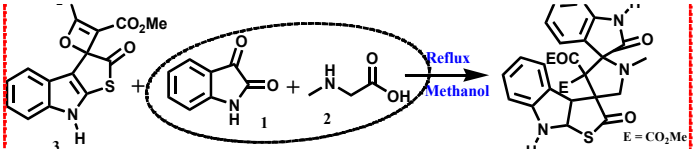
Background: Spiropyrrolidinyl oxindoles have long been considered as attractive templates for drug discovery. Recently the synthesis of polynuclear dispiroheterocyclic compounds have also gained importance. This is because such compounds exhibit significant antibacterial, antifungaland anti-cancer activities. On the light of this we have synthesized novel dispiroheterocycles incorporating spiropyrrolidine oxindoles and thieno[2,3-b] indoles.

Method: Isatin **1**and sarcosine **2**were used to generate the azomethine ylide which was then reacted with dimethyl-2'oxo-2',8'-dihydrospiro[oxete-2,3'-thieno[2,3-b]indole]-3,4-dicarboxylate **3**by refluxing for 12 hours in methanol. A product was formed as indicated by the TLC which was isolated by simple filtration. The scheme below shows the representative reaction.



Results: A logical mechanism for the reaction was proposed which is to be theoretically validated. The generality of the reaction was proved by varying the isatins as well as aminoacids. The structures of all compounds thus obtained were confirmed based on IR, 1D and 2D NMR spectroscopy and by elemental analysis. The compounds are to be tested for anti-inflammatory and anticancer activities.

Conclusions: Thus we have synthesized a series of new polynuclear dispiroheterocycles bearing spiropyrrolidine oxindoles and thieno[2,3-b]indoles. A new dienophile has been discovered which can be used for other cycloaddition reactions.

Keywords: Spiropyrrolidinyl oxindoles, Dispiroheterocyclic compounds, Anticancer, Antifungal, Isatin, Sarcosine.

03-02

LONG-LIVED PHOTOLUMINESCENT SILVER CARBOXYLATE FOR OPTICAL AND BIOLOGICAL APPLICATIONS

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Background: Photoluminescent materials have profound interest in the fields of optical devices, sensors and bioimaging probes. Long-lived photoluminescent phenomenon is usually exhibited by lanthanides and

several transition metal complexes originating due to their forbidden triplet to singlet transition. Further certain quantum dots, organic dyes and other nanoparticles are also known for their long-lived emission. However, heavy metal toxicity and expensive nature of these photoluminescent materials calls for the potential need of alternating options for simple systems with better biocompatibility. The study invents a simple silver carboxylate system with long-lived photoluminescent with high quantum yield and is biocompatible and film forming capacity presenting a multitude of applications.

Method: The present work report on the room temperature synthesis of biocompatible photoluminescent silver terephthalate system using silver nitrate and terephthalic acid using water, the green solvent.

Results: The as-synthesized silver terephthalate has been characterized byX-ray diffraction, thermogravimetric and FT-IR spectroscopic analyses. XPS analysis has been carried out to determine the elemental composition of the system and oxidation state of silver. TEM images indicated spherical crystalline nanoparticle with a diameter <10 nm. Photoluminescense spectra of the samples indicated high intense emission peaks at 486 nm, 517 nm and 557 nm. It has high quantum yield of 53.78 and life time of 3.91 ms. Biocompatibility has been ensured by MTT assay.

Conclusions: The study presents an advanced long-lived photoluminescent multifunctional metal organic system which is biocompatible and film forming for a wide variety of optical as well as biological applications.

Keywords: Photoluminescent, silver terephthalate, biocompatible, quantum yield

03-03

DEVELOPMENT OF β-CYCLODEXTRIN BASED FLUORESCENT DRUG CARRIER SYSTEM FOR SUPERPARAMAGNETIC IRON OXIDE NANOPARTICLES WITH POTENTIAL APPLICATIONS IN PHOTODYNAMIC ANTIMICROBIAL CHEMOTHERAPY (PACT)

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Background: While considering the biomedical relevance of iron oxide nanoparticles, their modifications and property enhancement in any sort is highly appreciated. When the particle size got considerably reduced, these particles may exhibit superparamagnetism which have potent applications in modern theranostic techniques. Encapsulation of such a system into an easily detectable sensor moiety may further enhance their application modalities.

Methods: Cyclodextrin stabilized superparamagnetic iron oxide nanoparticles (SPIONS) were synthesized by reduction of $FeSO_4.7H_2O$ using $NaBH_4$, followed by air oxidation. Fluorescent drug carrier system was developed by means of DCC (*N*,*N'*-Dicyclohexylcarbodiimide) coupling in presence of DMAP (4-Dimethylaminopyridine). SPIONs were then encapsulated into this fluorescent system by mixing both solutions at 80^0C for 1 hour and further for 4 hours at 25^0C under nitrogen flushing.

Results: FTIR and NMR studies confirmed the successful development of the fluorescent system and subsequent encapsulation of SPIONS. Superparamagnetic nature of the nanoparticles was studied using M-H measurement at room temperature. The antimicrobial activity of nanoparticle encapsulated fluorescent system was evaluated against two bacterial strains S.sureus and K.pneumoniae using Kirby-Bauer disc diffusion method. The system showed enhanced activity after irradiation with light for two hours.

Conclusions: The enhanced antimicrobial activity of the currently developed system after irradiation is propitious in photodynamic antimicrobial chemotherapy (PACT).

Keywords: Fluorescent, Superparamagnetic, Iron Oxide Nanoparticles, Photodynamic Antimicrobial Chemotherapy

03-04

CURE CHARACTERISTICS, STRUCTURAL, THERMAL, MECHANICAL PROPERTIES AND DIFFUSION BEHAVIOUR OF NATURAL RUBBER REINFORCED COPPER ALUMINA NANOCOMPOSITES

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The present society has shown increasing interest in the use of natural products in place of very expensive synthetic products. Among the natural products natural rubber (NR) is available in plenty and it is an unsaturated elastomer with good properties like high strength, good resilience, biocompatibility and moreover it is economically viable. But it shows high sensitivity to high temperatures and solvents due to excessive double bonds in the main chain hence the application of these elastomers are limited in the engineering applications. It is important to tackle this problem,so we have focused on the reinforcement natural rubber withcopper alumina nanoparticles ($CuAl_2O_3$).Composites based on this hybrid was fabricated by a two roll mill mixing technique and we studied the processing characteristics, crystalline, morphological, thermal properties and mechanical properties. These properties werewell elucidated by systematic characterization techniques such as FT-IR, XRD, SEM, DSC, TGA and sorption studies. FTIR spectra ascertain the attachment of nanoparticles in the NR chain.XRD in combination with SEM gives an idea of crystalline and the uniform dispersion of varying $CuAl_2O_3$ contents in the NR matrix. Thermogravimetric analysis along with differential scanning calorimetry revealed the enhancement of both thermal stability and glass transition temperature of NR due to the incorporation of nano$CuAl_2O_3$. The cure time of the prepared composites decreased with the loading of fillers which indicated that the lower energy is required for the fabrication of NR nanocomposites. The mechanical properties such as tensile strength, tear resistance and hardness of the composites were increased with the loading of nanoparticles whereas the elongation at break reduced. The effect of filler loading on the swelling behaviour of composite was also investigated in solvents like benzene, toluene and xylene. The swelling index and swelling coefficient of NR were lower for nanocomposites as compared to pure NR. Among the nanocomposites, 5 phr of $CuAl_2O_3$ filled NR showed the maximum mechanical properties. The outcome of the results imply great possibilities of replacing conventional rubber composites, which enables them for the fabrication of light-weight rubber products in advanced engineering applications.
Keywords: Natural rubber, Copper alumina, Nanocomposites, crystallinity, cure behaviour, mechanical properties, sorption

03-05

GRAPHENE, CARBON FIBRE AND CARBON BLOCK FROM DISCARDED BANANA STEM – PROMISING CARBON DIOXIDE ADSORBENT MATERIALS FOR ENVIRONMENTAL APPLICATION

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Background: Preparation of porous carbonaceous materials from renewable resources is an emerging area in terms of sustainable approach to realize functional materials. Porous carbon materials are used in variety of environmental applications viz., water and air purification. The present work describes the preparation of graphene, carbon microfibers and porous carbon block from biomass banana stem for CO_2 removal application. Banana stemis one of the inexpensive cellulose rich materials which are abundant in Kerala.
Method: Freeze drying method was adopted for the removal of water from banana stem.Porous carbon block

and fibre is prepared by the carbonization of the freeze dried precursor at 700 °C. For the preparation of graphene, the freeze dried banana stem is pre-crbonized at 200 °C and reduced using hydrazine hydrate. Prepared materials were analysed for structure confirmation, morphology analysis and textural property evaluation. Carbon dioxide adsorption evaluation was done at two different temperatures viz., 0 °C and 25 °C and at 1 bar.

Results: Interestingly, the size and shape of banana stem and fibre remained intact after high temperature treatment. High concentration of potassium salt naturally present in banana stem assisted the in situ chemical activation; resulted in high specific surface area of 1260 m^2/g. The carbonized Banana stem exhibited the CO_2 adsorption capacity of 7.1 mmol /g at 273 K and 1 bar, the highest efficiency recorded for a biomass derived carbonaceous material. Chemical reduction of pre-carbonised banana stem removed majority of oxygen functionality resulted in exfoliation of graphene layers. The prepared graphene with 5-6 layers is demonstrated as a good CO_2 capture material with an efficiency of 4.6 mmol/g at 0°C and 1 bar.

Conclusions: The work demonstrate the use of waste banana stem as precursor for porous carbon block, carbon fibre and graphene for CO_2 capture application.

Keywords: Banana stem, Carbon fibre, carbon block, porous carbon, graphene, CO_2 capture

03-06

GREEN SYNTHESIS OF 2,2'-DISUBSTITUTED PERIMIDINES *via* ANOVEL SOLID ACID CATALYZED ON-WATER PROTOCOL

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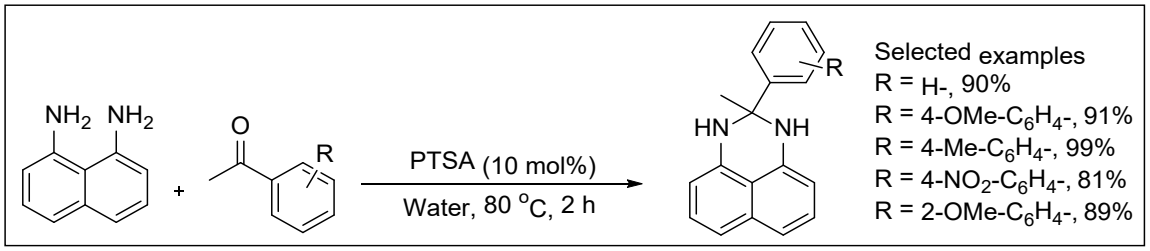
Background: Perimidines are important class of heterocyclic compounds that are found to exhibit a diverse range of biological properties, like anti-fungal, anti-microbial, anti-ulcer and anti-tumor activities and can be used as dye intermediates and coloring materials. "On water" reactions are reactions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

To the best of our knowledge, there areonlya few reports available on the synthesis of dihydroperimidines using ketone and 1,8-diamino naphthalene in presence of acid catalysts as well as metal catalysts. Issues such as high price, commercial availability and moisture sensitivity of many of these metal catalysts, prolonged reaction time, undesirable side products due to high acidity in the case of acid catalysts limit their applicability on commercial scale. Usage of organic solvents in all these cases reduced the greenness of the reaction. Herein we report a novel green protocol for the synthesis of 2,2'-disubstituted 2,3-dihydro-1*H*-perimidines using a solid acid catalyst (PTSA) on water at 80 °C, for 2 hours.

Method: To1,8-diamino naphthalene was added different ketones, PTSA (10 mol%) and water. The mixture was stirred for 2 hours at 80 °C.



Results: Different ketones were reacted with 1,8-diamino naphthalene on water.

2,2'-Disubstituted 2,3-dihydro-1*H*-perimidineswere obtained in moderate to excellent yields. **Conclusions:**We have developed a simple, rapid, efficient and green method for the synthesis of perimidines from 1,8-diamino naphthalene and ketones using PTSA catalyst on water at 80 °C, **Keywords**: Perimidine, 1,8-diamino naphthalene, ketone, water, heterocycle.

03-07

NOVEL MANGANESE-CATALYZED GREEN CLAUSON-KAAS REACTION FOR N-SUBSTITUTED PYRROLE SYNTHESIS

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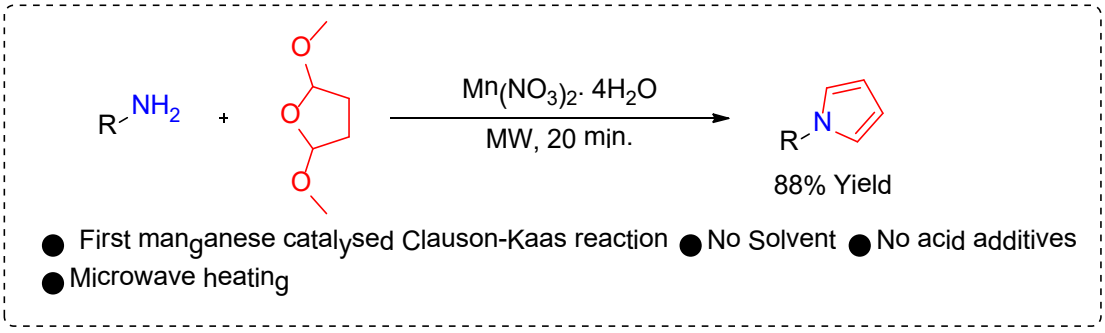
Background: Our continuously changing environment demands a sensible and sustainable chemistry. In synthetic organic chemistry, heterocycles are vital targets especially nitrogen containing ones because of its notable presence in natural products and widespread applications in pharmaceutical industries. Pyrroles are five membered nitrogen heterocycles with potent biological properties. In addition to the biological applications, they are important synthons for various heterocycles and functional materials. Among the various synthetic routes, Paal-Knorr synthesis possesses a dominance. The modified Paal-Knorr synthesis or the Clauson-Kaas reaction has an advantage that it uses 1,5-dimethoxytetrahydrofuran as the dicarbonyl source.Even though there exists various catalyst-promoted Clauson-Kaas protocols, since the new era of green reactions demands an eco-friendly catalyst with superior qualities, the use of a green promoter such as manganese is vital. The suitability of manganese as a catalyst in various transformations is a hot topic nowadays and thus we intended to develop a protocol with manganese as the catalytic promoter with green reaction conditions for a new Clauson-Kaas reaction.

Methods: Into an oven dried 10 ml microwave vessel containing magnetic stirring pellet was added aniline (1 mmol), $Mn(NO_3)_2.4H_2O$ (10 mol%) and 1,5-dimethoxytetrahydrofuran(1.2 mmol) without any solvent. Then the vessel was irradiated with microwave at 120 °C (constant temperature mode) for 20 minutes. The reaction mixture was then quenched using water and extracted with ethyl acetate, dried and concentrated. The crude mixture thus obtained was purified by silica gel column chromatography using hexane/ethyl acetate as the eluent.

Results:



Conclusions: The first manganese-catalyzed protocol for the synthesis of N-substituted pyrroles using 1,5-dimethoxytetrahydrofuran with variously substituted primary amines has been developed (up to 88% yield) This solvent-free reaction strategy avoids the use of additives such as ligands, co-catalysts and acids. Cheap, eco-friendly and easy to handle $Mn(NO_3)_2.4H_2O$ is employed as the catalyst under microwave condition with very short reaction time (20 min.).

Keywords: Pyrrole synthesis, Manganese catalysis, Clauson-Kaas reaction, Heterocycles.

03-08

FACILE SYNTHESIS AND PHOTOPHYSICAL PROPERTIES OF OCTANITRILE PHENYL CALIX[4] RESORCINARENE: SELECTIVE RECOGNITION OF Fe(II) AND Fe(III) BY FLUORESCENCE QUENCHING

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Background: To design new-fangled supramolecular structure, discrete techniques have been developed for complete and selective alkylation on the upper and lower rims of calixarene framework. In this work, we have synthesised a novel supramolecule having eight nitrile groups by O-alkylation of hydroxyl groups present in phenylcalix[4]resorcinarene. The photophysical properties, the influence of metal ions and their concentration on fluorescence emission spectra are undertaken in this work.
Method: Synthesis of octanitrile phenylcalix[4]resorcinarene (RESCN) was done by the functionalization of eight hydroxyl groups present in phenylcalix[4]resorcinarene. The photophysical characteristics of the RESCN has been studied in solvents of different polarity. The ability of RESCN to detect metal ions has been tested in DMF solution in the presence of various metal ions (Hg^{+2}, Pb^{+2}, Cd^{+2}, Ni^{+2}, Cu^{+2}, Co^{+2}, Sn^{+2}, Fe^{+2}, Fe^{+3}, Na^{+}, K^{+}) by usingUV- Vis spectrophotometry.
Results: Complete functionalization of eight hydroxyl groups was done in one step by reacting at room temperature with the alkylating reagent chloroacetonitrile. The absorption and emission spectra of the synthesised compound was found to exhibit strong solvent dependency, but did not show expected regular variation with the polarity of the solvent. The compound has exhibited significant fluorescence quenching upon interaction with Fe^{+2} and Fe^{+3} among the tested metal ions (Hg^{+2}, Pb^{+2}, Cd^{+2}, Ni^{+2}, Cu^{+2}, Co^{+2}, Sn^{+2}, Fe^{+2}, Fe^{+3}, Na^{+}, K^{+}).
Conclusions: In this wok we have synthesised a new supramolecule, octanitrile phenylcalix[4]resorcinarene. Interaction with various metal ions were investigated spectrofluorimetrically and the compound has exhibited selective recognition for Fe^{+2} and Fe^{+3}among various metal ions tested.
Keywords: Phenylcalix[4]resorcinarene, Flurescence quenching, detection of metal ions.

03-09

POLYEPICHLOROHYDRIN CORED POLYAMINE: A HOMOGENEOUS CATALYST FOR SELECTIVE SYNTHESIS OF (*E*)-NITROALKENES

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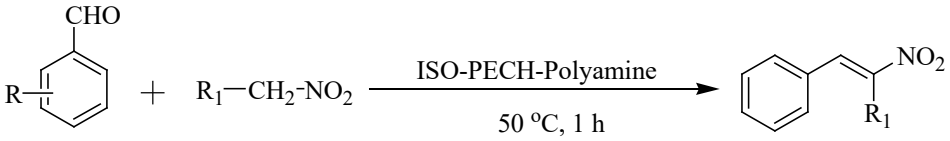
A new highly functionalizedpolyamine was developed by cationic ring opening polymerization of epichlorohydrin. The polyamine was characterized by FT-IR, GPC, TG-DTA, CHN, ^{1}H NMR and ^{13}C NMR techniques. The polyamine showed high thermal stability, higher solubility in polar solvents and high amine capacity. It could act as an efficient catalyst for selective one pot synthesis of (*E*)-nitroalkenes via the Henry condensation of aldehydes and nitroalkanes (Scheme 1). Various factors such as the amount of catalyst, effect of solvents, time and temperature affecting the catalyst's performance were studied. Here nitromethane/ nitroethane acted as both nucleophile and solvent. The reaction proceeded with good to excellent yield (88-96 %) under mild conditions. High catalytic activity and selectivity, safe reaction, step economy, solvent free reaction, reusability and high basicity of the catalyst were the notable advantages of the present method. The catalyst retained the benefits and reduced the drawbacks related to homogeneous catalysis.



Scheme 2: Synthesis of nitroalkenes using ISO-PECH Polyamine organocatalyst

Key words: Homogeneous catalyst, Reusable catalyst, Nitroalkene synthesis, Polyepichlorohydrin

03-10

IODINE CATALYSED DIASTEREOSELECTIVE SYNTHESIS OF SPIROAZIRIDINES

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Background: Aziridines are an important class of heterocyclic compounds. The inherent ring strain makes aziridine susceptible to undergo transformation to other nitrogen containing molecules. Hence, aziridines are important intermediates and building block in synthetic organic chemistry. On the other hand aza spyroclycles have gained greater attention owing to its significance as emerging drug candidates. Even though numerous protocols are being reported for the synthesis of various spiranic structures, spiroaziridines are least explored among them. Moreover, narrow substrate scope in terms of N-substituents is a huge drawback as the traditional methods requires an activating group.

Method: Owing to the biological as well as synthetic significance of spiroaziridines, we have developed an operationally simple I_2/TBHP mediated protocol for the diastereoselctive synthesis of N-alkyl spiroaziridines from primary amines and easily accessible α, β-unsaturated ketones.

Results and discussion: Scope of the reaction for various aylidinones such as 2-arylidene- 2,3-dihydro-1*H*-indenone, arylidene dihydronaphethalen-1-one, chroman-4-one, thiochroman-4-one were investigated. In all the cases, except arylidenen thiochroman-4-one, formation of *trans* isomer of spiroaziridine as the sole product was observed. Diversity of the reaction with respect to numerous primary amines was also evaluated. The desired products were obtained in quantitative yields.

Conclusion: We have developed an operationally simple methodology for the synthesis of N-alkyl spiroaziridines utilizing readily available substrates. The iodine/ TBHP mediated protocol proceeds in a diastereoselective fashion. The methodology does not require pre-functionalization of amines.

Keywords: Spiroaziridine, Diastereoselective

03-11

GRAPHENE OXIDE MODIFIED NANO TiO_2 PHOTOCATALYST FOR ACCELERATED PHOTODEGRADATION OF POLYSTYRENE PLASTICS

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Background: increasing plastic consumption has lead to a steep rise in the amount of plastic debris worldwide. Photodegradation could be considered as one of the safest and cheapest approach for the eradication of plastic wastes. TiO_2 proved to be an efficient photocatalyst in various environmental waste purification processes. Herein accelerated photodegradation of polystyrene (PS) is studied by surface modified nano TiO_2 using

graphene oxide (GO).

Methods: GO has been synthesized and successfully incorporated to nano TiO_2 through hydrothermal process. Photodegradation of PS, PS-TiO_2 andPS-TiO_2-GO was studied under artificial UV irradiation and monitored at regular intervals using GPC,IR, UV-DRS, SEM etc.

Results: XRD, HRTEM, SAED and FTIR analysis confirmed that the prepared TiO_2-GO existed as crystalline nano particles with molecular interactions between TiO_2 and GO. GPC and FTIR spectra of the polymer specimens revealed chain breakage and oxidation of polymer chains upon UV irradiation due to photodgradation. Degradation percentage was determined to be maximum for PS loaded with TiO_2-30% GO composite.

Conclusions: The catalytic efficiency of nano $TiO_2$for the photodegradation of PS under UV irradiation has been enhanced by GO incorporation.

Keyword: Photodegradation, polystyrene, TiO_2-GO, photocatalyst, ultraviolet irradiation,

03-12

VOLTAMMETRIC SENSOR FOR THE INDIVIDUAL AND SIMULTANEOUS DETERMINATION OF NOREPINEPHRINE AND TYRAMINE

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Background: Norepinephrine (NE), an important catecholamine neurotransmitter participates in various functions of central nervous system. Abnormal levels of NE indicates various diseases such as heart failure, thyroid hormone deficiency, ganglia neuroblastoma, parkinson's disease etc and hence its quantitative determination is highly demanded. Tyramine (TYM), belongs to the family of biogenic amines, plays an important role as catecholamine releasing agent. Excess concentration of TYM leads to blood pressure increase, difficulty in breathing, hypertension, flush, vomiting etc. Since higher amount of TYM leads to the release of NE, the simultaneous as well as individual determination of these two analytes is vital in current research. In this context, we have developed a simple voltammetric sensor for NE and TYM based on poly (L-arginine)/ graphene modified glassy carbon electrode.

Method: Glassy carbon electrode is modified with poly (L-arginine)/graphene based on a reported procedure. The quantification of NE and TYM were carried out using square wave voltammetric (SWV) technique by scanning the potential between 0 and 1 V at scan rate of 0.1 V/s in PBS of pH 7. Well defined and well separated peaks were obtained.

Results: The sensor parameters have been optimized and under such conditions, the sensor permitted the quantification of NE and TYM with wide linear ranges and low detection limits both individually and simultaneously. For the simultaneous determination, NE varied linearly in the ranges 3×10^{-7} - 1×10^{-6} and $2 \times 10^{-6} – 8 \times 10^{-6}$ and TYM in the ranges 6×10^{-7} - 6×10^{-6} and $2 \times 10^{-5} – 6 \times 10^{-5}$. The feasibility of the sensor has been checked in artificial blood serum and urine samples.

Conclusion: A voltammetric sensor for the individual and simultaneous determination of NE and TYM has been developed based on a composite film of poly (L-arginine)/graphene modified glassy carbon electrode. Wide linear ranges with lower detection limits make the proposed sensor superior to other electrochemical sensors. Simple, sensitive and rapid response makes the sensor highly useful in real time analysis.

Keywords: Voltammety, Simultaneous determination, Norepinephrine, Tyramine

03-13

A FLUORESCENCE SENSOR FOR CARDIAC BIOMARKER MYOGLOBIN BASED ON PALLADIUM NANOCLUSTERS

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Background: Acute myocardial infarction (AMI) is the leading cause of morbidity and mortality worldwide. Myoglobin (Mb) is considered as the best candidate for early clinical diagnosis of AMI.When a muscle is damaged Mb is released into the blood stream, its serum level increases to 4.8 μM from 0.48–5.9 nM. Fluorescent palladium nanoclusters have attracted considerable interest due to their facile synthesis and good photophysical properties.A simple fluorescence method for Mb has been developed based on methionine stabilized palladium nanoclusters (Met-PdNCs). The fluorescence of Met-PdNCs can be efficiently quenched by myoglobin. Development of sensors for cardiac biomarker such as myoglobin is important for developing countries like India. In this context, we have developed a fluorescence sensor for myoglobin based on palladium nanoclusters.
Method: The probe, fluorescent Met-PdNCs was synthesized based on a previously reported method. Fluorescent Met-PdNCs were excited at 350 nm and shows emission maximum at 440 nm. To a definite volume of Met-PdNCs different concentrations of myoglobin were added and the fluorescence intensity was measured in each case. A linear graph was obtained by plotting I_0/I vs. concentration of myoglobin with I and I_0 being the fluorescence intensities in the presence and absence of myoglobin, respectively.
Results: The effect of concentration of myoglobin on the fluorescence intensity of the probe was studied and it was found that there was a linear relationship between the concentration of myoglobin and I_0/I value within the range of 8.00×10^{-7} M to 1.00×10^{-5} M with a detection limit of 1.67×10^{-7} M. The mechanism underlying fluorescence quenching was investigated by studying lifetime, absorption and emission features of the Met-PdNCsin the absence and presence of Mb. It was concluded that inner filter effect facilitates the ground state interaction between probe and analyte.
Conclusions:A novel fluorescent sensor for the determination of the biomarker myoglobin was developed based on palladium nanoclusters. The proposed sensor was cost effective compared to the biosensors used in immunoassays. The reaction mechanism has been discussed and the developed method was successfully applied to the determination of myoglobin in synthetic blood serum. Simple, sensitive and rapid response makes the sensor highly useful in real time analysis.
Keywords: Cardiac biomarker, Myoglobin, Palladium nanoclusters, Acute myocardial infarction, Inner filter effect, Immunoassays

03-14

VOLTAMMETRIC SENSING PLATFORM FOR SIMULTANEOUS DETERMINATION OF XANTHINE AND HYPOXANTHINE

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Background: Xanthine (XA) and hypoxanthine (HX) are the important intermediate in the purine metabolism and are found mainly in body tissues and fluids. The concentration of these compounds in body are indicative of many clinical conditions. Also, in food industry XA and HX levels determines the fish and meat freshness. Thus an effective method for the simultaneous determination is necessary from the clinical diagnostic and industrial point of view. Among the reports, non-enzymatic electrochemical sensors offer rapid, reliable,

less expensive, sensitive and selective determination. In view of this, a voltammetric sensor was developed based on poly (para toluene sulfonic acid) and gold nanoparticles modified glassy carbon electrode [*p(*PTSA)/AuNPs/GCE].

Method: The electrochemical experiments were performed on CHI6023D electrochemical analyser comprising of a three electrode set up and *p(*PTSA)/AuNPs modified glassy carbon electrode (GCE) was employed as the working electrode.

Results: The experimental parameters for the simultaneous determination has been optimised.The increase in peak current with concentration was linear for individual as well as simultaneous determination for both XA and HX. For simultaneous determination, peak current changes with concentration in the range $6.0\times10^{-4}$to 6.0×10^{-6}M for XA and 6.0×10^{-4} Mto $4.0\times10^{-5}$for HX. The sensor was successfully applied for determination of XA and HX in artificial urine and serum.

Conclusions:A voltammetric sensor has been fabricated for the simultaneous determination of XA and HX. The utility of the proposed sensor for the determination of the purines in spiked urine and serum samples confirmed its reliability.

Keywords: xanthine, hypoxanthine, poly (para toluene sulfonic acid), gold nanoparticles, simultaneous determination.

03-15

SYNTHESIS, CHARACTERIZATION AND BIOLOGICAL ACTIVITIES OF METAL COMPLEXES OF 4-BENZYLOXYBENZALDEHYDE-N(4)-METHYL-N(4)-PHENYL THIOSEMICARBAZONE

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Background: Thiosemicarbazones are prominent sulphur donorligands, especially for transition metal ions. Their conspicuous biological activities, have since been proved to be linked to their metal complexing capacity. They are principally Schiff's bases obtained by the condensation of an aldehyde or a ketone with thiosemicarbazide.

Methods:4-Benzyloxybenzaldehyde-N(4)-methyl-N(4)-phenylthiosemicarbazone (L) was synthesized by the condensation of 4-benzyloxybenzaldehyde and N(4)-methyl-N(4)-phenyl thiosemicarbazide. Complexes of this ligand with Co(II), Ni(II), Cu(II), Zn(II) and Cd(II) were prepared. The structure of the ligand (L) was proposed based on elemental analysis, ESI-MS-, FT-IR- and ^{1}H NMR spectra. Its complexes were characterized by vibrational-, electronic- as well as EPR spectra and TGA- and magnetic moment measurements. The ligand and their metal complexes have been tested *in vitro* for their biotoxic effects. Their antibacterial activities against Gram-negative bacteria (*E- coli* and *P-aeruginosa*) and Gram-positive bacteria (*S-aureus* and *B-subtilis*) have been investigated. The *in vitro* antioxidant activities of the free ligand and its Co(II) complex have also been investigated.

Results: On the basis of these studies, all the complexes have been found to possess octahedral geometry. The metal complexes exhibited higher antibacterial activities than the parent ligand. The results of the studies on *in vitro* antioxidant activity of the compounds showed that the ligand exhibited higher antioxidant activity than theCo(II) complex.

Conclusions: This work establishes the use of the title compound as a novel ligand, yielding metal complexes with better biotoxic effects.

Keywords: 4-Benzyloxybenzaldehyde, Thiosemicarbazone, Electronic spectra, EPR spectra

03-16

A DUAL CHANNEL OPTICAL SENSING STRATEGYFOR THE NEUROTRANSMITTER HORMONE NOREPINEPHRINE

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A fluorometric and colorimetric dual channel sensor has been developed for the quantification of norepinephrine (NE). Brown colored silver nanoparticles are formed from the reaction mixture of silver nitrate and NE, which enables the visual detection of these particles, which alsoexhibits strong metal enhanced fluorescence signals. A linear relationship was obtained between the absorbance values and concentration of NE in the range 6.6×10^{-8}M - 1.0×10^{-6}M; the limit of detection being 1.7×10^{-8} M. There was also a linear relationship between the fluorescence intensities and concentration of NE over the range of 5.6×10^{-5} M - 8.9×10^{-3} M, with the corresponding detection limit being 5.5×10^{-6} M. Moreover, applicability of the proposed sensor waschecked in synthetic blood serum, which suggests its great potential for clinical analysis.
Keywords: norepinephrine, sensor, colorimetry, metal enhanced fluorescence, detection limit

03-17

CHEMICAL PROFILING OF *GARCINIA GUMMI-GUTTA* SEED OIL

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Background: Plant derived oils and fats have an important role, both in domestic and industrial sectors.India is one of the largest producers of oilseeds in the world, contributing about 7% of world production.However, due to increasing demand of oils and fats, about 50% of domestic demand of edible oils is met through imports.The purpose of the present study is to validate the viable methods of extraction of oil/fat from the seeds of *Garcinia gummi-gutta*and preliminary phytochemical evaluation of the oil.
Method: The oil yield using different extraction techniques were studied. The seed oil of *Garcinia gummi-gutta*was extracted using Soxhlet, reflux and cold extraction techniques, using hexane as the solvent. The physicochemical parameters such as refractive index and optical rotation were measured, along with UV-VIS spectroscopy, FT-IR spectroscopy and Nuclear Magnetic Resonance spectroscopy.
Results: Among the three extraction techniques studied, the oil yield was higher for Soxhlet extraction method. The solvent system hexane: ethyl acetate: acetic acid gave better resolution of components in the oil.The UV-visible spectrum of the seed oil of *Garcinia gummi-gutta* showed absorption maxima at 275 nm, which refers to transitions involving unsaturated systems. The IR spectrum of the extracted oil indicated the presence of characteristic functional groups such as aliphatic CH group, keto group attached to an ester and unsaturated double bond. Nuclear magnetic resonance spectroscopy is a widely used technique for the identification and structure elucidation of compounds, the ^{1}H-NMR spectroscopy has proven to be a useful tool for the analysis of various chemical parameters of the oil.
Conclusions: The viable methods for the extraction of oil/fatfrom seeds of*Garcinia gummi-gutta*, its physico chemical properties and the chemical composition have been evaluated.The present study highlights *G. gummi-gutta* seeds as a potential source of oil.
Keywords: *Garcinia gummi-gutta,* Seed oil, Extraction techniques, UV, IRand NMR

03-18

TANNIC ACID STABILIZED COPPER NANOCLUSTERS AS A FLUORESCENCESENSOR FOR HEMOGLOBIN

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Background: Hemoglobin (Hgb), which serves as an oxygen transporter is the most important component in the blood of vertebrates. As abnormal levels of hemoglobin can cause serious health effects such as anemia and polycythemia, the timely monitoring of it is very essential.The combination of Fe^{2+} and hydrogen peroxide known as Fenton's reagent can produce hydroxyl and hydroperoxyl radicals which can degrade organic pollutants like tannins. This is applied successfully here in the development of a turn off fluorescence sensor based on tannic acid stabilized copper nanoclusters (TACuNCs) for the sensitive and cost effective determination of Hgb which contains Fe^{2+} ions.
Method: The TACuNCs were synthesized ,characterized and to a certain amount of it about 50 µM H_2O_2 solution and various concentrations of Hgb were added and the fluorescence intensity was noted by exciting at 360 nm, after 30 minutes incubation. Application study of the sensor was also done in the same way in spiked artificial blood serum samples.Plausible mechanism is confirmed by various analysis.
Results: Effective determination of Hgb is possible in the linear range 4.00×10^{-9} to 5.00×10^{-8} M with a detection limit of 5.6×10^{-10}M under optimum conditions.The practical utility of the sensor is evident from good value (101%) of recovery from the spiked samples and it also has a good selectivity in Hgb detection. Various analysis confirms a static quenching mechanism of the sensor.
Conclusion: A very sensitive, selective and cost effective fluorescence sensor for Hgb, which is applicable in real samples has been developed utilizing the effect of Fenton's reagent on Tannic acid.
Key words: Hemoglobin, Copper nanoclusters,Tannic acid, Hydrogen peroxide, Fenton's reagent.

03-19

AN INVESTIGATION ON ANILINE-SODIUM NITROPRUSSIDE COMPLEX FORMATION IN VIEW TO DEVELOP A FACILE METHOD FOR THE ESTIMATION OF TRACE AMOUNT OF ANILINE

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Aniline readily reacts with sodium nitroprusside in basic medium imparting a green color to the solution. The presence of aniline-sodium nitroprusside complex in reaction medium was identified by IR, NMR and mass spectroscopy and the mechanistic interpretation of the reaction was proved by single crystal XRD of products formed in this reaction. The color intensity of the complex always kept a linear relationship with the absorbance and the Beer Lambert's law was proved by UV-visible spectroscopic method.

03-20

MALEIMIDE END- CAPPED POLYETHER TELECHELICS AS NOVEL TOUGHENING AGENTS FOR UNSATURATED POLYESTER RESIN

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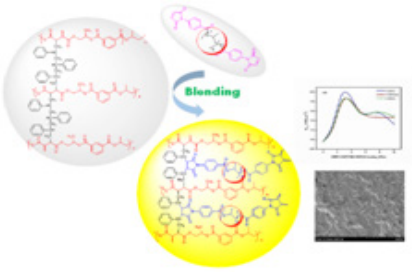
Background: For the development of more toughened and strong Unsaturated polyester resins, different approaches have been adopted by many research groups mainly by blending and composite preparation. In track with these thriving researches in this field, we tried to introduce a novel toughening strategy for UP resins. In the present study, we report utilisation of maleimide-end functionalised oligomeric polyethers as tougheners for UPR matrices. This is the first report on the toughening of a UPR system with bis-maleimide-modified polyether telechelics. The electron-deficient maleimide groups rapidly copolymerise with electron–rich styrene, or vinyl ether. We report here the synthesis of maleimide end capped PPG, PTMO and PEG and evaluation of their role in toughening of UPR resins derived typically from phthalic acid, maleic acid and PPG.
Method: These macro bismaleimides with large spacing between the functional groups were synthesized from the corresponding polyols (hydroxy telechelics) by reaction with (4-Maleimido) benzoyl chloride. These derivatives were characterised by chemical and spectral methods. These were then blended and co-cured with a UPR resin based on copoly-propylene glycol (terephthalate –maleate) and relying on maleic acid –styrene copolymerisation for curing. The impact of the nature, concentration and molecular weight of the telechelic additive on the physical and mechanical properties of the resultant UPR blends was examined.
Results: Addition of the telechelics improved the mechanical characteristics of the crosslinked systems significantly. Their effect on impact properties was tremendous. The improvement in fracture properties, for the telechelics was directly correlatable to a decrease in overall crosslink density estimated experimentally as well as theoretically. The additive's backbone structure dictated the Tg and related properties of the blend. The properties were found to be the best for the blend toughened with M-PPG with a molecular weight 2000g/mol, at 2.5 parts per hundred parts. The morphological features at this concentration as reflected in scanning electron microscopic analyses showed discrete poly ether particles microphase separation in the UPR matrix that acted as a crack path arrester.
Conclusion:

- Maleimide End- Capped Polyether Telechelics were successfully synthesised.
- A tough and strong resin was realised by blending and curing these telechelics with an unsaturated polyester resin.

Keywords: *Upr, Resin Toughening, Telechelics, Bismaleimide, Poly Ether Polyols*



03-21

SYNTHESIS, CHARACTERIZATION AND CATALYTIC ACTIVITY OF METAL COMPLEXES OF FLAVONE BASED SCHIFF BASES

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Two novel Schiff base ligands were achieved from the chemical transformation of flavone derivatives with o-phenylenediamine and their Co(II), Cu(II) and Ni(II) complexes were prepared and structurally elucidated by elemental analysis, magnetic and spectroscopic techniques. The spectroscopic and analytical data confirms square planar geometry of metal complexes and 1:1 metal to ligand stochiometry. The compounds were tested to ensure their ability to act as antimicrobial agents and catalyst in the aerial oxidation of benzaldehyde to benzoicacid. The result shows that the copper complexes are excellent at their antimicrobial activity and also catalytic activity.
Key word :*Flavone, o-phenylenediamine, Schiff base, Catalytic activity, Aerial oxidation*

03-22

NOVEL BINARY NANOCOMPOSITE CATALYST FOR THE TREATMENT OF TOXIC ORGANIC CONTAMINANTS

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The introduction of lanthanum and bismuth based photocatalyst for the successful removal toxic organic pollutants are described in this paper. The binary catalyst composite is synthesized via a microwave assisted method. The structural characterization of the composite is done by fourier transform (FT-IR) spectroscopy and X-ray diffraction technique (XRD). The morphological analysis of the composite is by scanning electron microscopy (SEM) and tansmission electron microscopy (TEM). The low band gap incurred by the composite bolster efficient photocatalytic applications. The photocatalytic degradation studies were optimized with the toxic organic dye such as methylene blue (MB) and contributing that about 47 weight percentage of lanthanum and bismuth based composite shows effective degradation applications. It is anticipated that an efficient degradation of the basic dye such as MB within 120 minutes and a heavy toxic insecticide acephate within 180 minutes. The total organic carbon (TOC) analysis shows the mineralization of about 81.32 % of MB after 120 minutes and about 65.21 % of acephate in 240 minutes solar irradiation. The prominent photocatalytic degradation property of the synthesized binary composite makes it a promising catalyst for future perspectives.

03-23

A NOVEL SGO-AG$_2$S CATALYST FOR THE PHOTO DEGRADATION OF METHYLENE BLUE

Neena John Plathanam,Ragam N. Priyanka and Beena Mathew*

Silver sulfide(Ag_2S) coupled with sulphur doped graphene-oxide composites were prepared by a one-pot microwave-assisted method. The samples were characterized by Scanning electron microscopy (SEM), Energy dispersive spectrometer (EDS),Transmission electron microscopy (TEM), X-ray diffraction(XRD), UV-vis. DRS Spectroscopy, and Fourier transformed infrared (FT-IR) spectroscopy. The as-prepared sulphur doped graphene-oxide/Ag_2S (sGO/Ag_2S) exhibited universally high photocatalytic activity toward typical methylene blue (MB) in aqueous solution. A possible photocatalytic mechanism was investigated by a series

of radical trapping experiment. The kinetics of the sGO/Ag_2S composites were also proposed. The results of the photocatalytic studies reveal that about 71.90% of methylene blue was degraded by the proposed catalyst, which is superior to pure Ag_2S as expected from the observed properties. Hydroxyl radicals were found to have major role in catalytic activity, followed by holes, while superoxide radicals had least effect. The predominant highlight of the work is the involvement of EDTA as the sacrificial agent for improving the degradation of methylene blue with 5%SGO-Ag_2S photocatalyst composite.

03-24

DISCOVERY OF POTENT PANCREATIC LIPASE INHIBITORS VIA NATURAL PRODUCT DERIVED LABDANE APPENDED TRIAZOLE

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Background: Obesity is a metabolic disorder in which excess fat is accumulated in the body. It is associated with serious health problems such as high cholesterol, hypertension, diabetes, cardiovascular disease, asthma, arthritis, and some forms of cancer.Pancreatic lipase plays a vital role in food fat digestion and absorption. Therefore to control obesity, inhibition of pancreatic lipase enzyme is the active therapy.Many natural/herbal products are used for the treatment of obesity and related disorders. Based on the traditional Ayurvedic applications and its wide spectrum of medicinal properties, we have selected *Curcuma amada Roxb*. for the exploration of its inhibition properties against the pancreatic lipase enzyme. *C. amada*, an edible ginger is one of the rhizomatous species in the Zingiberaceae family. *C. amada* used as antimicrobial, antioxidant, anti-inflammatory, anticancer, cardiovascular and gastrointestinal disorders etc.

Methods: Chloroform extracts were used for the extraction of curcuma amada. (*E*)-labda-8,(17),12-diene-15,16-dial isolated by column chromatographic technique using hexane and ethylacetate. The compound characterized by different spectroscopic technique such as IR, Mass, ^{1}H NMR, ^{13}C NMR, DEPT-135, etc. The isolated labdane molecule synthetically modified to triazole analogues through click chemistry. The parent molecule and triazole analogues are tested for their inhibitory activity against porcine pancreatic lipase and human pancreatic lipase.

Results: We have modified (*E*)-labda-8,(17),12-diene-15,16-dial to get the semi-synthetic, biologically important triazole appended analogues. Most of the compounds show better activity. Two of the synthetic analogues have excellent inhibitory activity than positive control orlistat. None of the compounds shows any sign of toxicity. Molecular docking studies have also performed. The docking results have shown that all the triazole analogues are able to interact with lipase.

Conclusion: As anticipated, synthetically modified triazole appended labdane analogues have shownpotent pancreatic lipase inhibitory activity.

Keywords: Zingiberaceae, *Curcuma amada*, Triazoles, Pancreatic lipase, Obesity.

03-25

NOVEL HOLE TRANSPORTING MATERIAL BASED ON CARBAZOLE FOR SOLID STATE DYE SENSITIZED SOLAR CELL

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Background: Nowadays the world is in great need of technologies for providing renewable energy. Solar

energy provides clean abundant energy and is therefore an excellent candidate for a future environmentally friendly energy source. Photovoltaic cells are the devices that convert light energy into electrical energy. Dye sensitized solar cell is one of the most promising photovoltaic technology which is used for the production of renewable and low cost energy. The present work focuses on the synthesis of a hole transporting material based on carbazole by Ullmann coupling. By using the synthesized compound and a natural dye, organic dye sensitized solar cell was fabricated and the performance analyzed.

Methods: The novel hole transporting material Tris(4-(3,6-dimethoxy-9H-Carbazol-9 yl)phenyl)aminewas synthesized by Ullmann coupling and the various intermediate compounds were synthesized by multistep organic reactions.

Results: The synthesized compounds were characterized by UV-Visible, FT-IR and ^{1}H-NMR spectroscopic techniques. The structure of the compounds confirmed from the spectral data. By using the synthesized compound and a natural dye extracted from red sandal wood a solid state dye sensitized solar cell was fabricated and the performance was analyzed.

Conclusion: Here we have synthesized a carbazole based starburst HTM,Tris(4-(3,6-dimethoxy-9H-Carbazol-9 yl)phenyl)amine. The synthesized compounds were characterized using UV-Visible, FT-IR and ^{1}H-NMR spectroscopic techniques. Efficiency of the dye sensitized solar cell is measured using current-voltage (I-V) characterization. Efficiency is minimum due to the presence of natural dye.The conversion of the non-conventional energy; even to its curtailed efficiency is an amelioration to mankind.

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

03-26

STUDIES ON ZINC OXIDE NANOPARTICLES - ENCAPSULATED FUNCTIONALISED BOVINE SERUM ALBUMIN

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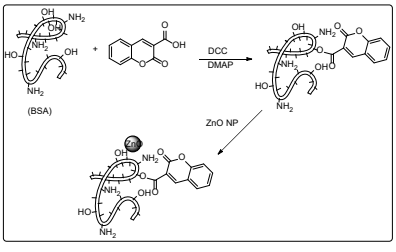
Background: The synthesis of metal oxide nanoparticles attracts an increasing interest due to their new and different characteristics as compared with those of macroscopic phase, that allow attractive applications in various fields such as medicine, biotechnology, optics, microelectronics, catalysis, information storage energy conversion etc. Herein we synthesis zinc oxide nanoparticle for encapsulation into the functionalised biopolymer matrix to investigate the suitability of the system in various applications.

Method: Zinc oxide nanoparticles were synthesized by sol- gel techinique. In the present study we make use of bovine serum albumin (BSA) biopolymeric core system which were functionalized using2-oxo-2H-chromene-3-carboxylic acid photochromic molecule.The chromophoric system selected for the study have free carboxyl functions which were attached to the biopolymeric cores through esterification of the free alcoholic groups of the cores by DCC coupling.(Scheme 1)The newly developed systems were soluble in polar solvents, nature friendly and green in their properties.The esterified products were isolated and purified by column chromatography and dried. Finally the synthesized zinc oxide nanoparticles were stabilized through the encapsulation of these particles into functionalized biopolymers. All the isolated products were then characterized.



Scheme 1. Synthesis of ZnO nanoparticle-encapsulated BSA functionalized with 2-oxo-2H-chromene-3-carboxylic acid.

Results: The functionalized biopolymer obtained after DCC coupling and the final nanoparticle encapsulated product were characterized by [1]H-NMR, FTIR, UV-VIS, XRD, SEM, TEM, DSC andTGA .The spectral and thermal analysis results were in good agreement that the nanoparticle encapsulated functionalized biopolymers show enhanced thermal stability and structural properties than its precursors.

Conclusion: Encapsulation of functionalized biopolymers with zinc oxide nanoparticles will enhance its properties from that of its precursor biopolymer, and chromphoric system.This type of biofunctionalised systems find wide utility in various medicinal fields like bio imaging, bio sensing,photoluminescence etc and also in the field of catalysis , which are areas of future research.

Keywords: Zinc oxide nanoparticles, Biopolymer, functionalisation, encapsulation, application.

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03-27

NOVEL SYNTHESIS OF 2-AMINOTHIAZOLES *via* Fe(III)-IODIDE CATALYZED HANTZSCH TYPE CONDENSATION

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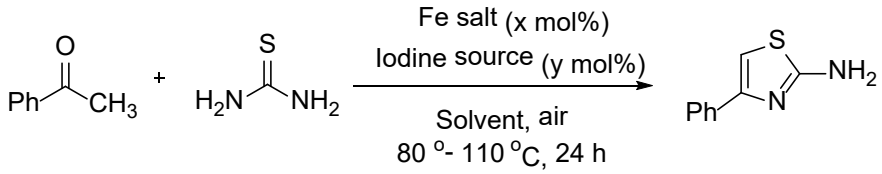
2-Aminothiazoles are very important thiazole derivatives known for their wide spectrum of biological activities. The known methods for the synthesis of these molecules include a) from acetophenone and thiourea mediated by strong oxidizing agentslike Sulfuryl chloride, Sulfur trioxide, Nitric acid, Sulfur etc. b) from α-diazoketone and thioureac) from primary amines and halo-thiocyanatoalkenes d) using stoichiometric amounts of a halogen (e) Hantzsch reaction which involves condensation of thioamides with α-haloketones. Hantzsch reaction was first reported in 1887 and still finds a wide range of applications. Our group's experience in developing transition metal catalyzed versions of classic name reactionsmade us investigate a similar scope in the case of Hantzsch reaction also. By using a catalytic amount of iron and iodine, we could develop a protocol that employs acetophenone and thiourea as the starting materials to afford 2-aminothiazoles. We propose that *via* repeated iron-iodide-involved catalytic cycles,*in situ* generation of α-iodoacetophenone from

acetophenone could take place in the reaction mixture which would react with thiourea to afford the product.



Choosing acetophenone and thiourea as the model substrates we have conducted several optimization reactions by varying the iron catalyst, iodide source, solvent, temperature, catalyst loading etc. We found that our Fe(III)/I^- system is active for theHantzsch type synthesis of aminothiazole. The initial studies provided a promising yield of 58% of the thiazole product. Efforts to achieve improvised yield of the product and to explore the scope of the reaction are going on in our laboratories.

Keywords: Hantzsch-type reaction, Catalysis, Iron, Iodine, 2-Aminothiazole

03-28

SYNTHESIS OF BIMETALLIC IRON PARTICLES AND APPLICATION IN DYE REMOVAL

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Background: Textile dye pollution is one of the major environmental problem faced by the world. Zero valent iron (Fe^0) is a promising material for wastewater treatment. The modification on Fe^0 with a catalytic metal improves its efficiency towards pollutant removal. The objective of this study is to find out the most appropriate iron-based bimetal for dye removal.

Method: Fe^0, Fe/Ni, Fe/Cu and Fe/Zn particles were synthesised using liquid reduction method under a nitrogen atmosphere. Characterization of these particles was done using XRD and SEM-EDAX.Batch experiments for dye removal were carried out on 4 textile dyes and the effect of parameters on dye removal was studied in malachite green dye.

Results: XRD results confirm the presence ofFe^0 in the prepared particles. SEM images show that the particles formed are microparticles and EDS spectra matched with the XRD results. In the application study, most of the dyes show high removal efficiency for bimetallic particles compared with monometallic Fe^0. The parameters such as the effect of the initial concentration of the dye, contact time and adsorbent dosage were studied in malachite green dye removal.

Conclusions: This study shows that bimetallic particles are more efficient than Fe^0 in textile dye removal. Further study is needed to reduce the size of the bimetallic particles.

Keywords: bimetallic nanoparticle, textile dye, zero valent iron

03-29

ISOLATION OF BIO-ACTIVE METOBOLITES FROM RHIZOPHORE SOIL OF MANGROOVE'S ASSOCIATED BACTERIAL STRAINS AND THEIR ANTIBACTERIAL EFFECT ON HUMAN PATHOGENS

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Background: Due to emergence of multidrug-resistant strains of bacteria and fungi, there is an ever-increasing

demand for novel antibiotics with broad antimicrobial spectra. Soil is a rich source of microorganisms, which include neutral, beneficial and harmful organisms. One of the most important beneficial organisms are belonging to *Actinomycetes*, a diverse group of free living saprobic mycelial bacteria present abundantly in the soil, maintaining the structure and integrity of soil. Mangrove soils are a brimful resource of microorganisms, and due to the dynamic physicochemical environment, microorganisms surviving in this area are equipped with various biomolecules, which has many potential applications in pharmaceutical industry. Moreover, many microorganisms isolated from mangroves are reported.

Method: Soil samples were collected from backwaters of Kollam, Kerala. One gram of such soil was suspended in 9 mLof sterile distilled water, vortexed for few minutes, a wire loop of the suspension was streaked on Starch Casein Agar(SCA) plates in triplicates and incubated at 28±2°C for 14 to 28 days. The emerging colonies with different morphological characteristics were selected and the purified strains were maintained on SCA slants.

Results: In this study, a Streptomyces strain designated as ATEA-1 and ATAO-1 showing a broad-spectrum antibacterial activity against *Staphylococcus aureus, Mycobacterium smegmatis, Bacillus cereus* and *Pseudomonas aeruginosa,* also later showing inhibition against*Escherichia coli*, *Klebsiella pneumoniae*, *Proteus mirabilis*, *Salmonella typhi.* Further the metabolite in crude form was isolated by fermenting in a Starch Casein Broth after 6 days of incubation. The fermented broth was extracted using ethyl acetate and then evaporated under vacuum and concentrated. The crude extract was also subjected to antagonistic studies, of which ATEA-1 and ATAO-1 produced metabolic extract showed promising activity against the specified human pathogens. When the characterization is complete we will get a clear idea of the compounds in metabolite.

Conclusion: Mangrove ecosystem harbours many rare actinomycetes with interesting physiologicalproperties. It is suggested that these unique strainsof mangrove actinomycetes be further studied insearch for some broad-spectrum, novel antibiotics.

Keywords: Rhizophore,*Actinomycetes,*Antibiotics,Mangroves.

03-30

Cu-CATALYZED GREEN PROTOCOL TOWARDS THE SYNTHESIS OF 2-AMINOBENZOTHIAZOLE

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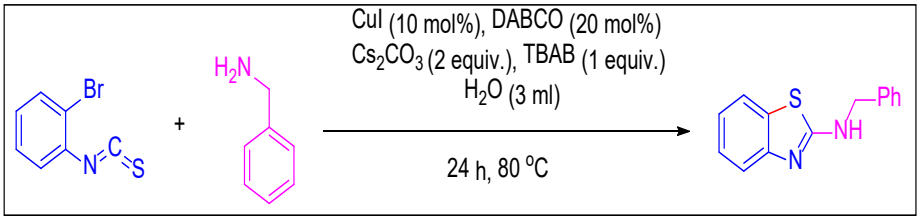
Background: The carbon-heteroatom bond forming reactions are valuable in synthetic organic chemistry, and among the different carbon-heteroatom bond formations, carbon-sulphur bond-formation had paved the way of synthesizing important chemical entities because organosulphur compounds are present in a plethora of biological systems[12].Transition metal-catalyzed protocols are of great important in carbon-sulphur bond-formation since they make any nearly impossible reaction possible. So we chose Cu as the catalyst since Cu is one such metal having low cost, low toxicity, high abundance, easy recyclability, high catalytic activity and excellent functional group tolerance. Thus, we herein report the synthesis of *N*-benzyl-1,3-benzothiazol-2-amine using Cu-catalyzed coupling reaction of 2-bromophenylisothiocyanate with benzylamine.

Methods: A dry sealed tube was charged with 2-bromophenylisothiocyanate (0.23 mmol, 1 equiv.), benzylamine (0.28 mmol, 1.2 equiv.), Cs_2CO_3 (0.46 mmol, 2 equiv.), CuI (0.1 equiv.), DABCO (0.2 equiv.) and TBAB (1 equiv.) in water (3 ml). The mixture was stirred at 80 °C for 24 hours. The reaction was quenched with distilled water and extracted with ethyl acetate (3 x 10 ml). The ethyl acetate layerwas separated, dried using anhydrous sodium sulphate, concentrated and the product was purifiedby column chromatography using a mixture of hexane and ethyl acetate as eluent. Similar fractions were combined on the basis of TLC and the solvent wasevaporated off using a rotary evaporator to give the products.

Results: The reaction was conducted by choosing 2-bromophenylisothiocyanate and benzylamine as model substrates in water and *N*-benzyl-1,3-benzothiazol-2-amine was prepared in 96% yield. Further optimization

studies are currently ongoing in our laboratories.



Conclusion: In short, we have developed a copper-catalyzed protocol for the synthesis of *N*-benzyl-1,3-benzothiazol-2-amine from 2-bromophenylisothiocyanate and benzylamine in excellent yield. The protocol is eco-friendly and cheap as we use water as the solvent and CuI as the catalyst. Further optimization studies and substrate scope explorations are going on in our laboratories.

Keywords: *Cu-catalysis, C-S bond formation, 2-amino benzothiazole, heterocycles, green chemistry.*

03-31

IRON CATALYZED GREENER PROTOCOL FOR THE SYNTHESIS OF 2-AMINO BENZOTHIAZOLES

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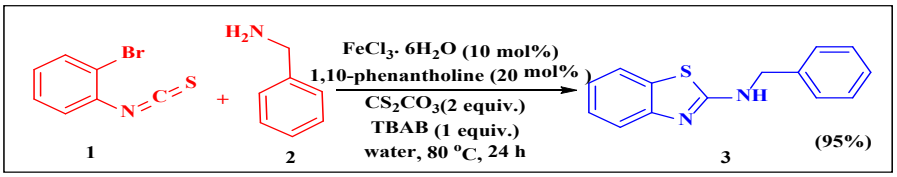
Background: Heterocycles having nitrogen and sulphur have prime importance in synthetic organic chemistry that possess a wide range of medicinal properties and biological activities[3]. 2-Aminobenzothiazole and its derivatives are a major class of fused heterocycles containing sulphur and nitrogen, which possess important pharmaceutical properties such as antiinflammatory[4], antibacterial[5], anti-HIV[6] etc. and are very special for the treatment of diseases like epilepsy[7], tuberculosis[8]and so on. Fe-catalyzed construction of C-S, C-N and C-O bonds found attraction nowadays beyond other transition metals because of their eco-friendly nature,catalytic recyclability,cost-effectiveness and easy availability. We herein describe the first green method for the Fe-catalyzed synthesis of 2-aminobenzothiazoles from 2-bromophenyl isothiocyanate and benzyl amine.

Methods: A 10 ml sealed tube was filled with 2-bromophenyl isothiocyanate (0.5 mmol, 1 equiv.), benzylamine (0.6 mmol, 1.2 equiv.), $FeCl_3.6H_2O$ (0.05 mmol), Cs_2CO_3 (2 equiv.), TBAB (1 equiv.) and 1,10-phenanthroline (0.1 mmol) in water (3 ml). The mixture was stirred at 80 °C for 24hours in an oil bath. The reaction mixture was cooled and then extracted with ethyl acetate (3 x 10 ml). The ethyl acetate layerwas separated, dried using anhydrous sodium sulphate, concentrated and the product was purifiedby column chromatography using a mixture of hexane and ethyl acetate as eluent. Similar fractions were combined on the basis of TLC and the solvent wasevaporated off using a rotary evaporator to afford the products.

Results: Initially we started the reaction by opting 2-bromophenyl isothiocyanate**1** andbenzylamine **2** in DMSO with ferric chloride hexahydrate as catalyst expecting the product, 2-aminobenzothiazole**3** and obtained 81% yield. We studied the reaction in the absence of metal catalyst, but no product was obtained. Then we decided to optimize the solvent for the reaction and found that water acts as a good solvent for this reaction.Among various iron salts screened, $FeCl_3.6H_2O$showed higher catalytic efficiency. We then screened the effect of different bases on the reaction, and Cs_2CO_3 was found to be suitable. Among the screened ligands, 1,10-phenanthroline gave the best result. Time optimization studies revealed that 24 hours reaction yielded the desired product with 95%.



Conclusion: In short, we have developed a novel iron-catalyzed strategy for the synthesis of 2-aminobenzothiazole through the reaction between 2-bromophenyl isothiocyanate and benzyl amine using water as the solvent.Under the optimized conditions, 10 mol% of $FeCl_3.6H_2O$, 20 mol% of 1,10-phenanthroline, 2 equiv. of Cs_2CO_3 and1 equiv. of TBAB in water as solvent at 80 °C afforded 2-aminobenzothiazole in 24 h. It is very essential to develop a cheap and green protocol for the synthesis of aminobenzothiazoles, since they play an important role in the construction of many biologically active and potentially useful molecules.
Keywords: *Fe-catalysis, C-S bond formation,2-aminobenzothiazole, Green Chemistry, Cross-coupling.*

03-32

ISOLATION OF SECONDARY METABOLITES FROM BACTERIAL STRAINS ASSOCIATED WITH SOIL SEDIMENTS OF *ACANTHUS ILICIFOLIUS* AND *RHIZOPHORA APICULATE*, SPECIES OF MANGROVES FROM AYIRAMTHENGU, KOLLAM DISTRICT, KERALA IN SEARCH FOR NOVEL ANTIBIOTICS

Vikas G.,[#,†] Krishnakumar K. A.,[#,†] Jesmina A. S.,[‡] Dileep Kumar B. S.,[‡] and Ravi Shankar Lankalapalli[†]

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Background: World Health Organization (WHO) urged the development of new antibiotics to fight infections produced by multidrug-resistant bacteria (MDR). If no new effective antibiotics are introduced by the year 2050,then there will be more deaths caused by MDR bacteria than by current leading causes of death, which includes cancer. It is believed that mangroves provide a balance in the natural ecological system. Mangroves sustain in highly stressed conditions like salinity with low-oxygen soil, where slow-moving waters allow fine sediments to accumulate.Hence,there is a high possibility of the production of novel secondary metabolites by microorganisms associated with these mangroves.
Method: Soil samples were collected from backwaters of Kollam, Kerala. One gram of such soil was suspended in 9 mLof sterile distilled water, vortexed for few minutes, a wire loop of the suspension was streaked on Starch Casein Agar(SCA) plates in triplicates and incubated at 28±2°C for 14 to 28 days. The emerging colonies with different morphological characteristics were selected and the purified strains were maintained on SCA slants.
Results: In the present study, two*Streptomyces* strains designated as VK-1 and VK-2 that exhibited a broad-spectrum antibacterial activity againstselected human pathogens.The secondary metaboliteswere obtained by fermentation of the strains in a starch casein broth after 7 days of incubation. The fermented broth was extracted using ethyl acetate and concentrated. The crude extract was further subjected to antagonistic studies against both Gram-positive and Gram-negative organisms with promising activity. Structural characterization by exhaustive spectroscopic analysis is underway for the elucidation of secondary metabolites.
Conclusion: This study establishes a new hope of light in the field of antibiotics, which may open new channels in the field of medicine.
Keywords: Mangroves, *Streptomyces,* Antibiotics, Secondary metabolites.

03-33

A NOVEL ZINC-CATALYZED SYNTHESIS OF 2-AMINOBENZOTHIAZOLES.

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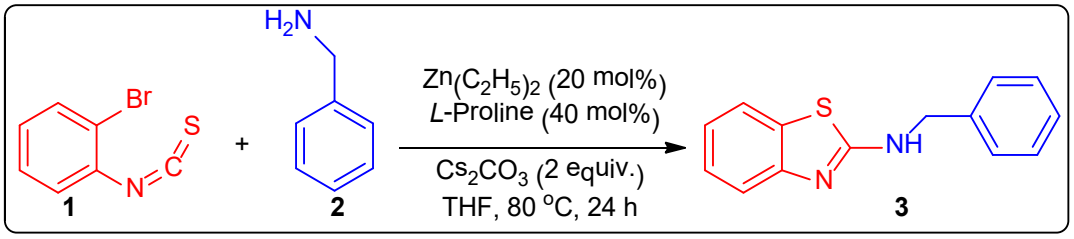
Background: Fused heterocycles have attracted tremendous attention of scientific community due to their biological activity and medicinal importance. 2-Aminobenzothiazole having a benzene fused thiazole bicyclic ring, gained interesting popularity since they are found in many pharmaceuticals and natural products[9]. 2-Aminobenzothiazole and its derivatives have a broad range of agrochemical and biological applications[10]. For the synthesis of 2-aminobenzothiazole and its scaffolds, innumerable efforts were done in the past few decades and many more are in progress. Because of the accessibility, abundance, biological relevance and lower toxicity when compared to other metals, zinc plays a promising role in oxidations, reductions, C-C, C-N, C-O bond formations[11]. This work discloses the first zinc-catalyzed method for the synthesis of 2-aminobenzothiazoles by using 2-bromophenyl isothiocyanate and benzyl amine.
Methods: A dry sealed tube was filled with 2-bromophenyl isothiocyanate (0.23 mmol, 1 equiv.), benzylamine (0.28 mmol, 1.2 equiv.), Cs_2CO_3 (0.46 mmol, 2 equiv.), diethyl zinc (20 mol%, 0.2 equiv.), and *L*-proline (40 mol%, 0.4 equiv.) in THF (3 ml). The mixture was stirred at 80 °C for 24 hours in an oil bath. The reaction was quenched and the mixture was cooled and then extracted with ethyl acetate (3 x 10 ml). The ethyl acetate layerwas separated, dried using anhydrous sodium sulphate, concentrated and the product was purifiedby column chromatography using hexane-ethyl acetate mixture as the eluent. Similar fractions were combined based on TLC and the solvent wasevaporated off using a rotary evaporator to give the products.
Results: The reaction of model substrates 2-bromophenyl isothiocyanate **1**and benzylamine **2** in presence of 20 mol% $ZnEt_2$, 40 mol% *L*-proline, 2 equiv. Cs_2CO_3 in THF solvent afforded the desired product *N*-benzyl-1,3-benzothiazol-2-amine **3** in 50% yield. Further studies on the optimization are now ongoing in our laboratories.



Conclusion: In summary, we have developed a novel zinc-catalyzed protocol for the synthesis of 2-aminobenzothiazole through the reaction between 2-bromophenyl isothiocyanate and benzyl amine using THF as the solvent. Further optimization and substrate scope studies are currently ongoing in our laboratories.
Keywords:*Zn-catalysis,2-aminobenzothiazole, C-S bond formation, Cross-coupling, Heterocycles.*

03-34

BIO ASSAY GUIDED ISOLATION OF SECONDARY METABOLITES FROM THE MUSHROOM *CLITOPILUS PRUNULUS.*

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Background: Fungi, present in our natural environment produce diverse secondary metabolites for its dominance over other living organisms is an extensive source of antimicrobial compounds. Mushrooms, being a part of fungal kingdom, are valuable sources of nutritional ingredients and biologically active compounds.

The mushrooms showing significant antimicrobial activity can either be used in its crude extract form or the active metabolites can be isolated from it. The mushrooms, if used as its extract, have advantages over the use of chemical substances; mushroom extracts are natural and have minimal unwanted side effects.

Method: 500 g of dried mushrooms kept for extraction in methanol for 3 days. The combined extracts were evaporated fully with rotary evaporator and the crude sample subjected to solvent partition. The Hexane fraction showed significant antibacterial activity and hence further fractionated into five components using 60-120 mesh silica gel. Another fraction in Chloroform also subjected to column chromatography using the same silica as above mentioned.

Results: Analysis of the extracts of *Clitopilus prunulus* resulted in the isolation of a secondary metabolite which is a triterpene and revealed the antibacterial activity of the hexane extract of the mushroom. The hexane fraction shows 20mm thickness activity against gram positive bacteria. The complete structural elucidation needs a stipulated time and more characterizations. The further studies of the active metabolites will be carried out using other spectroscopic and spectrometric characterization techniques.

Conclusion: It is hoped that this study would lead to the establishment of some compounds that could be used to formulate new and more potent antibacterial compounds with minimum side effects.However, it is difficult to scan the entire spectrum of mushrooms present in the area as many of them grow in limited amount in its natural environment. Still mushrooms are a proxy for the fungal metabolites and an effective source for structurally diverse molecules.

Keywords: Mushroom, Bio assay guided Isolation, Secondary metabolites, Antibacterial

03-35

COMPARATIVE STUDY ON THE MECHANICAL AND DIELECTRIC PROPERTIES OF E-GLASS FIBER REINFORCED BISMALEIMIDE-EPOXY NANOCOMPOSITES WITH NANOFILLERS$BaTiO_3$(BT) AND HYDROXYLATED $BaTiO_3$(BTOH)

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Background: Bismaleimide resins (BMI) are high performance thermosetting polyimides that find applications in radar, spaceware composites, stealth technologies,capacitors, printed circuit boards etc.In order to overcome the brittle nature of the cured resin, structural modification like blending with suitable compounds, reinforcement with glass fiber, carbon fiber etc. are adopted.

Method:E–glass fiber reinforced Bismaleimide-Epoxynanocomposites with 2weight %nanofillers;$BaTiO_3$(BT) and hydroxylated $BaTiO_3$(BTOH) were developed by hand lay up method and compression moulded. Mechanical properties like tensile strength and flexural strength and dielectric properties like dielectric constant and dielectric loss were also measured.

Results: Remarkable increase in mechanical and dielectric properties of the differentially loaded (BT & BTOH) BMI-Epoxy nanocomposites.

Conclusion: Bismaleimide-Epoxynano composites with 2 weight percentage of BTOH nanofiller show high tensile strength, flexural strength and dielectric constant indicating that this composition is more adaptable for high dielectric applications.

Keywords: Bismaleimide,$BaTiO_3$nanoparticles,Hydroxylated$BaTiO_3$nanoparticles,Tensile strength, Flexural strength, Dielectric constant

04- EARTH AND PLANETARY SCIENCES

04-01
PYROXENE CHEMISTRY AND AGES OF BASALTIC UNITS IN THE MARE HUMORUM ON THE NEARSIDE OF THE MOON: IMPLICATIONS FOR THE INTERIOR COMPOSITION OF THE EARTH'S MOON

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Mare basalts are the volcanic features on the lunar surface and act as proxies for understanding the volcanic and thermal history of the Moon. The present study investigates the mineralogy and chemical variations of the mare basaltic units in the Mare Humorum on the nearside of the Moon using orbital remote sensing data from recent lunar exploratory missions. The pyroxene compositional variations in these basaltic units have been determined based on their band parameter analysis which enable us to understand the crystallization history of the basaltic magma. The previous ages available for the Humorum basaltic units have been utilized in the present study to understand the chemical evolution of these basalts with time. Hyperspectral data from Moon Mineralogy Mapper onboard Chandrayaan-1 mission showed clinopyroxenes as the major compositions in these basaltic units. The band parameter analysis indicated that pigeonites and sub-calcic augites are the major components in these basalts. The compositional trend between pigeonites and augites pointed towards the differentiation of the basaltic magma while cooling. Two distinct trends, both are nearly parallel to the MgFe-Ca join, are interpreted to be indicative of different flow events within the Mare Humorum. The continuous trend of crystallization along the Mg-Casideline of the quadrilateral plot indicates slow cooling (800°-1200°C) of the magma and more Ca-rich proxene crystallization as the cooling continued. The trend towards the Fe-Casideline of the quadrilateral plot suggests a rapid cooling of the magma as indicated by the clustering of the pyroxenes within a short range of compositions as well as fast cooling rate (1100°C-1000°C). A continuous fractionation was also observed in this trend as compositions change from low-calcium pigeonites to the high calcium augites as the cooling continued. These two distinct compositional trend of pyroxenes
suggest their formation from two different pulses of magmas. It is presumed that the episodic eruptions of different pulses of the magma would have been taken place in the Mare Humorum during its geological history. The longward and shortward shifts in the Band I and Band II centers in the younger and older basalts respectively also indicate that the older basaltic units crystallized more Fe2+-rich pyroxenes or clinopyroxenes with less Ca2+ contents while younger basaltic units were formed from a calcium-rich magma.

04-02
SPATIAL VARIATION OF URBAN HEAT ISLAND IN THE COASTAL CITY OF KOCHI IN INDIA

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Background: The urban population of the world has grown rapidly from 751 million in 1950 to 4.2 billion in 2018.Rapid growth in urbanization significantly alters the natural environments and lead to distinct urban climates. Many urban and suburban areas experience elevated temperatures compared to their outlying rural surroundings; this difference in temperature constitutes an Urban Heat Island (UHI).The present study focuses on the UHI intensity in the coastal city of Kochi in the southern India based on the Local Climate Zone classification (LCZ).
Method: Kochi in Ernakulum district is one of the fast growing cities in the south west coast of India. Mobile surveys were conducted within the city and adjacent rural areas during winter and summer seasons, covering pre-dawn and early evening periods in 2019. In situ measurements were carried out to record urban parameters which best match with each Local Climate Zones.The correlation of UHI intensity and Local Climate Zone

classification was analysed.

Results: The Urban Heat Island intensity and spatial temperature distribution in both season exhibits good correlation with the Local Climate Zone Classification. Highest observed urban heat island intensity in Kochi is 5.3°C during winter morning. Maximum observed UHI intensity during summer morning is 4.3°C.

Conclusions: Proper planning of the built environment and selection of raw materials is necessary to reduce the problem of excessive nocturnal heat loads within the built environment. Conservation of wetlands and paddy fields is the easiest and appropriate method to reduce the heat island effect in the study areas. Cool pavements are also an effective method for the reduction of Heat Island Intensity.

Keywords: Urban Heat Island, Local Climate Zone, Urban Climate

04-03

TREND IN EVAPORATION ACROSS THE CENTRAL REGION OF KERALA(THRISSUR),INDIA

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Background: Evaporation is an essential weather variable influenced by various factors such as ambient temperature, relative humidity, wind speed(Hossein Davarzani et al., 2014.), and vapor pressure deficit, etc. Knowledge of the evaporation rate at a place is useful to assess the irrigation requirement/water demand of crops during dry periods. It also helps the hydrologists to monitor the water balance of an area. Keeping the above in view, an attempt has been made to understand the trend in evaporation across the central region of Kerala.

Methods: The daily evaporation and wind speed data were collected for the period from 1984 to 2008. The daily data were converted to a monthly, seasonal, and annual basis. Trend analysis was carried out monthly, seasonally, and annual basis.

Results: The analysis of evaporation data showed that the trend in evaporation is declining at a rate of 0.043 mm/year from 1984 to 2008. Within the study period, the average evaporation rate varied between 5.5 mm/year and 4.1mm/year. The rate of evaporation during the pre-monsoon period varied between 4.4 mm/day to 7.5 mm/day. During the southwest monsoon period, the highest average evaporation was 3.9 mm/day, while the minimum was 2.6 mm/day. The average evaporation during the post-monsoon period varied between 2.9 mm/day to 4.7 mm/day. The average rate of evaporation during winter was the highest (7.4 mm/day), while the lowest was 4.9 mm/day. Wind speed also showed a decreasing trend. We also found the average rate of evaporation was the highest with the magnitude of 7.1 mm/day with a corresponding average wind speed of 11.7 km/day during the period from 15th November to 15th February. The pentad analysis on evaporation indicated that the highest evaporation existed during the 1984 -1988 followed by 1989-1993 and the lowest was 1994 to 1998.

Conclusion: The analysis revealed that the rate of average evaporation is declining, and this decline in annual average wind speed may be a contributing factor for the present trend of evaporation rate. We found that the evaporation rate was the highest during the winter period due to the impact of easterly wind. This indicates that the crops are suffering from water scarcity beginning from December through May. Therefore, it is advisable to go for irrigating the crops to minimize the prolonged water stress.

Keywords: Evaporation, Wind, Trend analysis, Southwest monsoon, Central Kerala

04-04

VERTICAL DISTRIBUTION OF CLOUDS OVER THE ITCZ DURING WINTER

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Background: Inter Tropical Convergence Zone (ITCZ) is characterized by large scale convergence of moisture from either side of the hemispheres resulting in the building up of deep convective clouds. It serves as the ascending limb of the Hadley circulation. The studies on the vertical distribution of clouds over the ITCZ is rather limited. Our study focuses on the characteristics of the not so understood vertical distribution of clouds.
Method: Taping the potential of the spaceborne cloud radar (CloudSat) and lidar (CALIPSO) satellites to detect thick and thin clouds, we explore the latitude-altitide cross-sections of clouds for different longitude belts for winter season over the Indian Ocean.
Results: It is found that during winter, ITCZ has a east-west tilt over the Indian Ocean with clouds extending upto 17 km in the east equatorial Indian Ocean region. Amount of cloudiness and strength of convection vary in different longitude belts. The width of ITCZ is maximum in the east with 15—17° in the lower levels while the cirrus outflows to north and south extends to 35—40°. The frequency of occurrence of clouds in the vertical varies from 20—40% upto 12 km altitude and while it is as large as >60% from 12 to 17 km.
Conclusions: The latitude-altitude distribution of clouds in the ITCZ region is studied and characteristics are brought out for the winter season. The low altitude thickness is lesser compared to the upper levels. Meridional winds associated with the Hadley cell carries the outflow to large distance on either sides. The present study highlights the detailed characteristics of clouds over the ITCZ during the winter season.
Keywords: ITCZ, clouds, Indian Ocean, CloudSat, CALIPSO

04-05

ROLE OF CLOUD RESOLVING MICROPHYSICS AND AEROSOL-CLOUD FEEDBACK ON SIMULATION OF EXTREMELY HEAVY RAINFALL EVENT-2018 OVER KERALA

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During southwest monsoon 2018, Kerala located in the south-western part of India has experienced heavy to extremely rainfall events from 07 to 17 August 2018, leading to a devastating flood and causing extensive damage to property. Daily station rainfall analysis suggests that this prolonged heavy rainfall episode occurred between 14 and 18 August 2018. We chose this event to study the sensitivity of microphysics using Weather Research and Forecasting (WRF-ARW) model. We have also understand the aerosol-cloud feedback process in amplifying the rainfall over Kerala.

In this study, cloud resolving simulations with 2-way three domains of 9, 3 and 1-km resolutions are carried out with three cloud microphysics parameterization (WSM6, Thompson, and Thompson scheme with aerosol aware) schemes. We have performed two more combinations of simulations by keeping the intermediate domain (3-km) in explicit and implicit modes to find out what extent the different modes of schemes is predicting the extreme rainfall events. The model results are compared with the observations such as Automatic Weather Station, Tropical Rainfall Measuring Mission, radiosonde, Global Precipitation Mission precipitation estimates and Doppler weather radar observations. Results show that the significant differences in simulated surface winds, low-level convergence and rainfall pattern between cloud microphysics

parameterization schemes due to the variations of hydrometeors features in each scheme. Comparison of hydrometeor structure with Doppler weather radar estimates and thermodynamic diagrams of radiosonde reveal that the changes in microphysics play important role on the thermodynamic conditions. Indirectly, these thermodynamic conditions are favourable for the heavy rainfall over Kerala and associated strong convective instability due to the strong westerly jet along with formation of offshore vortex, conductive vertical shear of horizontal winds. The comparison of station rainfall data and satellite merge estimates suggests the new Thomson scheme with cloud-resolving implicit mode is better captured the observed heavy rainfall in both spatially and temporally.

Keywords: Heavy rainfall events, Kerala, Cloud Microphysics, and WRF-ARW model

05- ENGINEERING & TECHNOLOGY

05-01

ZnO DECORATED ANTI-BACTERIAL ELECTROSPUN ABS NANOCOMPOSITE MEMBRANE FOR OIL-WATER SEPARATION

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Here we report the fabrication and performance of a superoleophilic and anti-bacterial nonwoven nanofibrous poly(acrylonitrile-*co*-butadiene-*co*-styrene) [ABS]/ZnO electrospun nanocomposite membrane.The electrospun ABS membrane was decorated with floral ZnO nanoparticles (NPs) by a post-treatment method. The pristine ABS and nanocomposite membranes showed super oleophilic nature and could selectively separate different oils from the oil-water mixture by a gravity-driven technique. The ZnO NPs in the nanofiber could enhance the oil flux and also imparted anti-bacterial activity to electrospun ABS membrane against *Escherichia coli* and *Staphylococcus aureus*. The current nanofibrous system can be a good candidate for multi-functional oil-water separation.

Keywords: Polymer nanocomposite; Electrospinning; Nanofibrous membrane; Oil-water separation; Super leophilic system; Anti-bacterial property

05-02

BUFFER CAPACITY OF DIFFERENT MILKS IN RELATION WITH ITS PROTEIN AND MINERAL CONTENT

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Background: Milk can withstand small changes in its pH value due to the buffering capacity. This is called the buffering capacity which is important during processing of milk at different conditions. Some of the milk constituents itself act as the buffering agents. Many minerals in milk are associated together in the form of salts, such as calcium phosphate. The minerals and protein has an important role in regulating buffer capacity. So this study was proposed to find out the relation of minerals and proteins on the buffer action of different milks.

Method: Protein content of different milk samples of raw and pasteurised cow milk as well as raw and pasteurised buffalo milk samples were determined using standard methods like kjeldahl and formol titration method. The protein content were compared and the effect of protein on buffer capacity of the milk samples were analysed. The major minerals like Calcium, Potassium, and Sodium were determined using Flame photometer. The effect of mineral content on buffer capacity was also analysed

Results: The results showed that, both in the cases of cow milk and buffalo milk, protein content decreased

after processing (pasteurization). There were no significant changes in mineral contents of both cow and buffalo milk samples. Buffer capacities of buffalo milk samples were higher than cow milk samples in both raw and pasteurized samples. The results showed that the protein content has a direct relationship with buffer capacity eventhough the effect was more on raw milk samples compared to pasteurized ones. The mineral content in raw cow milk significantly affects the buffer capacity.

Conclusion: We can conclude that the compositional parameters like protein and minerls content has an important role in contributing buffering properties to milk.

Keywords: Protein, minerals, buffer capacity, cow and buffalo milk

05-03

DOPING ASSISTED FACET TAILORING OF MoO_3

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Background: Low dimensional metal oxides likeMoO_3 have stimulated great interest for basic scientific research due to their unique electrical, optical and mechanical properties making them suitable for applications in photodetectors, light-emitting diodes, photovoltaics, optical and electronic devices, gas sensors batteries and multi-chromic coatings. The ionic radius of manganese being closer to molybdenum, the doping of MnO_2 can be expected to influence the properties of MoO_3 significantly.As a transition metal, manganese exist in various valence states which in turns form a variety of mineral with distinct physical and chemical properties. When different phases of manganese oxide are mixed, they can inter-grow to form a new structure. Over the years, the variation in structural forms and properties has made manganese oxide a suitable candidate for different applications such as energy storage system, biosensor, and superconductors.

Method: In this work, we have grown manganese dioxide doped MoO_3 nanostructures on glass substrates using RF magnetron sputtering technique.The commercially available molybdenum oxide powder was mixed with manganese oxide powder at doping concentrations of 0,1,3,5 and 7 wt%.The deposited films were annealed in air for 1 hour at a temperature of 400^0Cand the effect of doping on the structural, morphological and optical properties of the films are also studied.

Results: It is found that for the argon pressure 0.02 mbar and for 7 wt% of MnO_2 perfect doping occurs as evidenced by the XRD pattern. For other doping concentrations the film exhibit amorphous nature. The rod-like morphology of MoO3 is found to grow in the direction of the (6 9 0) plane to form pillar rock structure.

Conclusion: In the present work, Manganese doped (MoO_3: Mn) nanostructures have successfully been grown by radio frequency (RF) magnetron sputtering technique. The study reveal that facet tailoring of MoO_3 is possible by the doping by MnO_2 at suitable at a weight percentage of 7 and argon pressure of 0.02 mbar. Thus the study suggests depending on the nature of application facet tailoring is possible by manganese doping.

Keywords: Radio-frequency (RF) magnetronsputtering,X-ray diffraction, Field emission scanning electron microscope.

05-04

STUDY ON THE EFFECT OF METRO ON THE MODE CHOICE BEHAVIOUR OF COMMUTERS IN KOCHI CITY

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Background: A steep rise in the travel demand of the commuters in Kochi city due to rapid urbanization and intense commercial developments in the recent years have adversely affected the existing transportation system in the city.The metro system was instrumental to mitigate traffic congestion, while providing safe

and rapid transportation to commuters and reducing pollution and noise levels.A proper analysis of the mode choice decisions of the commuters helps in addressing issues such as mitigating traffic congestion, allocating resources and examining the general efficiency of travel.

Method: The major objectives of the present study are to study the socio-economic and travel characteristics of existing metro users in Kochi city as well as to develop a mode choice model using NLOGIT by considering both socio-economic variables and trip characteristic variables. Revealed Preference Survey (R P Survey) was conducted among the existing metro users to study their socio-economic characteristics, travel characteristics, the reasons for using metro and their opinion about Kochi metro. Stated Preference survey was used to determine the commuter preference and willingness to shift to the metro system by providing eight distinct scenarios that consisted of both existing and proposed values for system attributes like travel cost, waiting time, parking facility and feeder services.

Results: About 41% of metro users surveyed had monthly family income below Rs 15000 whereas only 8% of the total number of commuters comprised of the higher income groups. A Binary Logit model was developed using the N LOGIT software and found out that the decision made by the commuters depends on the travel cost and availability of parking facility. Mode Choice Model predicted that the expected shift of non-metro commuters is 59.6%.

Conclusions: It was found out that the ridership in metro could be enhanced by reducing the travel fare and providing adequate parking facilities. A better physical integration between the metro and the feeder system would result in minimum transfers which could attract more commuters to metro service.

Keywords: Revealed Preference, Stated Preference, Binary Logit, commuters

05-05

NATURAL RUBBER LATEX FLOCK BASED PACKAGING MATERIAL – A GREEN ALTERNATIVE TO EXPANDED POLYSTYRENE

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Background: Expanded polystyrene (E-PS), a well-known rigid cellular plastic widely used for the secondary and tertiary packaging especially for brittle products as it is a light yet rigid foam with good thermal insulation and high impact resistance. However, E-PS is non- biodegradable in nature. Here we introduced a green approach to exploiting the unique characteristics of Natural rubber (NR) latex as a bio degradable alternative to EPS. We proposed a new method of approach by introducing organic filler anticipated to obtain better toughness.

Method: The Dunlop process of production of NR latex foam, Sulphur and accelerators are added to the latex. The latex compound then foamed by introducing air into it. After attaining the desired volume, cotton flock, foam stabilizer, zinc oxide and delayed action gelling agent were added.

Results: The morphological analysis of the NR latex foam and CNR latex foam was exemplifies a hierarchical arrangement of porous structure. From the SEM and optical microscopic images, it was observed that the cotton fibers are homogenously arranged. EDX analysis confirms the elements present in the NR and CNR latex foams. ATR analysis explore the various functional group present in the NR and CNR latex foam. The thermal degradation of CNR latex foam is faster than and leaves low residue when compared with pure NR foam

Conclusion: In Summary, this study presents a green packaging material alternative to E-PS developed by physically and structurally and modulating NRL foamby incorporating cotton flock. It processlow density,sufficient mechanical property and re-usable and hence become an environmental-friendly packaging

material. The results also create a new applicationto the natural rubber industry for environmental friendly packaging material for a multitude of applications.

Keywords: Cotton fiber, expanded polystyrene, Natural Rubber Latex foam, Packaging material, Thermal degradation.

05-06

EFFECT OF PHTHALOCYANINE INCORPORATION IN THE OPTICAL LIMITING PROPERTY OF NATURAL DYE

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Background: Materials with an ultrafast nonlinear response and optical limiting property has got significance in research areas due to their wide range of applications in optical computing, optical switches, optical memory devices etc. The phenomenon of optical limiting in nonlinear materials is because of the mechanisms like nonlinear scattering, reverse saturable absorption (RSA) and thermal defocusing/refractive index effects. The incorporation of suitable material with good nonlinear properties into the natural dye will help to enhance the nonlinear as well as optical limiting properties of the natural dye.

Method: In this work, the chlorophyll pigments extracted from the leaves of *ocimum sanctum* using acetone is taken as the natural dye. In order to study the effect of phthalocyanines in this natural dye, cobalt phthalocyanine(CoPc) and tin phthalocyanine (SnPc) are selected due to their good absorption in the visible as well as near IR region.For analysing the linear absorption of the samples, UV-visible absorption spectroscopic analysis is used and the simple and accurate Z-scan method is used for the nonlinear characterization of the samples and optical limiting study.

Results: The study reveals that the incorporation of the metal phthalocyanines considerably improves (i) linear absorption in the visible and near IR region, (ii) nonlinear reverse saturable absorption (RSA), and (iii) the optical limiting property of the natural dye.Among the metal phthalocyanines, cobalt phthalocyanine is found to enhance the linear and nonlinear optical properties of the natural dye compared to its counterparts. It is also interesting to note that this incorporation enhances the optical properties without disturbing the original characteristics of the natural dye. These results enable the material to be used as a potential candidate for dye-sensitized solar cell and sensor applications.

Conclusions: This work establishes a method for improving the linear as well as nonlinear absorptive properties of the natural dye and hence helps to make it as a good optical limiter.

Keywords:Z-scan method, optical limiting, natural dye, metal phthalocyanines.

05-07

DEVELOPING BIOACTIVE CROSSLINKED HIGH DENSITY POLYETHYLENE REINFORCED WITH CHITOSAN AND HYDROXYAPATITE: A STUDY BASED ON THE STRUCTURAL AND MECHANICAL CHARACTERIZATION

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Background: The traditional approach of designing composites comprising of available bio- materials offers numerous possibilities for designing implants. The current work focuses on the preparation and characterization of a ternary composite comprising of high density polyethylene (HDPE) - chitosan – hydroxyapatite, having

properties resembling the cortical bone.

Methods: The preparation of HDPE-chitosan-hydroxyapatite biocomposites was done in a Brabender plastogaph. Maleic anhydride was added to improve the miscibility of the composites by a peroxide initiated process at 160 °C. The plasticizing effect of palm oil was studied on the ternary system. Mechanical and structural characterization was done to understand the interaction between the components used. The biocompatibility studies on the composites were done using MC3T3-E1 cell lines.

Results: The present study defines a relation between the mechanical and structural aspects when modified HDPE is incorporated with chitosan and hydroxyapatite. The increase in tensile strength for the plasticized HDPE/CS/HA composites can be ascribed to the better interaction developed in the polymer interface with the filler. When varying concentration of hydroxyapatite is added to plasticized composites, the impact strength is increased upto 105.9 kJ/m^2 in addition of 8 wt% hydroxyapatite.The FTIR analysis further confirms this interaction. The loss modulus explained the crystallinity formed in the system. The composites exhibited good hydrophilicity which further enhanced the cell proliferation

Conclusions: Mechanical characterisation revealed that the prepared composites show comparable mechanical properties as seen in human cortical bone. Mechanical properties were further supported using dynamic mechanical analysis.The prepared composites have good potential in medical implants especially for cortical bone implants.

Keywords: HDPE, Chitosan, Hydroxyapatite, Impact strength, FTIR, Cell proliferation

05-08

IN SILICO ANALYSIS FOR PROBING THE BIOETHANOL PRODUCTION POTENTIAL OF ZYMOMONAS MOBILIS

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Background: Concerns on greenhouse gas emissions resulting from the consumption of petroleum derived fuels demand alternative energy sources and bioethanol is one of the potential substitutes. *Zymomonas mobilis*is a microorganism used for bioethanol production and has higher sugar uptake rate and ethanol yield. Reconstructed metabolic networks are now available for many of the microbes and it help the *in silico* predictions of metabolic phenotypes. Dynamic Flux Balance Analysis (dFBA) is an efficient mathematical approach for the investigation of such reconstructed metabolic networks. Here, dFBA is used for predicting the bioethanol production from glucose and xylose using genetically modified *Z. mobilis* and a sequential co-culture of wild-type *Z. mobilis* with *Pichia stipitis*.

Method: Flux Balance Analysis (FBA) is an efficient mathematical approach for predicting the metabolic fluxes in a metabolic network under steady state conditions. Dynamic FBA is an extension of classical FBA for accounting the dynamic situations in a bioreactor. The dFBA models are obtained by combining stoichiometric equations for intracellular metabolism with dynamic mass balances on key extracellular substrates and products. Here, the metabolic network of *Z. mobilis* is modified for xylose uptake by *in silico* genetic manipulation and is used for investigating the bioethanol production from glucose/xylose mixtures. The metabolic models of *Z. mobilis* and *P. stipitis* are used for predicting the bioethanol production from substrates having separated glucose and xylose fractions.

Results: The dFBA model for *Z. mobilis* is developed from a medium-scale metabolic model of central carbon pathway. After incorporating the *in silico* genetic manipulations for xylose consumption, the model predictions were compared with the experimental data for biomass production, substrates uptake and ethanol production. A good fit between experimental data and model predictions were observed. The sequential co-culture is considered for substrates having separated glucose and xylose fractions using two wild-type microorganisms, *Z. mobilis* and *P. stipitis* and this predicts an ethanol yield of 0.48 g/g from substrate having glucose and xylose in 3:1 ratio.

Conclusions: The dFBA models for mono-culture of genetically manipulated *Z. mobilis* and a co-culture of *Z. mobilis* with *P. stipitis* have been developed. Bioethanol production potential from both culture schemes are predicted and validated with experimental data. *In silico* analysis of the metabolism would providevaluable guidance for designing and conducting *in vivo* metabolic experiments.

Keywords: Bioethanol, Dynamic Flux Balance Analysis, *Pichia stipitis*, *Zymomonas mobilis*

05-09

AUTOMATIC OPEN-SHUT BIN WITH SMART COMPRESSING SYSTEM

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Background: Throughout the world we are facing a major challenge is the waste management. We have seen that the garbage bins placed at public places in the cities are overflowing and the excess garbage fills out due to increase in the waste every day. If it is not properly cleaned or disposed it creates unhygienic environment and also result in the spreading of deadly diseases and human illness. Cleaning the garbage bin is an important function of municipality which is directly related to health problems.

Here we have figured out an automatic open-shut bin with compressing system which will help the centre of municipality in immediately collecting and cleaning the waste bin. The waste bin is designed with IR sensor which helps the automatic opening and closing of the bin during waste deposal. A compression technique is also used to accommodate more quantity of waste inside the bin. Once the bin is full, the bin will be automatically locked. Then the user will not be able to use it. The status of the bin is available to the concerned authority from the location where they are placed through a wireless transceiver. If a bin is already full then the location of the nearest free bin location will be displayed on the LCD screen. Hence this will help in eliminating the current pathetic condition of the bins in the public areas. Thereby to a great extend ensures a clean and healthy environment.

Method: The brain of the system is Arduino Uno which is based on microcontroller ATmega328p. The main objective of the system is to inform the concerned authority about the status of the waste bin. The open-shut bin consists of two proximity sensors (IR sensors). One of the IR sensor is placed at outside the bin which will detect the presence of a person at the time of disposal. When the IR sensor detects, it will produce a low signal, and the lid will open with the help of a dc motor 1 connected to the microcontroller. The lid will be closed after certain time by the anticlockwise rotation of motor. The compression of the waste is executed by the rotation of dc motor 2. The rotational motion is converted to linear motion by using a linear gear system, the linear motion is used to compress the waste. The two dc motors are triggered by a L293D motor driver IC. One more IR sensor is arranged inside the waste bin to detect the waste level. When the waste level is detected IR sensor will generate a low signal, then microcontroller will send a message to the municipal office through UART. A wireless transceiver is used for the transmission of message. A message from the office with the nearest bin location is displayed on the LCD screen. Once the bin gets filled the lid of the bin is automatically closed. The concerned authority can open the bin by pressing the switch.

Results & Conclusion: The proposed open-shut bin is solution that has become a great motivation put forward for the betterment of our society. Our system consists of IR sensor, thus opening and closing is automatic. Also the linear gear system compresses the garbage immediately after the waste is deposited in the bin. Thus clearing the waste can be done without its overflow. Finally when the bin is full, due to its wireless connection, a message will be passed on to the concerned authority. Through such a small and effective process, we can avoid the overflow of garbage thus preventing from any kind of pollution as well as diseases. Accordingly, we can employ such a smart bin in office, institutions and public places.

Keywords: waste bin management, automatic open shut, smart compression

05-10

DEVELOPMENT OF VARIOUS TRANSPORT RELATED INDICES – A CASE STUDY OF ERNAKULAM DISTRICT IN KERALA

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Introduction: Transport influences and is influenced by the patterns of economic growth and development of a region. Development of a set of transport related indices can help with evaluating the existing transport scenario and help in comparison of similar trends across jurisdictions or regions. These indicators can also be used to evaluate the progress towards or away from the defined goals or targets. A set of transport related indices that were developed for Ernakulam District are discussed in this paper.
Method: In this study, five transport related indices were developed for Ernakulam District, namely Education Accessibility Index (EAI), Medical Accessibility Index (MAI), Road Safety Index (RSI), Road Network Accessibility Index (RNAI) and Transport Potential Index (TPI).In the formulation of Accessibility indices, size of institution/medical facility, distance and population were considered as the parameters. The parameters considered in the development of RSI are number of fatalities per 1000 vehicles, number of grievously injured per 1000 vehicles and number of minorly injured per 1000 vehicles. RNAI was computed as the ratio of the road distance of Panchayaths to the nearest Market center to the air distance between Panchayath center and market center. Municipalities in the District were considered as the Market centers. TPI was formulated using two indicators, Educational facilities and Medical facilities. The weightages obtained by the educational facilities and medical facilities in a corresponding Panchayath/Municipality were summed up to obtain the TPI.
Results and Conclusions: Aluva had the highest EAI value among Municipalities in the District. This may be due to the availability of more number of colleges with number of students more than 2500 within 2 km radius from the Municipality nodal center.Muvattupuzha had the highest MAI value among Municipalities in the District. This may be due to the availability of more number of Multi-Specialty Hospitals within 2 km radius from the Municipality nodal center. Rayamangalam Grama Panchayath had the highest MAI value among Panchayaths in the District. About 14 Panchayaths had no major medical facilities within their boundary.RSI values decreased from 2013 to 2015, and then there was an increase in RSI in 2016. This may be due to the increase in number of fatalities and grievously injured which are the parameters that are given higher priority in the index formulation.About 13% of the Panchayaths have a need for new linkages to their corresponding nearest market centers. There is a need for 11 new road stretches in the District for connecting the Panchayaths with RNAI values more than 1.5 to their corresponding market centers.Koothattukulam had the least TPI score among municipalities. Nellikuzhi Panchayath had the highest TPI score among the Panchayaths in the District, followed by Edathala and Vengola panchayaths.
Keywords: Accessibility, Transport, Index, Accident, Road network

05-11

Al_2O_3 DECORATED ELECTROSPUN POLYVINYLIDENE FLUORIDE CO TRIFLUOROETHYLENE NANOFIBROUS MEMBRANES FOR LITHIUM ION BATTERY SEPARATOR

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Background: Electrospun battery separators have drawn considerable attention due to their high porosity,

surface area, and electrochemical performance. Both P(VDF-TrFE) and Al_2O_3 are well known for their excellent properties, like mechanical strength, piezoelectric nature, thermal stability etc, and the electrospun membrane is prepared by combining the excellence of these two materials.

Method: Anovel class of Al_2O_3 nanoparticlesdecorated Poly(vinylidene fluoride-trifluoroethylene) (P(VDF-TrFE)) membrane was fabricated by electrospinning technique.

Result: The physical properties of P(VDF-TrFE) and the influence of nanoparticles on the physical properties were evaluated by morphological, thermal, XRD and FT-IR analysis.Melting temperature of P(VDF-TrFE) is increased by the addition of Al_2O_3 nanoparticles, and all the prepared membranes exhibit superior thermal and dimensional stability than Celgard 2320 separator. The potential applications of the prepared membrane were explored as a lithium-ion battery separator by characterizing their wettability, electrolyte uptake, % porosity, ionic conductivityand charge-discharge performance

Conclusion: This work proves that Al_2O_3 incorporated electrospun P(VDF-TrFE) membrane is a promising candidate to act as lithium-ion battery separator.

Keywords: P(VDF-TrFE) / Al_2O_3, nanofibrous membrane, Li-ion battery.

05-12

CAPTOR: A NOVEL TECHNIQUE PROPOSED TO IDENTIFY TRAPPED LIVING BEINGS IN DISASTERS

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Background: During the recent landslide disaster happened at Kerala, many of the people were not able to be detected. Even though there are some technologies and mechanisms to detect and rescue such affected people, they are found to be not much effective and lifesaving.This paper aims to propose a new technique,for easy detection of trapped people at the moment of occurrence of disasters.

Method: The proposed method mainly comprises of three units: a sensor unit, a processor unit and a drone. The sensor unit consists of an infrared (IR) sensor and sonar. The IR sensor is capable of measuring the heat being emitted by the human body and detecting motion. Meanwhile, the sonar is capable of sensing the heartbeat of the human which is trapped under debris. The processor unit gives necessary instructions to the sensors for retrieving pieces of information. The combined action of the sensors under the control of the processor unit helps to detect the trapped people in the debris.

Results: This paperproposes a new technique, which would be beneficial for the rescue officers such as fire force and other related people for easy detection of trapped people at the moment of occurrence of disasters. The proposed technology is capable to detect people trapped up to 10 m in depth.

Conclusions: In a normal scenario, it is very difficult to start rescue operations immediately after the unexpected natural calamity.So the development of unmanned technology that helps to detect the people trapped in debris is a need of the time. This helps to easy the rescue operation. The proposed technique is helpful to detect people immediately after the disaster happens.

Keywords: Disaster, Landslide, Infrared sensor, Sonar

05-13

TRAFFIC OPERATION PLAN FOR MEDIUM SIZED TOWNS IN KERALA- A CASE STUDY OF THALASSERY TOWN

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Background: Thalassery town is the majorcommercial center of Malabar region located in Kannur district. Thalassery town is well connected by roads. The town has road network comprising of National Highway, State Highways, Major District roads and other roads. The sad reality of the roads of Thalassery is that, even the National highway 66 passing through Thalassery does not have the standard dimensions specified by the IRC. Detailed road inventory study of the town roads reveal that 70% of the roads in Thalassery town do not have the standard two lane dimensions. The economic boom which is experienced by the town attracts more and more vehicular traffic into the town resulting in frequent traffic congestions and accidents. This paper focuses on scientific analysis of existing traffic problems of the town and proposes a traffic operation plan for the town.

Method: Traffic operation plan will focus on strategies, development concepts, proposals and control regulations for the town. Primary surveys and existing land use details were used to identify major bottlenecks in the study area. Results of volume/capacity ratio, parking accumulation, parking duration, pedestrian vehicle conflicts were thoroughly examined and were useful in identifying the major factors contributing to the traffic problems in Thalassery town.

Results: Proposed traffic operation plan suggests junction improvement proposals based on IRC guidelines, parking regulations, pedestrian facilities, development of new road connecting railway station and bus stand, shifting of market area etc. At-grade pedestrian crossing facilities have been proposed at all major intersections and CBD area of the town to ensure the safe crossing of pedestrians. Outer ring road, inner ring road and road widening schemes are proposed for upgrading the existing road network. Traffic signs and road markings were also proposed based on IRC-67 and IRC-35 respectively.

Conclusions: The study focused on scientific analysis of existing traffic problems of Thalassery town and traffic improvement measures are suggested based on the study. Implementation of junction improvement proposals, parking and pedestrian schemes would reduce the traffic congestion, improve journey speed and ensure safe and orderly movement of traffic in Thalassery town.

Keywords: Traffic operation plan, Volume/Capacity ratio, Junction design

05-14

HARDWARE ACCELERATION OF CONVOLUTIONAL NEURAL NETWORKS FOR IMAGE PROCESSING APPLICATIONS

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Background: Rapid advancements in the field of Artificial Intelligence (AI) and Machine Learning (ML) has enabled the technology to talk the language of images. Convolutional Neural Networks (CNNs) are promising solutions for various ML applications including self driving cars, cancer detection, video surveillance, image detection and recognition and so on. Deploying CNNs on computing systems have found to be extremely challenging due to the complex nature of CNNs. Since CNNs are widely used in portable embedded devices, hardware accelerators for CNNs have emerged as a promising approach due to their high performance and energy efficiency.

Method: This work explores various techniques for efficiently realizing CNNs on hardware, for image processing applications. A unified architecure using Winograd algorithm and general matrix multiplication has been proposed to accelerate CNN with high performance and low power consumption. A novel algorithm is proposed, which transforms Winograd algorithm into blocked general element-wise matrix multiplication which targets optimal utilization of memory and bandwidth.
Results: Proposed architecture has been implemented in Xilinx Virtex-7 FPGA and shows 1.4x to 4.02x performance improvements with less than 15% additional hardware resources compared to existing implementations. Popular CNN models like AlexNet, VGG-16 and ResNet-18 were accelerated using the proposed architecture.
Conclusions: CNNs are widely used in image classification tasks in embedded devices which require low power consumption. This work presents an energy efficient hardware accelerator for CNNs using unified Winograd and general matrix multiplication algorithm.
Keywords: Machine Learning, Convolutional neural networks, Hardware acceleration, Energy efficiency

05-15

GEOPOLYMER CONCRETE BASEDPRE-CAST CONSTRUCTION PRODUCTS

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Background: Geopolymer is an inorganic polymer binding material derived from waste material like Fly ash and Ground Granulated Blast furnace Slag (GGBS) activated by alkaline solution.No water curing is required. The main advantage of using Geopolymer based construction components are economy with regard to strength and durability aspects. The products will be at par with cement based products but more strong and durable. The ultimate advantages are developing building products making use of waste products like fly ash and GGBS, lower carbon dioxide emission (ECO_2e), lower embodied energy, conservation of lime stone, water conservation etc. thus paving a way for GREEN and LEAN construction.
Method: Geopolymer commonly made with F-class fly ash, GGBS and alkaline solution made with Sodium silicate and sodium hydroxidecombinations as activator solution. Generally Fly ah based Geopolymer is heat cured at 60 to 90 degree Celsius, but the curing can be completed at ambient temperature using suitable mineral admixture like GGBS. Even though fast setting and higher compressive strength can be obtained using alkaline solution of sodium silicate and sodium hydroxide mixture, sodium hydroxide is a hostile material. Surface erosion can occur due to the formation of sodium carbonate by reaction of sodium hydroxide with carbon dioxide present in air. When sodium silicate, Fly ash and GGBS are used in right proportion compressive strength in the range of 40 to 50 MPa with better durability can be obtained for Geopolymer concrete (GPC).
Results: We have developedmore than a dozen of pre-cast components with GPC. The compressive strength obtained for specimen made with Geopolymer based Self compacting concrete (SCC) is about 95% of compacted specimen made with GPC.
Conclusion: Geopolymer concrete can be used at par with cement concrete but with better strength and durability. It has high flow ability without segregation&bleeding required for SCC.
Keywords: Geopolymer, Geopolymer concrete, Geopolymer products,Pre-cast concrete, High performance concrete

05-16

BIOMETRIC ELECTRONIC VOTING MACHINE

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Background: Traditionally, a voting machine has been defined by the mechanism the system uses to cast votes and further categorized by the location where the system tabulates the votes. Voting machines have different levels of usability, security, efficiency and accuracy. Certain systems may be more or less accessible to all voters, or not accessible to those voters with certain types of disabilities. They can also have an effect on the public's ability to oversee elections. Electronic voting systems may offer advantages compared to other voting techniques. An electronic voting system can be involved in any one of a number of steps in the setup, distributing, voting, collecting, and counting of ballots, and thus may or may not introduce advantages into any of these steps. Moreover it is also important that a false entry should not be made so for this one of the most secure methods for voting is using a biometric sensor like a fingerprint reader.
Method: The Fingerprint Voting System (FVS). Since the basis of any voting system is "One Person− One Vote", it stand to reason that must verify that a voter is who they claim to be and that they have not previously voted in this election at another site (to eliminate double voting). The main purpose of fingerprint voting system is to 'Preventing Fraudulent Voting'. This system has basically 5 types of modules. There were

- Fingerprint Enrolment
- Fingerprint verification
- Cast the votes
- Alert for wrong voting
- Generate final report

Results and Conclusions: In total, this system overcomes most of the problems faced during the voting period by the paper ballot system. The efficiency of this system depends upon the web interface, its usability. This will surelyensure a safer voting method which is very much what is required for a healthy growth of a developing nation. In this paper, the proposed Fingerprint based voting system which is better and faster than previous systems. The new system prevents access to illegal voters, provides ease of use, transparency and maintains integrity of the voting process. The system also prevents multiple votes by the same person and checks eligibility of the voter. It also allows a person to vote from anywhere provided that the voter is within electoral limits. Fingerprint based voting system has provided chance to avoid invalid votes, It reduce the polling time, Easy to carrying to polling center from the polling box, Reduce the staff of voting center, It provide easy and accurate counting without any troubles, Provisioning of voting preventive measure
Keywords: FVS, Arduino

05-17

DEVELOPMENT OF PAVEMENT DESIGN STRATEGY FOR RURAL ROADS

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Background: Local Self Government Department (LSGD) in Kasargode district approached NATPAC for the

design of pavement of eleven road stretches in their jurisdiction.

Method: The said roads were catering to low volume of vehicular traffic. The scope of the study was confined to the design of pavement for the roads under the study as per the subgrade strength characteristics and projected traffic. A common methodology was adopted for the all the roads which included reconnaissance and inventory of study corridors and soil sample collection from the subgrade depth towards conduct of various laboratory tests. Trial pits were taken to identify the thickness of the existing pavement layers, along with a general assessment of the materials. Traffic volume Survey was conducted to find out the daily volume of traffic and number of commercial vehicles per day plying on the project roads. Based on the projected traffic as well as the subgrade strength, expressed in terms of CBR, the pavement design strategy for the study roads has been prepared for all the roads.

Results: The result of the study is the design for the 12 roads.

Conclusion: In majority of the roads it is observed that constructing Macadam roads is beneficiary in a long run. The approach was taken in such a way to reuse the base layers wherever possible.

Keywords: Pavement Design, Traffic Volume, Subgrade Strength

05-18

EFFECT OF COUPLING AGENT IN DIFFUSION BEHAVIOUR OF SILICA-GRAPHITE HYBRID NATURAL RUBBER COMPOSITE

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Background: The latest major development in rubber technology is the replacement of carbon black by silica as reinforcing filler. Silica is capable of significantly improving the rolling resistance and wet traction of the tread compounds compared to carbon black. Indeed, by using silica in a tire tread compound, 3-4% fuel can be saved, corresponding to a reduction of rolling resistance of about 20%.

Method: Silica-graphite hybrid filler reinforced natural rubber composites with and without coupling agent were prepared via two roll mill mixing and compression moulding technique. The cure, mechanical, and diffusion properties of the prepared composites were analysed.

Results: Diffusion study shows that the natural rubber composites with coupling agent have minimum solvent uptake or maximum solvent resistance due to the good filler-matrix interaction. The mechanical property also shows similar trends, i.e., composites with coupling agent shows higher tensile strength and elongation at break. Due to the enhanced filler dispersion and mechanical properties, the prepared composites finds various industrial applications.

Conclusion: This work establishes how the coupling agent influences the properties of rubber composites by emphasising the diffusion and mechanical properties.

Keywords: Silica, Graphite, Coupling agent, Natural Rubber, Composites.

05-19

TRAFFIC STUDIES AND PARKING MANAGEMENT FOR MEDICAL COLLEGE CAMPUS, THIRUVANANTHAPURAM

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Introduction: The Government Medical College, Thiruvananthapuram is one of the busiest activity centres in the city. The entire medical college campus that is spread over 139 acres. The existing parking spaces inside the campus are insufficient to meet the existing parking demand. The streets inside the medical college

campus are becoming parking lots with haphazard parking reducing effective road width and affecting the safe mobility within the campus and resulting in congestion. Hence, there is a need for parking space optimization and control in the campus.

Need for the Study: The existing transport infrastructure in the medical college area seems to be highly inadequate to serve the public with a means of safe mobility. The large number of patients, visitors and their vehicles entering into the campus on a daily basis has clogged up the road networks. The parking facilities inside the campus are insufficient to meet the existing parking demand. The present study aims to prepare a comprehensive parking management plan along with suitable parking policy framework that could be easily implemented in Medical College Campus and the surrounding locale.

Scope and objectives of the study: The scope of the study was confined to traffic and transportation improvement measures for medical college area. The main objectives of the study are as follows:

1. To assess the parking demand and supply characteristics in the influence area of medical college campus and the internal roads and to estimate the gap between demand and supply
2. To work out the parking statistics to evaluate the adequacy of parking facilities provided to meet the short duration and long duration parking demand.
3. To identify the appropriate locations for on-street and off-street parking lots depending on the space availability and parking demand.
4. To identify the best Parking Management Strategiesfor on-street and off-street parking and prepare the preliminary design for on-street and off-street parking lots

Data collection and Analysis: Parking survey was conducted at the Medical College campus. 34 parking locations including both on street and off street parking, were surveyed. The license plate method of survey was used to capture the total parking demand. Every parking stall is monitored at a continuous interval of 15 minutes or so and the license plate number is noted down. This will give the data regarding the duration for which a particular vehicle was using the parking bay.

Results: Total parking space available in the medical college campus can house around 400 ECS comfortably with sufficient maneuvering space. As the peak demand is 2037 ECS and parking turnover is 5.1, there is no sufficient space to park the vehicles; these are parked inconveniently causing traffic problems. Thus there is an excess demand and since the area is limited, more land cannot be made available for parking. Parking index for the off-street locations were worked to be values higher than 1 with an average of 2.29. This is because the vehicles are parked haphazardly in the campus occupying the space required for maneuverability as well.

Conclusion: Medical college campus is faced with the twin problem of low supply and ineffective management of existing parking spaces. From the demand assessment study carried out on site, it was found that there is a huge demand for additional parking space and the solutions recommended for overcoming the same are short and long term measures. Short term measures suggested includes provision of demarcated parking bays wherever possible at on-street locations and at other identified off-street locations, provision of sign boards, road markings and lighting facilities on all the internal roads and off street parking locations as per the IRC guidelines, improvements of existing road and intersections etc. It is recommended to provide long term facilities for parking like automated multilevel car parking system at selected locations. The automated multilevel car parking system equipped with the pick and place facility can be adopted, so that the vehicles get a safe parking automatically. In cases of financial constraints the possibility of MLCP with ramp facilities also could be considered. Two vacant sites were identified for the provision of multilevel car parking; one is in the front of OP and other behind the CDC inside the campus.

Keywords: Parking statistics, parking management plan, multilevel car parking system (MLCP), Equivalent car space (ECS).

05-20

DIELECTRIC PROPERTIES OF THERMALLY REDUCED GRAPHENE OXIDE/ POLYANILINENANOROD HYBRID NANOCOMPOSITES

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Background: Graphene is the most widely studied carbon allotrope. But the synthesis of graphene in bulk quantity is a very difficult matter. Generally chemical or thermal reduction of graphene oxide (GO) was employed. Graphene and conducting polymer nanocomposites are employed for wide variety of applications including charge storage devices like capacitors.
Method: Initially, thermally reduced graphene oxide (t-rGO) was prepared via low temperature reduction (400 °C). Further, Pani /t-rGO hybrids were prepared via insitu oxidative polymerisation of aniline in the presence t-rGO. Varying ratios of aniline:t-rGO was used to prepare the hybrids (PGr) . The nanohybrids were characterized using FTIR, XRD, TGA, FESEM and its dc conductivity and dielectric properties were analyzed.
Results: GO was reduced by the low temperatute thermal exfoliation resulted in t-rGo. Pani maintained the nanorod like morphology when prepared as hybrid (PGr). The dc conductivity of hybrids increased with increase in t-rGO loading. Dielectric constant and dielectric loss also increased with t-rGO loading.
Conclusions: This work provides an easy technique for the preparation of graphene at low temperature. The effect of varying aniline/t-rGO ratio in the hybrid (PGr) revealed that the dielectric constant and electrical conductivity increased with increasing content of t-rGO.
Keywords: Dielectric properties, Graphene, Polyaniline, DC Conductivity

05-21

THERMOPLASTIC ELASTOMER BLENDS CONTAINING MWCNTs AS AN ELECTROMAGNETIC INTERFERENCE SHIELD

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Back ground: Electromagnetic interference (EMI) is a major concern in the present era and the rapid growth in electronic equipment and telecommunication devices led to the demand for high performance electromagnetic interference (EMI) shielding materials.The ability of shielding material to block electromagnetic waves depends on materials electrical conductivity, permittivity and permeability. Polymer nanocomposites have gained popularity in this field because of their light weight, resistance to corrosion, structural flexibility, superior processability which can be further tuned based on user needs compared with traditional metal based structures.
Method: Blends of polypropylene (PP) and natural rubber (NR) with different loadings (1,3,5 &7 wt%) of multiwalled carbon nanotubes (MWCNTs) were prepared by melt blending process to design a nanocomposite with tunable electromagnetic interference (EMI) shielding performance. PP/NR blends with two different composition (80/20 & 50/50) were chosen for this study.
Results: Addition of MWCNTs have significant effect on the morphology of PP/NR blends.Scanning electron microscopy (SEM) studies show that the addition of MWCNTs changes the droplet morphology into quasi co-continuous morphology for PP/NR 80/20 (wt/wt) blend system. However there is a refinement in the co-

continuous morphology of PP/NR (50/50) by the addition of MWCNTs. The effects of the blend morphology and selective localization of MWCNTs on the dielectric, electrical properties and EMI shielding performance were systematically investigated. The largely enriched dielectric performance originates from the interfacial polarization of MWCNTs within the polymer. It is understood that the shielding performance significantly enhanced due to the selective localization of MWCNTs in the NR phase that provided high conductivity and heterogeneous dielectric media with multiple interfaces. The blend nanocomposites show a shielding effectiveness of ca.29 dB at 3 GHz for 7 wt% of MWCNT loading

Conclusion: This work opens up new paradigm for electromagnetic shielding applications with the aid of a sustainable and simplified method also.

Key words: Polymer nanocomposites, Dielectric performance,Electromagnetic interference

05-22

INCORPORATION OF WATER HYACINTH IN THEMANUFACTURE OF SUSTAINABLE CONSTRUCTIONMATERIALS: A REVIEW

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Background: The rapid urbanization is creating a shortfall of conventional building construction materials due to the limited availability of natural resources. On the other hand, energy consumed for the production of traditional building construction materials pollutes the air, water and land. To meet the ever-increasing demand for the energy-efficient building construction materials, there is a need to adopt cost-effective, environmentally appropriate technologies and upgrade traditional techniques with available local materials. At the same time, invasive aquatic weeds like water hyacinth (WH) are posing severe economic and environmental issues in Kerala. The plant chokes the life out of the freshwater ecosystem by preventing penetration of sunlight, required for the survival of underwater fauna. Mass fish die-off in lakes appeared several times due to drop in oxygen level caused by WH infestation. Other impacts of WH are a decline in water quality, enhanced evapotranspiration, and reduced biodiversity.

Method: The current article provides a summary of the existing knowledge about the successful use of WH in the production of panel boards, bricks and concrete. WH based sustainable construction materials are evaluated for their physical, mechanical and thermal properties, methods of production and environmental impact. A comparative study with other construction materials is also discussed.

Results: For panel boards, an optimum mix of 80 % WH with 20% cement shows excellent thermal insulation properties. Hence it could be used as an alternative to thermal insulation material. An optimum mix of 10% WH with soil is appropriate for brick production using WH as a partial substitute to the soil. The incorporation of 10% WH leads to 7% net saving in the consumption of fuel required for firing the bricks. In the case of concrete production, the optimum chemical admixture replacement is 20%, at which concrete shows good workability and compressive strength.

Conclusions: The application of water hyacinth for sustainable construction materials provides a solution which offers a reduction in natural resource use as well as energy. The use of WH in the construction industry would contribute to a cleaner environment.

Keywords: Water Hyacinth, fish die-off, underwater fauna, WH infestation, evapotranspiration

05-23

RHEOLOGY, MORPHOLOGY AND VISCOELASTIC PROPERTIES IN EPOXY BASED BLENDS

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Background: Viscoelastic phase separation in polymeric blends were not explored much. The dynamic asymmetry due to the difference in molecular weight and T_g contributed to the viscoelastic phase separation. The nanofillers could vary the viscoelastic phase separation of epoxy/poly (styrene-*co*-acrylonitrile) (SAN) blends and can change the morphology of the system and thereby the processing parameters and ultimate properties.
Methods: This work implies on assessing the processing parameters of epoxy/SAN blends via rheology, optical microscopy. The microstructure evolved as a result of curing reaction was established with scanning electron microscopy. And the final viscoelastic properties were analysed by dynamic mechanical analysis.
Results: Organically modified cloisite20Ananoclay had decreased the processing parameters, ie the time for onset of phase separation, gelation and vitrification of epoxy/SAN blends. Cloisite 20A had caused plasticizing of polymeric chains and had increased the stiffness before glass transition.
Conclusions: This work establishes the use of epoxy/SAN/cloisite 20A nanocomposites which undergoes viscoelastic phase separation for high temperature applications.
Keywords: Nanocomposites, Epoxy resins, Viscoelastic phase seaparation, Glass transition temperature

06- ENVIRONMENTAL SCIENCES, FORESTRY & WILDLIFE

06-01

LANDSLIDE SUSCEPTIBILITY MAPPING USING GIS AND REMOTE SENSING FOR WAYANAD DISTRICT IN KERALA

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Background: Rapid downward movement of a mass of rock, debris and soil move down a slope this is known as Landslips or Landslide due to the gravity. Mapping of Landslide Susceptibility of Wayanad districts in the parts of western ghats in Kerala. Geographical Information System (GIS) has become an important tool for landslide susceptibility mapping because it provides the various functions of handling, processing, analysing, and reporting geospatial data and estimate, assessment, management and relief operations carried out of using this GIS and Remote sensing technology.
Method: Collecting of existing information and data for the investigation area Wayanad. The important parameters of Rainfall, Landuse land cover, Slope, Aspect, Drainage, Drainage density, Lineament density, Soil, Geomorphology and Geology voluminous data can be properly Prepared and Weightage and Ranking methods analysed with ArcGIS 10.3.1 and ERDAS 14 tools.
Results: The weighted and ranked themes were overlay in GIS. The cumulative map is classified based on its Mean, Standard deviation, Sum. The study area was classified into Four susceptible classes. They are zone I, zoneII,zone III, and IV. Whereas zone I is low susceptible while zone IV is very high vulnerable zone. When we compare pre-occurred landslide locations over landslide susceptibility zone map, we found that most of

the landslide locations falls under zone III and zone IV and angle of slope is more than 36 degrees. This zone covered highly Fine loamy and Clayey mixed and High lineament respected to the sedimentary rocky formation are formed.Heavy rain fall is the another important factor of landslides in this study area.

Conclusion: Landslide Susceptibility zones are classified into four classes in wayanad district like zone I to IV. ThisSusceptibility zones approach to land use land cover for which is more dominants to occurrence of landslide. So this zones are Very High and high Landslide susceptibility.Most of the forest lands are converted to the plantations in the zone II, III and IV and development of road constructions using heavy vehicle, mining and quarry ismain causes of landslides. Climate change, flood, excess rainfall and soil piping are other factors of landslides. Forest conservation and restoration is the important measure to avoid huge landslides. Government and NGO conducting awareness programmes to convey the importance of conservation of forest to the people. For disaster management and early warning system always active for mitigation like Kerala state disaster management authority(KSDMA),Indian Meteorological department (IMD); Weather warnings, Central Water Commission (CWC); Geological Survey of India (GSI) / National Centre for Earth Science Studies (NCESS) Landslide Warnings)/State Emergency Operations Centre (SEOC).

Keywords: Landslide, ArcGIS, Erdas, Weightage and Ranking, Susceptibility,Soil Piping

06-02

WESTERN GHATS; ENVIRONMENTAL SUSTAINABILITY UNANSWERED

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The term 'Ecological Sensitivity' is an Indian invention, which means 'areas that are ecologically and economically very important, but vulnerable to even mild disturbances and hence demand conservation'. The Ministry of Environment and Forest set up two committees namely Western Ghats Ecology Expert Panel (WGEEP) popularly known as Gadgil Committee in 2011 and High Level Working Group (HLWG) known in public sphere as Kasthurirangan Committee in 2013 to identify the Ecologically Sensitive Areas of Western Ghats and to make suggestion to conservation of forest in the region. The WGEEP report included entire Wayanad district within ESA and all villages are demarcated as *'no go areas'* whereas according to HLWG report the total area of ESA in the Wayanad district is 952 sq.km, which constitute 44.5 percentage of total geographical area of the district and 13 villages are ESA's. As per the recommendations of these two reports the economic activities should be restricted. In this context environmental protection versus agricultural, commercial and residential land use comes into action. The district has remarkable variation in land use pattern, which is dominated by plantation with a growing urban center surrounded by forested area. This paper analyzes the parameters of the Committees and emerging developmental issues of the district using geospatial technology.

Keywords: Western Ghats, Ecologically Sensitive Area, Land use.

06-03

DIET OVERLAP BETWEEN NATIVE PEARLSPOT (*ETROPLUS SURATENSIS*) AND INVASIVE MOZAMBIQUE TILAPIA (*OREOCHROMIS MOSSAMBICUS*) IN LAKE VEMBANAD, INDIA

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Background: *Oreochromismossambicus*listed as one among the 100 most invasive species in the globe causing adverse ecological impacts.*Etroplussuratensis* is a tropical cichlid fish of southern India having huge

economic value. *O. mossambicus*may pose threats to *E. suratensis* through competition for food. The present study evaluates extends of diet overlap between the two fish species.

Method: Fish samples were collected monthly from June 2011 to May 2013. The feeding intensity, gut contents and index of relative importance were calculated. Diet overlap between the fish species was determined using Schoener index.

Results: *E. suratensis*and*O. mossambicus* principally fed on detritus, blue-green algae, green algae, diatoms and macrophytes. The feeding intensity of *E. suratensis* and *O. mossambicus*was computed as 15.19 and 17.13 respectively. There was a significant annual average diet overlap between the fishes (index value 0.845).

Conclusions: The dietary features of *O. mossambicus* like the similarity of diet with *E. suratensis*, significant diet overlap, higher feeding intensity, rapid digestion, similar habitat utilization make *O. mossambicus* a superior feeder than *E. suratensis* which may result in the gradual depletion of *E. suratensis* population. The study indicates that *O. mossambicus* is a successful invader of consequence and its continued and unchecked spread throughout should be treated with concern.

Keywords: Invasive Species, Gut Contents, Diet Overlap, Competition, Vembanad Lake

06-04

BIODEGRADABLE PRINTABLE POLYMER MATERIAL FOR TEXTILE PACKAGING FROM RENEWABLE RESOURCE

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Background: The conventional packaging films leads to serious environmental issues such as pollution, drastic changes in the climatic conditions, affects aquatic life and induce health hazards. A major percentage of the packaging films are made up of non-biodegradable polymers for which the monomers are of petroleum origin. The day-by-day increase in the depletion of fossil fuels is an alarming situation leads to the scarcity of these polymers. Moreover, the environmental issues calls for alternating options. Hence it is highly imperative to find a new way to produce non-toxic and biodegradable packaging films from renewable sources.

Methods: In this work we propose a biodegradable printable composite polymer film, CT-G-P from renewable resources. The film is composed of Cotton, Glycerol and PVA fabricated successfully by a solution casting method and the physico-chemical, mechanical, morphological and degradation properties were studied by various characterization techniques.

Results: Morphological studies conducted by optical microscopy and SEM demonstrated the uniform porous structure of the films which shall aid the biodegradation of the films. ATR spectroscopy and TGA confirms the better interaction between cotton fibres and the PVA matrix in the fabricated films. Mechanical properties were found to be comparable with that of conventional non– biodegradable films for textile packaging applications. The degradation behavior and degree of swelling confirmed the complete degradation of these films in water at room temperature. Printing proficiency has been evaluated by printing on the films

Conclusion: This work proposes a new biodegradable and printable polymer based packaging film produced from renewable sources. This product which has better aesthetics and biodegradability compared to that of the current paper textile bags shall be a successful replacement for the existing materials in the textile packaging industry.

Key words: Polyvinyl alcohol, Cotton fibres, Printable films

06-05

BROADBAND MULTI-PASS CELL FOR THE SENSITIVE DETECTION OF OZONE IN THE PRESENCE OF AEROSOLS

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This work describes a state-of-the-art, incoherent broadband multi-pass cell for quantification of ozone in ambient air. The instrument was operated in the ultraviolet spectral region between 237 and 274 nm. The net effective path length produced by the cell with the help of multiple reflections was 1100cm. A powerful Laser-Driven Light Source (LDLS) was used as the light source to generate the UV light. To verify the accuracy of this approach, the laboratory-generated ozone was passed simultaneously to the cell and a commercially available ozone monitor (Dylec 1150) and found in quantitative agreement to a reasonable level. The instrument precision was assessed through Allan variance analyses and showed minimum deviations of 20ppb (2σ), at an optimum acquisition time of 5s.
Keywords: Trace gases, spectroscopy, and broadband extinction coefficient.

06-06

CHARACTERIZATION OF VEGETATION CANOPY DYNAMICS USING TERNARY FRAMEWORK

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Background: The characteristic interaction of the visible and the near-Infrared region of the electromagnetic spectrum with vegetation underpin the success of space-based Earth observation programs. Reflectance spectra of vegetation canopy is unique with strong chlorophyll absorption, centred at about 650 nanometre (nm) (red) and strong chlorophyll and carotenoid absorption at 450nm (blue) followed by an abrupt increase in the reflection in the near-infrared region (690nm). Based on the wet/dry events in a year, the tropical forests, savannahs and grasslands, exhibit differential period of growth and stress.
Method: Repeated global observations that are sensitive to these vegetation conditions are provided by remote sensing satellites. A ternary plot is useful to depict a system with three variables that sum to a constant. Representative sample of MODIS surface reflectance bands of near-Infrared, red, and blue from a period of 15 years (2003-2018) was used to study the inter-annual vegetation dynamics in a tropical rain forest and arid deciduous forest in India.
Results: The dynamics of *vegetation loci* of the study regions present a novel means to objectively characterize vegetation health.While conventional linear analysis is commonly used to understand temporal dynamics of vegetation, we explore the prospect of using ternary framework.
Conclusion: The findings unveil a new perception of vegetation health monitoring and phenological studies.
Keywords: Vegetation health, vegetation loci, Ternary Plot,MODIS surface reflectance Bands, NIR, Red, Blue

06-07

VETIVER SYSTEMS: AN ECO-FRIENDLY TOOL FOR SUSTAINABLE DEVELOPMENT OF WATERSHEDS

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Background: Vetiver'sunique morphological, physiological and ecological characters play a key role in the area of environmental protection and land rehabilitation. Insufficient availability of quality planting material is the major bottleneck in production and area expansion of vetiver. Nursery management is an important factor for better establishment and production of quality planting materials of vetiver. The choice of suitable planting geometries and intensive intercropping systems can strengthen the potential of vetiverto combat erosion hazards.Similarly, the phytoremedial technology can be explored with its potential for decontamination of polluted water.
Method: The investigation comprised of three field experiments and one pot culture study and it was conducted at College of Agriculture, Vellayani.The techniques for quality planting material production were standardised by testing planting materials, planting systems, rooting medium and moisture regimes in a 2^4 factorial RBD. Combinations of vetiver vegetative barriers were developed for soil and water conservation in three different planting geometrieswith three different sequential intercropping systems. Thevetiver systems were developed for waste water utilization by conducting an experimentin CRD with seven types of waste water.
Results: Considering the dual benefit of planting material production and root yield, inoculation of vetiver slips with biofertilizers and planting in polythene mulched trenches, filled with enriched rooting medium followed by application of cowdung slurry at monthly interval and irrigation scheduling at 8 mm CPE resulted in the highest net income (₹.5.84 lakhs ha^{-1}) and benefit cost ratio (2.96) after four months of planting.Substantial reduction in runoff (95 %), soil loss (166 %) and nutrient erosion (76 %) could be achieved through high density planting with greater galangal intercroppingwithin a period of 18 months. Vetiver was proved as a good phytoremediator with respect to decontamination and water purification properties (heavy metal uptake).
Conclusions: Vetiversystems in relation to cost effective quality planting material production, alley cropping systems for soil and water conservation and phytoremediation techniques for waste water and biosolid utilization were efficient for the sustainable development of watersheds.
Keywords: Vetiver, soil and water conservation, phytoremediation

06-08

HOW RELATED ARE THE AFRICAN AND INDIAN *CALAMUS*?

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Background: Genus *Calamus* L. (rattans) are spiny climbing palms. They have a worldwide distribution ranging from the Indian subcontinent to the southern part of China, east towards Malaysia, Indonesia and Fiji, and tropical and subtropical regions of eastern Australia with only a single species, *C. deeratus,* present in Africa. As India was a part of the Gondwana land mass, and holds a unique geological past, the relationship between the Indian and African *Calamus*has to be investigated by phylogenetic analysis to understand the biogeography.
Method:36*Calamus* species and out groups from different geographic zones of Indiaand the single species of Africa, *Calamusdeeratus,*were analysed in the present study. The phylogenetic analysis was carried by Bayesian Inference using Mr Bayes. The divergence time was estimated in our study using BEAST. Ancestral area was estimated using Bayesian Binary MCMC Method (BBM) implemented in RASP to construct ancestral area.
Results: Five species (*C. dransfieldii*, *C. delessertianus*, *C. neelagiricus*, *C. lacciferus*, *and C.shendurunii*) of Western Ghats clustered together in a clade in the phylogenetic tree along with *C. deeratus* from Africa. They

had also similarities based on morphology. The possibility of dispersal of *Calamus* from Africa to India has to be rejected since the divergence shown here is of recent origin (28 mya).

Conclusions:*Calamus*species of Africa and India are closely related. The possibilities of *Calamus* reaching India from Asia seems to be higher than from Africa. Further probability of oceanic dispersal from Western Ghats to Africa may not be negligible, though more fossil studies and sampling from all regions including Africa has to be done inorder to ascertain the hypothesis

Keywords: *Calamus*, Biogeography, Phylogeny, Rattan

06-09

ECOLOGICAL STUDIES OF VATICA CHINENSIS L., A CRITICALLY ENDANGERED DIPTEROCARPS OF SACRED GROVES, KERALA

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Background: The sacred groves are important reservoirs of biodiversity, preserving indigenous plant species and serving as asylum of Rare, Endangered and Threatened (RET) plants. The species*Vaticachinensis* L. (Dipterocarpaceae), an endemic and Critically Endangered (CR) tree, distributed in coastal areas including sacred groves of Kerala has been selected for ecological analysis in an identified sacred grove at Kozhikode district.

Method: The present study was carried out in the MuchukunnuKotayilKavu, 3.3 km away from Koyilandy Town. The study area extends between N 11.49786, E 75.66399, at an elevation of 17 m altitude.The methodology is divided into three major working components viz., Population mapping, ecology, covering population structure and regeneration along with analysis of climatological and edaphological factors *in situ.*

Results: The area of occupancy of *Vaticachinensis* L. in the study area was found to be approximately 0.031 Km^2. A total 41 adult individuals (gbh≥30cm) of the species were enumerated in the sampled and non-sampled areas and also 11 seedlings and 12 saplings of less than 30cm gbh were enumerated from the study area. The associated species are*Hopeaponga, Syzygiumcumini, Mangiferaindica* and*Terminaliapaniculata* etc.

Conclusions: A total of 35 species were recorded, vegetation is over-dominated by *Hopeaponga* (53.934%) and 8 thposition are*Vaticachinensis* (11.986%). The least dominant species based on IVI value was *Aphanamixispolystachya* (1.934%). The low diversity index value (8th out of 41 associate species) indicated moderately poor dominance of the species.

Keywords: Dipterocarpaceae, Population diversity, Muchukunnukavu, *Vaticachinensis*

06-10

INVASIVE ALIEN PLANTS IN KERALA: A DECADAL REVIST

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Background: The state of Kerala in India has around 82 established Invasive Alien Plant Species till date. A statewide baseline survey was conducted in the year 2011, in which all these 82 species are recorded from the 14 districts of the state. A resurvey is planned in the year 2018 after a gap of seven years to see the rate of change in the distribution and abundance of the invasive alien species in Thrissur district.

Method: 424 localities were surveyed in the year 2011 in the Thrissur District of Kerala. The same 424 localities were visited in October – November 2018. Vehicular transects were conducted to resurvey the previous survey points. The Geographic Coordinates of the previous survey were fed in to a hand-held Global Positioning System and tracked back to find the exact localities. In the survey/resurvey localities, the number of species, its abundance in percentages and aggression levels in a scale of three *viz*., high, medium and low

were recorded in accordance with the previous survey in the year 2011. The data was plotted and a comparative analysis was done in Geographical Information System.

Results: In the year 2011, a total of 30 invasive alien species belonging to 12 families were recorded in the Thrissur district. Of the 30 species, 14 species falls under high risk category, 5 in medium risk category, 7 in lower risk category and 4 insignificant species. In 2018, 38 species from 14 families were recorded with 10 new additional invasive alien species which were not recorded in the previous survey of 2011. Two species which were present earlier in 2011 are also not recorded in 2018. Of the 38 invasive alien species present now, 15 species falls under high risk category, 9 in medium risk category, 7 in lower risk category and 7 insignificant species. Out of the 10 newly reported invasive alien plant species, one species belongs to high risk category, 5 belongs to medium risk category and 4 to insignificant categories. Out of 15 high risk species, 9 species were from Central and South America, one species each from Tropical Asia and Africa, South Asia and Africa, and 3 species from Tropical Asia. There are 8 climbers, 3 herbs and 4 shrubs among the high risk species. The major invasive species are dispersed mainly by seeds (11 species), seed and vegetative (2 species) and vegetative (2 species). Comparative analyses were done with the species abundances, aggression and landuse between the two time intervals. There is a significant change in the abundances and local distribution pattern. The invasive alien species has also shown shifts in their occurrence with respect to the landuses across the time interval.

Conclusions: Invasive alien species do vary in their composition, abundance and spatial distribution at a regional scale over time. The present study has captured an overall increase in the number of invasive species across time intervals.

Keywords: Kerala, Species persistence, Invasive Alien Plants

06-11

FLORAL RADIOMETRY: QUANTITATIVE REPRESENTATION OF FLORAL COLOURS AND ITS SIGNIFICANCE IN BIODIVERSITY CONSERVATION

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Background: Pollination; an ecosystem service offered by insect pollinators is now considered asthreatened process. The first global thematic assessment from the Intergovernmental Science Policy Platform on Biodiversity and Ecosystem Services (IPBES) in 2016 confirmed large scale decline of wild pollinators. This has led to development of national pollinator strategies with high level political commitments and backing by the Convention on Biological Diversity (CBD). To safeguard the pollinator diversity, it is essential to identify the factors which are able to enhance pollinator diversity. This study evaluates the scope of floral radiometry to assess the plant pollinator communication information broadcasted through the floral display.

Method: The floral spectral reflectance of 121 species of angiosperms in Kerala, India were measured during February 2019 using Analytical Spectral Device (ASD Inc. Field spec® 3). Continuous reflection spectra from 350 to 700 nm (nm) were recorded with 2° view angle at 3 nm resolution. All measurements were taken between 10.00 and 11.30 AM on fully open, healthy flowers. The floral reflectance of each species was taken as a mean reflectance of randomly selected flowers (N:10–15) from within the study region. Measurements were recorded only from plants growing in open spaces and forest fringes within the region. The spectroradiometer was calibrated before each reading with standard white reference. The floral reflectance of 132 angiosperms from Germany and 105 from Norway were accessed from Floral Reflectance Database (FReD). Data collected were converted to human and bee pollinator perceived floral colour using CIE L a b and chromatic hexagon. The result obtained were then compared with the pollinator abundance of the respective region.

Results: The human pollinator perceived floral colours were distributed in three hue clusters: red, yellow and blue. An equiproportional distribution of red and yellow hued flowers was observed in Kerala. The proportion of yellow hued flowers were dominant in Norway and Germany. The pollinator perceived floral colours within

all the regions were clustered in 6 bee perceived floral colours within the bee space, in which blue green coloured flowers are dominant in all the three regions studied. Almost equal distribution of UV,UV- blue, green and UV - green coloured flowers were visible in Kerala.

Conclusion: The dominance of human perceived yellow hued flowers are due to the higher proportion of green yellow wavelength in the incoming solar radiation. The dominance of blue green coloured flowers indicates the preference for lepidopteran pollination and the abundance of UV and UV Blue indicates the preference for hymenopteran pollination. The results reveals that the predominance of pollinator varies geographically and has strong effects on which flower species are most abundant. The study reveals that the floral radiometric approach will be invaluable in the efforts to develop monitoring strategies for national pollinator strategies and to select appropriate plants to safeguard pollinator diversity as well as biodiversity.

Keywords: Floral radiometry, National Pollinator strategy, Pollinator diversity, Biodiversity.

06-12

EXTREME CLIMATIC EVENTS IN CHALAKKUDY TOWN, THRISSUR DISTRICT

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Background:the study area has experienced disastrous climatic events in the past years. The present study involves the analysis of land use/land cover change and climatic events. **Method:**The study has made use of various primary and secondary data. The Survey of India toposheet58 B/71 at 1:50,000 scale and satellite images were used in this study. Land surface temperature data were collected from Landsat 8. Field surveys were made for collecting details about flood.ArcGIS and QGIS were the software used. **Results:**The analysis shows the changes occurred in land use/ land cover over years. Land surface temperature of the area is increasing over years. The town and surroundings were highly affected in the flood of 2018. The town is experiencing strong wind and high temperatures. The study area is vulnerable to earthquakes. **Conclusions:**the occurrences of these extreme climatic events are associated with the land use/land cover changes. These changes increase the impact of flood and strong wind. The decreased amounts of wetlands increased the impact of flood. In the case of appearance of strong wind the increasing amounts of human made infrastructures play a major role.

Keywords:GIS, landuse/land cover change, extreme climatic events, Land surface temperature, flood, cyclone, earthquake, chalakkudy

06-13

EVALUATION AND MODELLING OF WATER QUALITY IN RIVER PERIYAR, SOUTH INDIA

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Fresh water resources are one of the important resources for protecting and sustaining life on earth. Conservation of these resources has become an important priority for any nation to survive and progress. River defines the socio-economic, political, geographical well being of a nation. Rivers around the world are very much polluted and stressed of overuse. Management of these rivers requires continuous and scientific assessment of water quality of the river. Understanding the past historical trend, analyzing the present scenario and forecasting the future of the river helps in planning management strategies. Such long term evaluation helps policy makers to bring in policy level changes and to plan future conservation of the river. Periyarriver is one of the most polluted rivers in Kerala, South India. River is abused by discharges from industries along the Eloor-Edayar stretch. So here, an attempt is made to evaluate the quality of the Periyarriver with one year

monthly water sampling. Analysing the past historical data, present scenario and forecasting of data of the river helps in planning long term management strategies in the river.

Water quality assessment was done for a year during 2007-2008 periods. Water quality index was prepared for the river to give grading for pollution in the river. Long term trends of water quality parameters were analysed using trend analysis. Parameters were modelled using QUAL2K and predicted for year 2030 using WEAP water quality model. Models are calibrated using 2008 and 2013 data. Different scenarios are evaluated and analysed for variation of dissolved oxygen in the river.

Water and sediment quality analysis revealed that the quality of the river has improved from the 2004 scenario. However, certain parameters and sampling sites needs special attention in reducing the pollution especially during the pre-monsoon season. Water quality index showed "poor" quality grading. Trend analysis of hydro-climatic variables presents an increasing trend for all variables while dissolved oxygen showed a decreasing trend. From the models developed using statistics and QUAL2K it was found that both models can be used for modelling and prediction of variables in Periyarriver. The model can further be used in other similar ecosystems. Scenario analysis showed that reducing the pollution load and reducing parameters and maintaining the flow rate in the river, we can sustain dissolved oxygen level in the river.

Keywords: Water quality, sediment quality, trend analysis, water quality model, QUAL2K model, WEAP model, scenario analysis.

06-14

MANAGEMENT STRATEGIES FOR SUSTAINABLE HOME GARDEN AGROECOSYSTEMS - A CASE STUDY FROM KERALA

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Home garden agro ecosystems are the most common type ecosystems seen in Kerala. These ecosystems have been traditionally managed, and suited to address the needs of a family in terms of food, natural resources and sustainable livelihood options. The work tries to analyse the home garden agro ecosystems of a village in Kerala, India with a view to examine the mangement practices followed in these home gardens. Thirty home gardens were selected randomly. They were categorised into flooded/ non flooded and old/new home gardens. The home gardens were examined for land use pattern, vegetation, ecofriendly initiatives and management measures. The results showed that the home garden agro ecosystems were not environmentally sustainable in terms of management measures, vegetation pattern and ecofriendly initiatives. The research puts forward certain points for sustainable management of home garden agroecosystems to target an ecofriendly lifestyle and a climate resilient livelihood.

Keywords: climate resilience, ecosystem management, ecofriendly initiatives, floods, management measures

06-15

'PROPER FUNCTIONING CONDITION' OF CHALAKKUDY RIVER TRIBUTARIES BASED RIPARIAN AGRO- ECOSYSTEM

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Background: Climate change is no more a myth and the worst affected are the water bodies across the world. 'Coordinating framework for environmental management' was espoused to address the highest priority problems in terms of 'Proper Functioning Condition (PFC)' within hydrologically defined geographic areas of

Chalakkudy river tributaries based riparian agro-ecosystem.

Method: This was primedthrough evaluation of the riparian sites focussing the main tributaries of Chalakkudy river in the upper reaches, middle reaches to lower reaches using the PFC checklist developed by United States Environmental Protection Agency in 1995with slight modification suiting the study condition. Participatory transect combined with 'focus group observation and discussion' was used to arrive at the problems associated with the riparian ecosystem.

Results: The results revealed that the upper reaches were more functional and biodiverse compared to mid and lower reaches as evident with the high mean value of 'yes statements' (56.9%) which were indicators of positive contributing factors towards 'functionality' of riparian agro-ecosystem when compared to the mid to lower reaches (20.53%) of the riverbanks. In case of the mid to lower reaches, the riparian agro ecosystem was highly vulnerable and fastly degrading compared to the upper reaches of Chalakkudy river as evident from the score attributes of the middle to lower reaches for parameters under 'hydrology, vegetation and erosion/ deposition' that was high (77.43%) compared to the upper reaches (41.2%).

Conclusion: These points of observation revealed that the sites lack adequate vegetation, landform, or large wood to dissipate stream energy associated with high flows especially during the rainy season and are not capable of reducing erosion or improving water quality.Thus, ecologically sustainable water management that is an iterative process should become an actionable policy in which both human water demands and ecosystem requirements should be defined, improved and altered to meet human and ecosystem sustainability

Keywords: Biodiversity, Function, Ecosystem, Erosion, Landform, Extension

06-16

EFFECT OF SUPPLEMENTATION OF VITAMIN C ON COCOON CHARECTERISTICS OF MULBERRY SILKWORM BOMBYX MORI EXPOSED TO THERMAL STRESS

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Background: Silkworms are well known industrial insects which produce natural silk. No other fabric in the word can match silk for its luster and elegance. Because of economic importance of silk yarn the main objective of silkworm rearing is the progressive improvement of economic traits to produce quantity and quality silk. In a tropical country like India environmental factors such as temperature and humidity play a major role in the success of sericulture industry. Global warming is the foremost threat for the survival and reproduction of many insects. Because of the extensive and careful domestication over centuries, the silk worm, *Bombyxmori,* is very much susceptible to abrupt temperature changes.

Method: The experimental larvae were divided into three groups and one maintained as control. Thirty numbers of silk worms were placed in each group. The Group 1 and Group 2 were fed with fresh mulberry leaves while group 3 and group 4 was fed with fresh mulberry leaves soaked in 0.2% ascorbic acid solution .By the completion of 4th instar, the Group 2 and Group 3 were exposed to heat shock ranging from 40^{0}C – 42^{0}C for 1 hour per day by placing in the thermostat oven. various economic parameters like larval weight,length, pupal weight, length,cocoonweight,cocoon length, cocoon width,shellweight,shellpercentage,total filament length,Average filament length(AFL),Average non-breakable filament length and Denier was calculated.

Results:Dietary supplementation of vitamin C showed a significant increase in all the economic parameters while group 2 induced thermal stress showed significant decrease as compared with that of control and experimental groups.The results revealed that ascorbic acid treatment can overcome the adverse effect generated by thermal stress.

Keywords: Heat shock, Cocoon, Silkworm, Ascorbic acid

06-17

A COMPARISON OF TWO METHODS FOR MEASURING PLANT COVER OF INVASIVE ALIEN SPECIES

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Background: Biological invasion is the second most important reason for biodiversity loss next to habitat destruction. Estimating the abundance of a particular species in a particular area aids to understand the infestation caused in a particular habitat. Coveris among the most widely used measures of abundance of plant species becauseit is not biased by the size or distribution of individuals. This paper puts forward a comparative study to measure species ground cover using Photoshop and Daubenmire methods.
Method: The study was conducted in three selected sites in the Athirapilly - Vazhachal forest area. Each study site comprised of 5 sample plots. The plant cover for each plot (20*50 cm^2) was measured using Daubenmire method. To measure the cover using Adobe Photoshop, these plots were captured using photography from above. The area covered by each species was then recorded separately using various tools of Photoshop.
Results: From the study conducted it could be understood that both the methods can be used for studying species having the height up to waist level. Considering the Daubenmire method, the values recorded are based on the cover classes, thus unable to decipher the accurate value. The estimation using Photoshop is more precise with minimal human error. The time to be consumed in the field for each plot is less when the cover is determined using Adobe Photoshop thus assisting in covering more area in less time. In the case of Daubenmire method, the cover classes used are continuous classes leading to perplexity in including the value to the cover class.
Conclusions: The evaluation from the study reflects that even though there is less variation in the value determined from both the methods, the Photoshop method is more accurate, more advanced and less time consuming. The Adobe Photoshop method is more accurate in estimating the species cover for invasive alien species as different species cannot be separated in a highly infested habitat.
Keywords: Species ground cover, Daubenmire method, Photoshop method

06-18

DISTRIBUTION OF SELECTED INVASIVE ALIEN PLANTS IN WAYANAD WILDLIFE SANCTUARY

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Background: The present study "Distribution of selected invasive alien plants (IAP) in Wayanad Wildlife Sanctuary" was conducted in three vegetation types (Plantation, NF and Vayal) of WS II part of the sanctuary. The distribution of selected invasive alien species (IAPS) viz. *Lantana camara* L., *Sennaspectabilis* (DC.) H.S. Irwin and R.C. Barneby and *Chromolaenaodorata* (L.) R.M. King & H. Rob were studied.
Method: Eighty five sites were haphazardly interspersed throughout the study area across a continuum of *Lantana, Chromolaena* and *Senna* invasion. At each site, a 10 m ×10 m quadrat was established. The percentage of ground covered by the invasive alien plant species (IAPS) like *Lantana camara, Chromolaenaodorata*and *Sennaspectabilis*in these 10 m × 10 m sample plots were estimated by measuring the crown area.
Results: *Lantanacamara* and *Chromolaenaodorata* invaded all areas of the sanctuary except in the borders of Kurichiat and Sulthanbathery forest ranges. *Lantana* invasion was high in the Kurichiat RF (Reserve forest) and Rampur RF.*Chromolaena* invasion was found to be high in Mavinahalla and Kurichiat RF. In WS II part

of the sanctuary, *S. spectabilis* was mainly distributed along the boundaries of Sulthanbathery and Muthanga ranges. In Muthanga, *Senna* invasion was extended up to "Kakkapadam" (2.5 km from Muthanga station). Among the IAPS,*Chromolaena* showed the highest density in all the three vegetation types, while the density of *Senna* was lowest in all the three vegetation types in WS II area.

Conclusion: *Lantana camara*was widely distributed over the WS II part of sanctuary. Higher densities of *Chromolaena*were seen in Kurichiat RF of Kurichiat range, Mavinahalla and Noolpuzha RF of Muthanga range. *Senna*was seen only in Muthanga range.

Keywords: NF (Natural Forest)

06-19

DIVERSITY OF YEASTS FROM MANGROVE OF MULAVUKAD:A PRE AND POST KERALA FLOOD STUDY

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Mangrove wetlands are a unique ecosystem richin bioresources (Chi et al., 2012). The microbial community of this ecosystem has been found to be composed mainly of bacteria, fungi and actinomycetes (Cao et al., 2008). Mangroves provide several microhabitats that harbour yeast communities (Chi et al., 2012). Yeasts in these ecosystems play an important role in the food web, decomposition and nutrient cycling, biodegradation of xenobiotics and as parasites. Some human-associated species too have been isolated from polluted water of mangrove ecosystem(de Araujo et al.,1995).Very little is known about the effect of natural disasters on these communities. Therefore, this study therefore aims to investigate the effect of 2018 Kerala floods on the diversity and hydrolytic potential yeasts from the mangroves of Mulavukadu, also known locally as Bolgatty island.

Sampling was done during two different periods a) April –May 2018(pre flood) b) September-October2018(Post flood) .The colony count of yeast in water was found to be less than that found in sediment samples.The yeast population of both the sediment and water samples was found to be greaterduring the preflood sampling (sediment 1985cfu/gm&water 1000 cfu/ml)than during postflood(sediment 1825cfu/gm&water420cfu/ml) sampling.The isolates were screened for the production of different hydrolytic enzymes. All the isolates were lipolytic. The percentage of lipolytic,ureolytic,amylolytic forms were, 100%, 35%, 15%, and respectively. In Sept-Oct sampling, no caseinolytic forms were isolated. There was a drop in ureolytic forms (20%) amylolytic (13.2%) and increase in gelatinolytic (2.9%) forms in the Sep-Oct samplingThe isolates were identified up to generic level based on morphological, biochemical and physiological characteristics. The identified isolates were found to belong to 4 genera. ie,*Trichosporon*,,*Candida* sp,*Cryptococcus*sp, and *Rhodotorula.*The diversity (H'(log2)), Peilou's evenness (J') and Species richness (d) was found to be reduced during the Sep-Oct(Post-flood) as compared to Apr-May sampling (Pre-flood). This reduction is likely to have been caused by the floods in the month August 2018 in Kerala.

06-20

NATURAL WATER PURIFICATION OF SASTHAMKOTTA LAKE IN SOUTHERN KERALA -A REALITY BEHIND MYTH AND SCIENCE

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Background: Sasthamkotta Lake also famous as "The Queen of Lakes" is an incomparable charm in "Gods

own Country", Kerala. A classical folklore spinning around the lake is that the water is extremely pure owing to an enormous population of a kind of larva that mainly consumes on bacteria in water. Pioneer researchers believed that the larva is *Chaoborus*. So the water has been a drinking source to Kollam city and suburban areas. The present investigation is focused on the authenticity behind the myth regarding the purification of water by benthic larva in lakebed.

Methods: Sasthamkotta Lake is located between latitudes 9˚00'-9˚05' North and longitudes 76°35'-76°40' East in Kollam district of Southern Kerala, India. The rain fed lake is flanked by moderately sloping hillocks, valleys and plains and no tributaries connect the lake with other waterbodies. Water and sediment samples were collected from ten randomly selected stations during the period from January 2016 to December 2016. Physicochemical parameters of water and sediment were estimated following Trivedy and Goel (1986) and APHA (2005). Quantitative and qualitative analysis of the organisms were done as per the methods of Michael (1984), Morse *et al.,* (1994) andMerrit and Cummin (2008). Bimonthly collections of water, sediment and benthic fauna were made from six stations for microbiological analyses. Enumeration of TBC in water, sediment and benthic samples was carried out using pour plate method of IS 1622-1981 (Reaffirmed 2003) Edn 2.4 (2003-2005) and IS 5402:2002.A semi diurnal experimental study on the distribution of bacteria in water in terms of Total Plate Count (TPC) was carried outin the laboratory conditions in one week intervalto find out the absorption of microbes by benthic larva in Sasthamkotta Lake.

Results: The physicochemical parameters of water and sediment are within the desirable limit. A total of eight species of benthic invertebrate are recorded. Six species belong to Order Diptera, one species each on Order Trichoptera and Order Tubificida. *Phaenopsectra* sp. belonging to the order Diptera is dominant organism accounting to about 97.927% of the total benthic invertebrates. Maximum bacterial count was found in sediment-dwelling organism related to sediment and water. The rate of microbial load was in the order benthic invertebrate > sediment > water. The bacterial count shows that natural microbial pollution in the lake is regulated by this benthic invertebrate by feeding on bacteria. The quantity of microbes in experimental sample set up was reducing from time to time compared to the control. Experimental study established an association between bacterial decrease in water and consumption of bacteria by the benthic invertebrate. The investigation on the bacterial load from lake environment and laboratory environmental set up noticed that the bacteria are consumed by the sediment-dwelling larva.

Conclusions: The large benthic population that consumes bacteria is *Phaenopsectra* sp. *Chaoborusasiaticus* is found to be the least benthic invertebrate in Sasthamkotta Lake. The water in Sasthamkotta Lake is of pristine quality due to the presence of this benthic dwelling larva. The investigation proved that water in Sasthamkotta Lake is purified by*Phaenopsectra* sp. which endorses the ancient myth.

Keywords:myth, water**,** purification**,** *Phaenopsectra* sp.,Sasthamkotta Lake

06-21

POST-FLOOD MONITORING OF NELLIYAMPATHY HILLS IN SOUTHERN WESTERN GHATS, KERALA, INDIA

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The present investigation focuses on the aftermath of flood 2018 at Nelliyampathy hills in southern Western Ghats. The heavy downpour had seriously affected Nelliyampathy hills with heavy landslides, mudslides and uprooting of trees in different sites making the area isolated for more than one week. Visible habitat modification and species loss was evident in this area and flow of water has destroyed the small herbaceous surface dwelling taxa. Uprooting of large trees has opened up the canopy increasing light penetration to the under-storey causing drying up of ground vegetation. The survived taxa suffered a higher temperature than the temperature before the calamity. This study assimilated data on resilient and vulnerable

taxa in forest ecosystems and information regarding loss of diversity could also be documented. Most of the primary colonizers of the landslide hit areas were representatives of degraded forest elements and increase in biological invasion by alien invasive taxa was evident in these areas since the flood helped their propagules to reach new areas. The increased ecological amplitude of these taxa made them surmount such denuded areas and anabrupt shift in the phenologicalbehavior of the survivor taxa and the primary colonizers was also evident showing a lag in their flowering and fruiting. Majority of the landslide sites were in the fringes of forests, indicating that disruption of slop continuity due to forest fragmentation was a major contributing factor to landslides in most part of the district.The large scale monoculture systems and unhealthy developmental policies added up to the reasons. Continuous monitoring in landslide hit areas is necessary for making an assessment of loss of species and to elucidate the management policies.

06-22

PARMELIOID LICHENS OF KERALA: A TAXONOMIC SURVEY

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Background: Kerala regions have high diversity of Parmelioid lichens. The lichen exploration of this area is still incomplete. Current study is an extensive survey and taxonomic re-evaluation survey of Parmelioid lichens to solve taxonomic and nomenclatural problems and the proper documentation and biodiversity assessment.
Methods: The article mainly based on the field explorations conducted through various lichen rich areas of Kerala part of Western Ghats.
Results: About 300 more specimens were by the survey through the different regions of Kerala such as Anamudishola National park,Pothamedu, Chokanad, Chokramudi, Meesapulimala, Lochart, Devikulam, Gundumalai, Suryanelli, Rajamala of Idukki district, Kavumannam of Wayanad district, Nelliampathy of Palakkad district, NBPGRI Campus of Thrissur District etc. Of the above 47 species were able to identify which belongs to 11 genera. Genus *Parmotrema*and *Hypotrachyna* were the most dominant genera which were represented by 19 and 10 species respectively. While analyzing the nature of the substratum of Parmelioid lichens it was evident that they mostly prefer trees (Corticolous) as their substratum. *Parmotremareticulatum*(Taylor) Choisy, *Parmotremaindicum*Hale, *Parmotrematinctorum*(Nyl.) Hale etc. were the most dominant species.
Conclusions: From the above study it was evident that Parmelioid lichens are one of the dominating lichen family in Kerala. There are still more area to be explored and probably a good number of species can be recorded from Kerala.
Keywords: Parmelioid, Diversity, Kerala.

06-23

PHYTOCHEMICAL INVESTIGATION OF *GARCINIAGUMMI-GUTTA*VARIETIES

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Background:*Garciniagummi-gutta*is an economically important crop, and though 3 varieties are reported for *G. gummi-gutta*, the diversity of phytochemicals in the varieties has not been investigated. Phytochemical profiling is important for standardisation of authentic crude plant material, and the present work evaluates the phytochemical diversity of the three varieties of *G. gummi-gutta*namely var.*gummi-gutta*, var.*conicarpa* and var. *papilla*, and also examine the difference in the chemistry of male and female accessions.
Methods: The volatile chemicals were isolated by hydrodistillation and analyzed by GC-MS, while the non

volatile compounds were isolated by solvent extraction using Soxhlet and analyzed by HPTLC. The hierarchical cluster analysis was done using SPSS ver.16.0.

Results: HPTLC profile showed remarkable variation for *var. conicarpa* with characteristic peaks compared to other varieties. The GC-MS analysis of leaf essential oil showed the presence of sesquiterpenes such as α-copaene, β- caryophyllene, γ-cadinene and δ-cadinenein remarkable quantity. The male and female accessions showed similar chemical profiles, but the place of collection has some influence in the chemical profiles. Cluster analysis of three varieties based on leaf volatile chemicals showed remarkable variation for var. *conicarpa* compared to the other two varieties, while the HPTLC confirmed the difference in non volatile chemical profile for var. *conicarpa*.

Conclusions: The phytochemical profiling of the varieties of *Garciniagummi-gutta* is of great relevance in authentication of original crude plant material, and also in standardisation of value added products from the plants. The results also indicate the revision of varietal status for *Garciniagummi-gutta*var.*conicarpa*.

Keywords:*Garciniagummi-gutta,* GC-MS, HPTLC, Hierarchical Cluster analysis

06-24

POLLUTION STATUS OF SELECTED TEMPLE PONDS OF KANNUR DISTRICT, KERALA

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Background: Assessment of pollution status of large water carrying systems like ponds were important for the sustainable use of water services.The temple ponds were coming under category which facing less threat of pond fill-up because it is related to ethical believes.

Method: Systematic analyses of some physico-chemical parameters were conducted to assess water quality of selected temple ponds in mid lands of Kannur district. The three ponds selected for the present study were *Vadukunda Temple pond of Madayi para*, *Cherukunnu Sri Annapoorneswari Temple Pond* and *ChirakkalChirra*. Water samples from each site were collected, analyzedand compared with standard values of Bureau of Indian standardsfor knowing the overall pollution index

Result: Status of Site 1- *Vandukunda pond* and Site 3-*Chirakkal Chirra* were slightly polluted while considering seasonal average of parameters. Site 2-*Annaporneswari temple pond* was in an acceptable pollution index. And all ponds were suitable for outdoor bathing, fishing,irrigational purpose and also for drinking by adopting conventional treatments. The ponds surrounded by the human settlements were more prone to drought (in case of Site 2 and 3) than pond which situated in an open hilltop (in case of Site 1).

Conclusion: In the present scenario of water scarcity, these types of temple ponds were significant in holding water and directly function in recharging ground water system. Analysis of pollution status of temple ponds helps in planning conservation strategies. Most of such fresh water systems are under exposure to anthropogenic activities, need detailed study.

Keywords: Physico-chemical parameters, temple pond, pollution status, water quality, BIS

06-25

STUDIES ON MINERAL PROFILES, NUTRITIONAL AND NUTRACEUTICAL PERSPECTIVES OF DOMESTIC SEWAGE WATER AND WELL WATER IRRIGATED, *MANIHOTESCULENTA* CRANTZ, COLLECTED FROM DIFFERENT AREAS OF PALAKKAD DISTRICT, KERALA.

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Background: Water deficiency is one of the main factors for limiting sustainable agricultural development in most arid and semi-arid regions. There is a gradual decline in availability of fresh water to be used for irrigation in developing countries like India. In future, the major disputesamong states/ nations may be for water and this in turn leads to more investment of time and money for water management. Sewage farming is quite common in all urban areas in India. Effect of its direct and long term use for irrigation needs thorough study with reference to the crop quality, soil fertility and nutrient parameters.
Method: This preliminary study is an attempt to evaluatethe effect of domestic sewage water irrigation on cultivation of *Manihotesculenta* Crantz from selected areas of Palakkad, Kerala. For this, parameters analyzed were: Water / Soil health (physico-chemical parameters), Crop quality which includes the tuber, peel and plant residue quality (proximate composition), Mineral analysis (using ICP-MS) including heavy metal composition and*in vitro*antioxidant potential.
Result: From the results, the physico-chemical parameters of both domestic sewage water irrigated and well water irrigated samples were within the permissible limits according to the WHO /FAO suggested pattern. In mineral analysis the heavy such as Pb, Zn, Cd, Cr, Cu, and Ni were found to be within the permissible limit in both the respective study areas. The proximate composition provides general overview of the nutritional value of a food and includes analysis of moisture, crude ash, crude protein, crude lipid, and crude fiber. *Manihotesculenta* samples collected from domestic sewage water and well water irrigated samples reported to be adequate mineral profile required for growth and nutrition. In addition, the plant residues were exploited as a as potential animal feed. Both the samples showed significant antioxidant values ($p<0.05$).
Conclusions: This study emerges from the fact that the country suffers from arid and semi-arid conditions without adequate water sources. Accordingly, the use of domestic waste water is an option to save water resources for irrigation purposes. The results demonstrated that the physicochemical properties of domestic sewage water have potential attributes to allow for a safe use. Micronutrient and heavy metal contents in the investigated plant samples are not extremely high and found to be within the range of FAO/ WHO standards. So, it is still too early to recommend the use of the domestic sewage water as an alternative option for irrigation and the sustainable development of the Environment.
Keywords: ICP-MS, Domestic sewage water irrigation, *Manihotesculenta*, Heavy metals, Nutraceuticals, Soil.

06-26

ESTIMATION OF SOIL EROSION USING RUSLE AND SOIL EROSION PRONENESS BY AHP METHOD

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Soil erosion is one of the most important forms of soil degradation. It's a natural process by which the soil particle get detached, transported and deposited by water, wind and gravity (agents). Soil degradation in India

is estimated to be occurring on 147 million hectares (Mha) of land, including 94 Mha from water erosion, 16 Mha from acidification, 14 Mha from flooding, 9 Mha from wind erosion, 6 Mha from salinity, and 7 Mha from a combination of factors. This is extremely serious because India supports 18% of world's human population and 15% of the world's livestock population, but has only 2.4% of the world's land area. Causes of soil degradation are both natural and human-induced.In India it has been estimated that about 5334 million tons of soil are being annually due to various reason (Narayan and Babu, 1983).

In the present study soil loss was estimated using Revised Universal Soil loss Equation (RUSLE) and identification of soil erosion proneness of the area through Analytical Hierarchy Process (AHP method) . The soil erosion assessment is based on quantitative approach and erosion prone area is based on qualitative approach.Variables like slope, land use/land cover, elevation and soil texture along with geomorphology of the area make the terrain more susceptible to soil erosion. The high soil erosion proneness class is concentrated on the denudational hills (92.568 Km2). The assessed annual average soil loss of the area had shown a wide range of value varying from 0 - 729.35 t h^{-1} y^{-1}. The spatial distribution of high annual soil loss is seen precisely in denudational hills and piedmont regions. The areas with high and severe soil erosion warrant special priority for the implementation of control measures.

Keywords: Soil proneness, Revised Universal Soil Loss Equation (RUSLE), Analytical Hierarchy Process(AHP).

06-27

MOLECULAR CHARACTERIZATION OF DNA VIRUSES AND THEIR ROLE IN TROPICAL ESTUARINE ECOSYSTEM

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Background: Viruses are the most copious biological entities and approximately 10^{30} viruses are present marine ecosystem. The present study is aimed at the identification, molecular characterization and phylogenetic analysis of DNA viruses from the Cochin estuary.

Method: Viral particles were purified and concentrated by centrifugation, filtration and precipitation from the sediment samples of Cochin estuary. Presence and purity of the viral particles were confirmed at each stage of purification by epifluorescence microscopy stained with SYBR Gold. Metagenomic DNA was extracted from the viral particles and PCR amplification was performed using specific primers designed for the major capsid protein gene, T4 portal protein gene and DNA polymerase gene. Positive amplicons were sequenced and analysed using GeneTool, BioEdit, BLASTx, ViroBLAST, ExPASy, ClustalW and MEGA 6.0 programmes.

Results: A 444 bp fragment encoding 148 amino acids possessing homology to the major capsid protein gene of *Megaviridae* and a 147 bp fragment encoding 49 amino acid possessing homology with T4 portal protein gene of *Myoviridae* were obtained. The phylogenetic relationship of *Megaviridae*and *Myoviriade*was established based on MCP and T4 portal protein gene from various sources. Further analysis based on DNA polymerase gene revealed that Cyanophages are major Myoviridians.

Conclusions: The present study provides a clear insight in to how the biological productivity and biogeochemical cycle of a tropical estuarine system is controlled by the viral community and forcing us for predictive interdisciplinary seasonal studies.

Keywords: DNA virus; Cochin Estuary; Phylogeny; Primary productivity; Biogeochemical cycle

06-28

A COMPARATIVE STUDY ON THE PHYSICO-CHEMICAL CHARACTERISTICS OF SEWAGE WASTE WATER AND SLUDGE COLLECTED FROM DIFFERENT URBAN AREAS OF COIMBATORE, TAMILNADU

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Background: One of the foremost problem that the humanity is facing in the twenty-first century are water scarcity and water quality issues which have raised due to industrialization and urbanization. Freshwater reserves are impacted by sewage discharges, hazardous industrial effluent, agricultural activity, groundwater leaching and runoff.The reuse of municipal wastewater, primarily in agriculture lands is a sustainable solution for arid and semi-arid regions. Also application of sewage sludge for agricultural purposes is an effectual way of disposal as it consists of a high amount of organic matter, humic and fulvic acids which tend to promote plant growth.The knowledge of the physicochemical parameters of sewage waste water and sludge is very crucial for appropriate management of water channels and its further handling.
Materials: Sewage waste water and respective sludge samples were collected from four major urban areas of Coimbatore. An agricultural soil and water sample were collected as control. All the common physico-chemical parameters were done for sewage water, sludge and control samples including Humic and Fulvic acid for sludge samples. All the parameters were done according to APHA Standard Methods for the examination of water and waste water and AOAC official methods of analysis.
Results: All the physico-chemical parameters of the sewage water as well as sludge was under the permissible limits of FAO and CPCB for irrigation water. Only site 4 (Singanallur) showed high amount of CODwhich shows greater amount of oxidizable organic matter. For sludge samples,humic and fulvic acids were also present. Among them, fulvic acid was higher in rate.
Conclusion: Wastewater use in urban and rural agriculture is increasing where such use derives significant economic activity and supports the livelihood of resource poor farmers. Plenty of mitigation measures have been occupied now a days in order to trim down the contamination of water channels or waste water coming out from residential as well as industrial areas. The present study also concludes that the quality of both sewage waste water and sludge samples were within the permissible limits for irrigation water. Thus the usage of sewage waste water and sludge for agriculture can be recommended and will be an environmental friendly moreover a zero waste discharge and effective water recyclingapproach.
Keywords: Sewage waste water, Sludge, Physico-chemical parameters, Water recycling, Soil fertility

06-29

MOLECULAR CHARACTERIZATION OF *CUNNINGHAMELLAELEGANS*LENDN., A BARK INHABITING FUNGI ON *TECTONAGRANDIS*L.FFROMSALIM ALI BIRD SANCTUARY, ERNAKULAM, KERALA

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Saprobes are present on and in the bark of healthy trees and that these, as part of the “biological community”, play an important role in determining the susceptibility of trees to canker diseases. It is this biological community, composed of the bark and the microorganisms which colonize it, which is here being referred to as the “caulosphere”.In the present study, a bark inhabiting fungi was isolated from *Tectonagrandis*L.f and further

characterization was carried out DNA isolation and molecular analysis using ITS primers. Based on BLAST search of the sequence, the ectophytic fungi were found to be closest homolog of *Cunninghamellaelegans*. The sequence obtained was submitted to Genbank.

Key words: *Tectonagrandis*L.f, *Cunninghamellaelegans*Lendn, ITS sequencing, Genbank.

06-30

BRIDGING DATA DEFICIT ON HUMAN-WILDLIFE CONFLICT IN KERALA: RESULTS OF MEDIA CONTENT ANALYSIS

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The never ending conflict between man and wildlife that cause grief and grievances are of a serious concern throughout the world and it's contentious in the state of Kerala. The main objective of this study was to identify the type of human-wildlife conflicts (HWC) in various districts of Kerala and to provide holistic documentation of the human-wildlife conflict issues. This was required since there exists no holistic documentation on the variety of HWCs in Kerala which seriously impair out effort to draw inferences. Media content analysis was done from June 2018 to June 2019. District wise editions of Malayalam dailies *(Deshabhimani, MalayalaManorama, Mathrubhumi, Deepika, Chandrika and Mangalam*) were referred for data collection. Major types of HWC problems perceived from the media content analysis were crop damage, human casualties, human injuries and cattle lifting. A total of 437 instances were recorded during the period. Palakkad District reported the highest number of crop damage. Asian Elephant, Wild boar, Gaur and Bonnet macaque were the animals involved in crop raiding. Stray dogs was the major species that caused human injuries all over the State along with Asian Elephant .Calicut district reported the highest number of human injuries. A total of fifty seven cases of cattle lifting were recorded all over the state. This study identified Palakkad, Idukki and Waynad as districts with the highest intensity of HWC. The paper discuss the management implications of these results.

Keywords: Human wildlife conflict, Kerala, Media reports.

06-31

CHARACTERISATION OF *ANNONA GLABRA* L. – AN INVASIVE SPECIES OF WETLANDS

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Background: *Anonnaglabra,* commonly called as pond apple is a restricted invasive plant under the Biosecurity Act 2014. It is an aggressive invader which forms dense monotypic strands which displaces native vegetation.Recently its wide spread presence was found in the wetlands of Kannur district. The present study was conducted to analyse the adaptive features and its spreading in the present context. **Method**:Variousmorphological,anatomicalandphysiologicalcharacters were studied. The study was carried out in Kannur district of Kerala state for a period from September to December 2018. Frequent field visit to different parts of Kannur to find out the distributionof *Annonaglabra*was done. Samples were collected from different sites and interview was carried out with some stake holders. Morphologicalcharactersoftheplantwasdetermined.Microscopic sections of leaf, stem and root was analysed for studying anatomical features. Physiologicalanalysisforchlorophyll(Arnonmethod,1949),proline(Batesmethod, 1973)andprotein(Lowry'smethod,1951)wascarriedout. The physico - chemical parameters of soil and water were also studied.

Results: The wetlands of Kuppam River in Kuttikkol and Vellikeel support rich growth. The density

of the plant species was much greater at Kuttikkol.The morphological features of stem, leaves, fruit, seeds, roots were studied. The species can grow up to 10 feet or taller. This species can bear fruit starting at two years. It contains approximately 200 seeds resembling pumpkin seeds in both appearance and size. Theanatomyofstemshowedawavyoutlinewiththickepidermisandhardperidermwith lenticels. Mechanical tissues like sclereids and stone cells were prominent. Physiological analysis of selected sites, Kuttikkol and Vellikeel showed high chlorophyll, proline and protein content. **Conclusion**:*Annonaglabra,* oneofthecommonweedinwetlands,isnowfastlyspreadinginKuttikkol andVellikeelareasofKannurdistrict.Itestablishedalongtheriversideand invadethecroplands. They form thick vegetation by completely replacing the existing vegetation. The effective utilization of this plant is recommended to reduce its intensity of spreading.
Keywords – *Annonaglabra*, *Kuttikkol, Vellikeel*

06-32

EFFECT OF TRADITIONAL PROCESSING METHODS ON PROXIMATE COMPOSITION, MINERAL PROFILE AND ANTIOXIDANT POTENTIAL OF TWO INDIGENOUS PEARL MILLET [*Pennisetumglaucum* (L.)] VARIETIES OF RICE PEARL MILLET AND GAINT PEARL MILLET.

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Background: Millets are a diverse group of small seeded grasses, widely grown around the world as cereal foods. Pearl millet is important millet of India, second to sorghum in area and production. In India, it is one of the important millet crops which flourish well even under adverse conditions. It provides staple food for the poor in a short period in the relatively dry tracts of the country. It is the most drought tolerant crop among cereals and millets.
Methods: After collecting the sample were washed with water to remove debris. The samples were divided into four portions. First portion was taken as raw; the second portion was taken for autoclaving at 121°C 15lbs for 30mins, the third portion was taken for dry heat at 105°C for 3 hrs. and the last one was taken for the Germination for one day with the help of muslin cloth. The raw, autoclaved, dry heated and germinated samples were ground to fine powder and stored in screw capped bottles for further analysis such proximate composition, mineral profile and antioxidant capacity.
Results: Cereals serve as a good source of natural antioxidants. Among cereals, millets are considered to be highly nutritious. Based on the results of studies carried out, the millet grains contain many health-promoting components such as dietary fiber, minerals and they are comparable to those of major grains and they also have several potential health benefits. The grain of pearl millet is superior in nutritive value to sorghum grain but inferior in feeding value.
Conclusions: The present investigation is a preliminary approach to study the influence of cost effective indigenous process on the proximate composition, mineral profile and antioxidant capacity of *Pennisetumglaucum*.With its short crop life cycle, rapid grain filling, and exceptional ability to tolerate drought, pearl millet is well suited for food and feed grain production. It is also used as feed for poultry and green fodder or dry kadbi for cattle.
Keywords: Rice pearl millet, Gaint pearl millet, Proximate Composition, Mineral profile, Antioxidant potential.

06-33

FLOOD IMPACT ANALYSIS OF KUZHUR PANCHAYAT, THRISSUR DISTRICT

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Backround: This study analyzes the flood impact of KuzhurPanchayat, Thrissur District, where more than 60% of the panchayat was affected by the flood of 2018. The study was carried out using Remote Sensing and GIS.
Method: Survey of India (SOI) Toposheet 58 B/8 (1st edition) on 1:50,000 scales and Google Satellite image of 2018 were used to prepare land use and land cover maps. ArcGIS 10.3 and QGIS 2.16 are the soft wares used. The questionnaires were prepared to interview the people of the panchayat to record the details of the flood, its intensity and impacts.
Results: The panchayat has an area of 19.11 Sq. Km. in which 13.9 Sq. Km. was affected by the flood. The flood zones were marked based on the flood intensity as unflooded zone, high flooded zone, medium and low flooded zones. These flood zones were differentiated using the range of water level.
Conclusions: Most of the wells had contaminated water, evident from a yellowish tint. After the floods, the villagers of the Alamattaom ward tested severe damages to the built-ups, affecting up 3723 structures. Some of the built-ups had collapsed and most of the households were found with long cracks. About 100 samples of the well water, of which only 10 were potable. Changes observed in the agricultural fields are, the reduced production, disease and pest attack in vegetable crops, yellowing of leaves, formation of lesions, drying of nutmeg trees and plantains, etc. caused due to the fertility changes in the soil. Soil tests indicated lack of macro and micro nutrients. Places showing potassium deficiency also showed failure of Plantains.
Keywords: Kerala flood flood depth mapping

07- FISHERIES & VETERINARY SCIENCES

07-01

ANTIMICROBIAL EFFICACY OF INDOLICIDIN, LACTOFERRICIN (17-30) AND THEIR COMBINATION AGAINST MULTI-DRUG RESISTANT ENTEROAGGREGATIVE *Escherichia coli*

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Background: Cationic antimicrobial peptides (AMPs) have gained considerable attention to source antimicrobial as well as anti-biofilm technology solutions. *In vitro* and *in vivo* antimicrobial efficacies of two short-chain AMPs, Indolicidin, lactoferricin (17-30) and their combination were explored for the first time against multi-drug resistant enteroaggregative *Escherichia coli* (MDR-EAEC).
Methods: Minimum Inhibitory Concentrations (MICs) and Minimum Bactericidal Concentrations (MBCs) of AMPs were determined by broth micro-dilution technique. The AMPs were tested for its stability at temperatures (70^0C and 90^0C), proteases (Proteinase-K and trypsin) and physiological concentration of cationic salts (NaCl and $MgCl_2$); safety in sheep RBCs and cell lines (RAW 264.7 and HEp-2); adverse effect on beneficial flora and membrane permeability. *In vitro* dose- and time-dependent time kill assay was also carried out. Later, *in vivo* studies of AMPs (alone and in combination) employing *Galleria mellonella*(survival assay, bacterial burden, haemocyte density, melanisation assay, cytotoxicity assay and histopathological examination) were

carried out.

Results: Both the AMPs were stable (high temperature, physiological concentration of cationic salts and proteases, except for Indolicidin with trypsin) and tested safe (sheep RBCs, RAW 264.7 and HEp-2) at lower minimum inhibitory concentrations (MIC). Also, the adverse effect against beneficial flora was not observed. AMPs alone and in combination, exhibited bacterial membrane permeability as evidenced by flow cytometry. *In vitro* time-kill assay revealed concentration-cum-time dependent clearance of MDR-EAEC in the AMP-treated groups, while, in the *in vivoG. mellonella* experiment, the infected group treated with AMPs revealed an increased survival rate, immunomodulatory effect, reduced MDR-EAEC counts and were tested safe to the larval cells which was concurred histopathologically.

Conclusion: The AMPs seem to be effective candidates against MDR-EAEC strains and warrants further investigations using appropriate animal models.

Keywords: Enteroaggregative *Escherichia coli*, *Galleria mellonella*, Indolicidin, Lactoferricin (17-30), multi-drug resistance

07-02

BIOLOGICAL CONTROL OF CRUSTACEAN PARASITIC ISOPOD: *ALITROPUS* SP

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Background: Crustacean parasites are organisms which are present inside or outside of the fishes. Parasitic infections affect the fish growth and normal functioning which leads to economic losses and the marketability of the same will reduced drastically, Nowadays, farmers are using chemical substances to treat the parasitic crustaceans in aquaculture to reduce the financial losses caused by them. But the use of chemicals causes so many problems to the fish ecosystem and consumption of such cultured fish may present risk to human health. The present study thus aims to develop a biocontrol agent to control this parasite without causing any damage to fish ecosystem.

Method: This work explores the metabolic versatility of microorganisms isolated from sea food processing effluent and based on their potency in hydrolytic activity, grouped into a consortium to act against isopod without causing any damage to fish ecosystem. The minimum dose of the consortium which cause mortality of the isopod, the mode of action, antimicrobial activity, chemotaxis, ESEM analysis, pathogenicity and species level identification of the strains in consortium were tested.

Results: Seven potent strains from the effluent sample were selected and formulated five consortia. Based on their effectiveness in the mortality of isopod, only one consortium was selected which cause death of the isopod within 48h.Positive chemotaxis was also observed towards the isopod culture and ESEM analysis revealed the damages in the exoskeleton. Acriflavine agglutination and congo red agar test showed the nonpathogenicity of the strains in consortium and the experimental challenge with fish and isopod with the consortium showed the mortality of isopod without causing any damage to the fishes.

Conclusions: We developed a consortium with three different bacteriato degrade the isopods for possible use in aquaculture system without causing any damage to fish ecosystem.

Keywords: Consortium, Nonpathogenicity, Chemotaxis, Agglutination

07-03

EMBRYONIC FIBROBLAST CELL LINE AP7EF1 DERIVED FROM THE ORANGE CLOWNFISH *AMPHIPRION PERCULA*(LACEPEDE, 1802): OPTIMISATION OF CULTURE CONDITIONS, CRYOSTORAGE AND CHARACTERISATION

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Background: Fish cell lines serve as useful tool for investigating basic fish biology, as a model for bioassay of environmental toxicants, toxicity ranking and for developing molecular biomarkers.*In vitro* embryonic fibroblast (EF) cell culture systems represent powerful tools to test gene function due to their easy accessibility, rapid growth rates, and the possibility of facilitating large number of experiments. Embryonic fibroblasts can also serve as feeder fibroblasts in embryonic stem cell culture. A new continuous fibroblast cell line designated as AP7EF1 was established and characterized from the embryo of the popular aquarium fish *Amphiprion percula* (Lacepede, 1802).
Method: Embryo phase 29 (168 h post-fertilization) of *A.percula* was used for initiating *in vitro* cell culture. Primary culture was done by trypsinisation method using Leibovitz-15 (L15) medium supplemented with 20% fetal bovine serum (FBS) and confluent monolayers obtained were subcultured and passaged. A successful cell culture system designated as AP7EF1 was derived, which was continuously passaged and also cryopreserved at different passage levels. To determine optimum growth conditions, different growth characteristics studies such as effect of temperature, pH and FBS concentration as well as seeding and plating efficiency were performed. Mitochondrial COI gene sequence analysis was carried out to authenticate the cell line. The cells were also characterised by chromosome analysis. Cell morphology and cell type were determined using Giemsa and immunofluorescence staining.
Results: The *in vitro* cell culture system derived has crossed 30 passages.The optimum growth conditions were found to be at temperature of 28±2°C, pH 7.2 and FBS supplementation at 10%.Cryopreserved cells showed 80-85% viability on revival. Cells were found to be bipolar in nature and showed strong immunoreactivity to the antibodies directed against fibroblast marker. CO1 gene sequence analysis authenticated purity of the cell line and cells were found to be aneuploid.
Conclusions: The present study optimised the protocol for primary culture of embryonic fibroblasts from fish embryo. Further, the culture conditions were optimised and a continuous cell line AP7EF1 was established and characterised.
Keywords: A*mphiprion percula*, AP7EF1, Cell line, Embryonic fibroblasts, Orange clown fish, Primary culture

07-04

IN VITRO DETECTION OF BENZIMIDAZOLE RESISTANCE IN ORGANIZED FARM AND SMALL HOLDER FLOCKS BY EGG HATCH ASSAY

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Background: Egg hatch assay (EHA) evaluates the ability of benzimidazoles to inhibit or prevent embryonation and hatching of nematode eggs and is the standard *in vitro* test for detection of benzimidazole resistance. The present study reports the *in vitro* detection of benzimidazole resistance in an organized government goat farm and small holder farmers' flocks in Palakkad district by EHA.
Method: Strongyle eggs extracted from anaerobically stored, pooled fecal samples of goats were used for

the assay. Hundred µl of egg suspension (with approximately 50 eggs) was incubated in 0.5, 0.3, 0.2, 0.1 and 0.01µg/ml of pure thiabendazole in Dimethyl sulfoxide (DMSO) in 24 well plates at 26^{0}C for 48 hrs. From theper cent unhatched eggs at each drug concentration, ED_{50} (dose required to prevent 50 per cent of the viable eggs from hatching) values were calculated by log probit analysis using SPSS version 24.0. ED_{50} values were above 0.1 µg/ml indicated benzimidazole resistance. The result of EHA was also interpreted using the discriminating dose criterion in which the proportion of eggs that hatched at the discriminating dose of 0.1 µg/ml thiabendazole (H_{dd}) was considered and H_{dd} values over 0.5 µg/ml indicated resistance.

Results: The results indicate benzimidazole resistance in the organized farm with ED_{50} of 1.429 µg/ml of thiabendazole while susceptibility was observed in the small holder farmers' flocks with ED_{50} of 0.023 µg/ml. Considering the discriminating dose criterion benzimidazole resistance was detected in organized farm with H_{dd} of 0.835 while susceptibility was identified in the small holder farmers' flocks with H_{dd} of 0.086.

Conclusion: The results indicate general agreement between ED_{50} and H_{dd} values in egg hatch assay. The development of benzimidazole resistance in organized farms might be attributed to the prolonged and frequent use of the drug.

Keywords: Egg hatch assay, benzimidazole resistance, organized goat farm, small holder farmers' flocks

07-05

CHARACTERIZATION OF QUORUM QUENCHING SOIL BACTERIUM BACILLUS THURINGIENSIS ISOLATED FROM FISH CULTURE POND AND ASSESSMENT OF ITS PROBIOTIC ACTIVITY IN GOLD FISH CARASSIUS AURATUS

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Background: Quorum quenching (QQ), the obstruction of quorum sensing, is the most attractive way to break down the N-acyl-homoserine lactones (AHL) molecules. This work was aimed at isolating AHL degrading bacteria from fish culture pond soil, with abilities appropriate for use as probiotic in aquaculture.

Method: Twenty AHL degrading isolates were screened for the presence of an autoinducer inactivation (aiiA) homologue gene and whole cell AHL-inactivation ability. Isolates were also screened for acid, bile salt and phenol tolerance, surface properties, antibacterial activity and antibiotic resistance. *In vivo* test was carried out to evaluate the efficiency of QQ isolate to reduce mortality in gold fish experimentally challenged with pathogenic *Aeromonas hydrophila*.

Results: The presence of an autoinducer inactivation (aiiA) homologue gene and AHL-inactivation assay showed that *Bacillus thuringiensis*QQ17, which was one among the 20 isolates, could rapidly degrade synthetic C6-HSL *in vitro* and hampered violacein production by *Chromobacterium violaceum*. It had excellent biodegrading ability of natural N-AHL produced by *Aeromonas hydrophila,* suggesting that it can be used as a potential quencher bacterium for inhibiting the virulence of *A.hydrophila*. The isolate grew well at pH 3.0-7.0, was resistant to high level of bile salts (0-0.9%) and 0.5 % of phenol. QQ17 also exhibited high degree of auto-aggregation and co-aggregation, confirming that it possessed good probiotic attributes. It was susceptible to all the 11 antibiotics tested and exhibited antagonistic activity against *A.hydrophila*. Gold fish fed diet incorporated with 10^8 and 10^{10} CFU/g of the QQ17 for 30 days showed 73.33-83.33% survival when challenged with pathogenic *A.hydrophila*.

Conclusions: The study indicates that the isolate *B.thuringiensis* QQ17 could be used as a non- antibiotic feed additive in aquaculture to control bacterial diseases.

Keywords: Quorum sensing, Quorum quenching, N-acyl-homoserine lactones, Probiotic, *Bacillus thuringiensis*

07-06

IDENTIFICATION OF MULTIDRUG RESISTANT MECA GENE POSITIVE STAPHYLOCOCCUS AUREUS AND ACINETOBACTER BAUMANNII ISOLATES IN AQUATIC ENVIRONMENT

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Background: Resistance to antimicrobial agents among clinically important pathogens in the community and environment has become a serious concern. Methicillin-resistant *Staphylococcus aureus* (MRSA) is a major challenge for hospitals due to the development and spread of isolates with resistance to multiple classes of antibiotics. Multi drug resistant *Acinetobacter baumannii* has emerged as one of the world's most troublesome pathogens acquired by hospitals. The present study screened samples for the presence of mec A gene in methicillin-resistant *S.aureus* and *A.baumannii* from aquatic environment adjacent to aprominent hospital of Kerala and two aquaculture farms using the water as inlet water source.
Methods: Water, soil, fish and clam samples were collected from the area where hospital effluent was being discharged into public water body and two aquaculture farms using the same water as inlet water source. Microbiological analysis of the samples including biochemical tests was carried out following standard procedures to identify the isolates. Standard disc diffusion and E-test were used for determining the antibiotic susceptibility pattern and minimum inhibitory concentration. The samples were screened for the presence of mecA gene by PCR and confirmed by sequencing.
Results: A total of175 *S.aureus* and 55 *A.baumannii* isolates were obtained from the soil, water and fish samples collected from the study area. Antibiotic sensitivity test showed that most of the isolates had high level of resistance against beta-lactam, fluoroquinolones, aminoglycosides, macrolides and chloramphenicol. Prevalence of MecA gene in *S.aureus* was 34.2% while the prevalence was 46.1% in *A.baumannii*.
Conclusion: Detection of antibiotic resistant mecA positive *S.aureus* and *A.baumannii* in different samples revealed that hospital environments could be a potential source of transmission of antimicrobial resistant (AMR) isolates. The findings highlight the importance of strict implementation of effluent treatment in hospitals before discharge to prevent the spread of multi-drug resistant bacterial pathogens.
Keywords: *Acinetobacter baumannii, Staphylococcus aureus,* Antibiotic resistance, multi-drug resistant, mecA gene

07-07

DIET PATTERN OF A RECENT INVADER, *PIARACTUS BRACHYPOMUS* (CAVIER,1819) DURING 2018 FLOODS IN A WESTERN GHATS RIVER OF KERALA

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Background: The unexpected and persistent heavy monsoonal downpours during August 2018 in Chalakudy river have resulted in massive and catastrophic flood scenario bringing a new non-native species, Red Belly Pacu, *Piaractus brachypomus*. The present study is to provide the diet composition of *pacu* to evaluate the ecological impacts of the species on the food web structure of the river.
Method: Fish samples were collected seasonally from the local fishermen around the river. The specimens were dissected and gut contents were identified. The relatively important food contents in the guts were analysed following Index of Relative Importance.
Result: The fish consumed crustaceans, plant parts, insects, fish remains, molluscs, soil particles, fruits and seeds, reptiles and others**.** The feeding habits of *P. brachypomus*revealed a high preference for preying

crustaceans and aquatic plant parts, considerably vary from that of individuals in its native range which prefer allochthonous food resources such as fruits, seeds etc.

Conclusion: The study concluded that *P. brachypomus*have shifted to a more generalized diet in comparison to native population and there is an urgent need to evaluate the extent of the population spread of the species to eradicate them from the river ecosystem.

Keywords: Flood, Chalakudy river, Exotic fish, Diet shift, Impact

07-08

TOXICITY AND OXIDATIVE STRESS INDUCED BY NANO-TiO_2 IN NILE TILAPIA (*OREOCHROMIS NILOTICUS*) AND ITS MODULATION BY DIETARY SUPPLEMENTATION OF *TINOSPORA CORDIFOLIA* EXTRACT

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Background: Nano-TiO_2 (TNP) is added to water of fish farms to prevent or mitigate bacterial disease outbreaks. Unfortunately, the interaction of TNP with cells impaired host defenses of fish resulting in increased mortality and morbidity during subsequent bacterial challenges. Nanotoxicity is recognized to be mediated by oxidative stress and therefore, the approach of preventing oxidative stress is an ideal strategy in circumventing it. The present acute study investigated the efficacy of *Tinospora cordifolia* (Family–Menispermaceae) in ameliorating TNP induced oxidative stress in Nile tilapia (*Oreochromis niloticus*).

Method: The antioxidant potential of ethanolic extract of *Tinospora cordifolia* plant (TCE) was evaluated prior to fish diet preparation. The status of innate antioxidant enzymes (catalase, superoxide dismutase, glutathione peroxidase), activity of transaminases and phosphatases, extend of protein and lipid oxidation, expression of anti-apoptotic and apoptotic proteins, and histopathology of organs were evaluated in fishes exposed to TNP and fed with TCE diet supplements at various concentrations.

Result: TCE was rich in phenolic content and showed significant *in vitro* antioxidant activity. TNP induced oxidative stress via decreasing the innate antioxidant enzyme activities and increasing protein oxidation, lipid peroxidation and, apoptotic proteins. It also caused significant morphological and pathological alterations in gill, liver and kidney of fish. TCE supplemented feed reverted the oxidative stress caused by TNP by improving the endogenous antioxidant status, decreasing protein and lipid oxidation, and down-regulating apoptotic proteins in Nile tilapia. TCE also up-regulated the anti-apoptotic protein Bcl2 and improved the morphology of the organs.

Conclusion: The study revealed the protective efficacy of polyphenol rich TCE against nanotoxicity in Nile tilapia and sheds light on the therapeutic potential of TCE in aqua farming.

Keywords: Nano-TiO_2, Nile tilapia, Oxidative stress, *Tinospora cordifolia,* Toxicity

07-09

ALARMING INCREASE IN TETRACYCLINE RESISTANCE AMONG BACTERIA ISOLATED FROM POULTRY FAECAL SAMPLES

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Background: Antibiotics are used commonly in poultry feed for prophylaxis and enhancement of growth. However, bulk use of these drugs in poultry and other livestock has recently been identified

to favour evolution and transmission of antimicrobial resistance strains. The resistant bacteria evolved and disseminated into environment through poultry faeces will ultimately get introduced in agriculture farm and thereby contaminate waterbodies. The risk of these to humans can be at the life-threatening level as the accruing of these genes by human pathogens will make them difficult to treat.
Method: Feed and faeces samples were isolated from selected poultry farms in Ernakulum district, Kerala. Extraction of antibiotics was done from powered feed samples using acidified methanol and quantified using LC/MS. All the faeces samples were subjected to the isolation of *E. coli* and *Klebsiella* spp. on MacConkey agar plates. The isolates were purified and confirmed by morphological characters and 16S rDNA identification. The selected isolated were screened for antibiotic sensitivity by disc diffusion. Molecular confirmation for tetracycline resistance was also conducted by PCR amplification of *tet*A and *tet*B genes using specific primers.
Results: Tetracycline, oxytetracycline and chlortetracycline antibiotics detected in all the feed samples were below the Maximum Residue Limit (24.30 mg/kg). Out of the total *E. coli* isolates (25), 60% (15) were resistant to tetracycline followed by 20% (5) to aztreonam. All the *Klebsiell*a isolates (8) were resistant to tetracycline, but 37.5% (3) were resistant to aztreonam. Interestingly sequence analysis of *tet*A and *tet*B showed amino acid substitutions when compared to the reported sequences.
Conclusion: From the study, antibiotic supplemented in the feed might be considered to be the reason for enhanced rate of tetracycline resistance among the *E. coli* and *Klebsiella* spp. The observed MRL limit of tetracycline identified in the feed further indicates the likely chance of antimicrobial resistance evolution at an enhanced rate. From the results, environmental release of poultry faecal material can considered to have long-term impact due to the tetracycline resistance and its likely role to favour resistance to other antibiotics such as doxycycline and minocycline. Hence, the observed result indicates the need for periodic monitoring of both animal feed and gut microflora to predict the threat from AMR.
Keywords: Tetracycline, Antimicrobial resistance, *tetA*

07-10

MACROLACTIN FROM MARINE ALGAE ASSOCIATED *BACILLUS AMYLOLIQUEFACIENS:* PROSPECTIVE ANTI-INFECTIVE AGENT AGAINST DRUG RESISTANT BACTERIA

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Background: Continuously evolving antibiotic-resistance of microbial pathogens has raised demands for the development of new and effective antimicrobial compounds. Marine *Bacillus* strains were proved to be the prolific sources of diverse secondary metabolite classes with approximately 8 % of genome devoted to synthesize antibiotics, including polyketides, such as macrolactins.
Method: Heterotrophic bacteria associated with *Hypnea valentiae* were isolated and screened by spot over lawn assay. Antibacterial activity of the bioactive secondary metabolite purified from the most active strain was assessed by disc diffusion method and microdilution method. The biosynthetic gene clusters in the genome were mined by antiSMASH 5.0.0. *In silico* molecular docking was performed against Peptide Deformylase (PDF) of *Staphylococcus aureus*.
Results: The macrolactin isolated from *Bacillus amyloliquefaciens* MTCC 12716 displayed broad spectrum of anti-infective activities against pathogens causing nosocomial infections, such as methicillin-resistant *Staphylococcus aureus*, vancomycin-resistant *Enterococcus faecalis*, *Pseudomonas aeruginosa* and *Klebsiella pneumonia* with MIC ≤ 1.50 µg/mL, whereas standard antibiotics ampicillin and chloramphenicol were active at concentrations of ≥ 6. 25 mg/mL. Biosynthetic pathway of macrolactin through sequential decarboxylative Claisen condensation was established and the structures were correlated with the gene organization of the *mln*

operons in the genome. The best binding poses for the compound revealed docking scores (> 9.70 kcal/mol), greater than that of a natural peptide deformylase inhibitor, actinonin (6.96 kcal/mol).

Conclusion: The study revealed promising antibacterial potential of the macrolactin isolated from the marine symbiotic *Bacillus*, and the compound could be a potential lead for biotechnological and pharmaceutical applications against emerging multidrug resistant pathogens.

Keywords: macrolactin, marine *Bacillus*, heterotrophic bacteria, biosynthetic gene clusters, methicillin-resistant *Staphylococcus aureus*

07-11

IMMUNOTOXICITY OF POLYCYCLIC AROMATIC HYDROCARBONS IN DEVELOPING CHICKS

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Polycyclic aromatic hydrocarbons (PAHs) are pollutants which are persistent in nature characterized by the presence of fused organic rings. They are formed by the incomplete combustion of organic materials and fossil fuels hence the most predominant air pollutant. The aryl hydrocarbon receptor (AHR) is a ligand-activated cytosolic transcription factor of which physiological action unknown, but activated by xenobiotics. The objective of the present study was to elucidate mechanisms of immunotmoxicity of PAH chemicals such were pyrene, fluoranthene, phenanthrene. AHR m RNA transcript in thymus, bursa of fabricius and spleen of developing chicks was isolated and correlated with the DNA damage produced in these immune organs. Specific pathogen free (SPF) embryonated eggs on day nine of incubation were inoculated with a solution of pyrene, phenanthrene and fluoranthene dissolved in tricaprylin through the allantoic route at three dose levels: 0.2mg/kg, 2mg/kg and 20mg/kg. The chicks were harvested on day 21 of incubation and immune organs like bursa of Fabricius, spleen and thymus were collected under sterile conditions. Total RNA was isolated from these tissues, cleaned and quantified and reverse transcription was carried out. Histopathological examination of immune organs were also carried out. The leves of immunoglobulins and interleukins were also analysed. The concentration of Aryl hydrocarbon receptor was analysed by sandwich ELISA. DNA adduct produced by PAHs in immune organs were analysed by DNA adduct ELISA and DNA damage was assessed by comet assay. A 650 base pair product was observed by RNA extraction and reverse transcription PCR from thymus, bursa of Fabricius and spleen.Among the three chemicals, pyrene showed maximum potency in inducing AHR and DNA adducts in thymus. A significant increase in the AHR concentration and DNA adduct levels was found in thymus and bursa in 2mg and 20mg dose levels of pyrene, fluoranthene and phenanthrene treated groups, whereas those in spleen simulated the value of controls. The histopathological lesions in spleen, bursa of Fabricius and spleen indicate that all the three compound lead to immunotoxic lesions at 20 mg/kg levels. Hence this experiment can be considered as a strong evidence of genotoxic potential of PAHs like pyrene, phenanthrene and fluoranthene at their corresponding dose levels.Pyrene, phenanthrene and fluoranthene did not affect immunoglobulins at tested dose levels. However T lymphocyte activating cytokines was markedly affected by these PAHs. This study explains the possible mechanisms immunotoxicity of PAH of DNA damage in immune organs by AHR activation.

07-12

AN INVESTIGATION ON THE NUTRITIONAL ASPECTS OF NON CONVENTIONAL TROPICAL SEAWEEDS

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Background: Seaweeds are non conventional food source which has gained tremendous attention in the food industry. In this study six tropical green seaweeds namely *Ulva fasciata, Ulva lactuca, Halimeda macroloba, Halimeda gracilis, Chaetomorpha linum* and *Chaetomorpha antennina* were analyzed for its nutritional qualities with the view for the utilization in human consumption. This data is first of the kind as the nutritive values of the present study were higher when compared to terrestrial plants. Thisinformation is essential in the search for additional healthyfood sources from the sea for use in human and animalnutrition.
Method: The method includes collection, identification, processing of seaweeds. The seaweeds were analyzed for its proximate composition, micro and macro nutrients, pigments, fatty acid and amino acid profiles.
Results: *Ulva lactuca*(13.02%)and *Ulva fasciata*(68.1%) recorded higher carbohydrate and protein contents when compared to *Halimeda* and *Cheatomorpha sp.* The pigmental composition showed that *H. macroloba* registered higher total chlorophyll 18.57 (µg/ml) compared to the rest of the seaweed. The macronutrient levels of *C. linum* exhibited higher Ca, Mg and P (82.99, 76.46, 57.74 mg/100g) respectively. The micronutrient Mn was found to be highest in *U. lactuca* (4.7 mg/100g) whereas *C. linum* recorded B, Zn and Cu (3.25, 3.70, 1.45 mg/100g). *U. fasciata* displayed a high Linolenic acid C18:3n-3 (13.65%) and C18:2n-6 Linoleic acid (7.90%) content when compared to the other species studies.*U. fasciata* registered higher amino acid content (94.57 mg/g) which was followed by *U. lactuca* (79.33 mg/g).
Conclusion: This study showed that species from family Ulvaceae are a rich source of proteins amino acids, fatty acids and carbohydrates when compared to calcareous*Halimeda sp*. C*haetomorpha linum* otherwise known as the spaghetti algae demonstrated large proportion of macronutrients like calcium, magnesium and phosphorous. The nutrient contents also revealed that if proper processing measures were developed it would be suitable for human consumption.
Keywords: Green seaweeds, Proximate composition, Macronutrients, Micronutrients, Amino acid, Polyunsatuarated fatty acid.

07-13

MOLECULAR CHARACTERIZATION AND PHYLOGENETIC ANALYSIS OF ROTAVIRUS ASSOCIATED WITH PIGLET DIARRHOEA IN KERALA

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Background: In Kerala, pig rearing is adopted as a source of income in many districts. One of the important health problems in suckling and recently weaned piglets is neonatal diarrhoea. Rotavirus is a major causative agent for diarrhoea in piglets. Though the incidence of rotaviruses in Kerala has been established, a thorough study of the agent with respect to genotypes of the virus has not been carried out so far. Hence the present study was conducted to genotype the rotaviruses associated with piglet diarrhoea in Kerala by molecular methods.
Method:A total of 100 diarrhoeic faecal samples were collected from piglets reared in organized farms in

Kozhikode, Wayanad, Palakkad, Thrissur and Ernakulam districts of Kerala. The samples were tested for the presence of Group A rotavirus (GAR) by employing VP6 gene based reverse transcriptase polymerase chain reaction (RT-PCR). The G and P genotypes of the positive samples were elucidated by RT-PCR followed by nucleotide sequencing.

Results: Of the 100 diarrhoeic faecal samples, 12 (12%) samples was found to be positive for VP6 gene of GAR as evidenced by a 309 bp amplicon. Positive samples were obtained from Palakkad and Wayanad districts. The G and P genotypes detected were G2, G4, G5, G6, G9, P[6], P[19] and P21-5 like.

Conclusions: The present study could successfully detect and characterize GAR in the pig population of Kerala. Some of the sequences showed close similarity to rotaviruses isolated from humans and from bovines. Thus results of the study indicate that the rotaviruses of pigs in Kerala are genetically diverse. Of the G and P types detected, G2, G9 and P[6] have been reported in humans in Kerala. This finding has important implications in the control of rotavirus infection in animals and man.

Keywords: Pigs, Group A rotavirus, G and P genotyping, Reverse transcriptase polymerase chain reaction (RT-PCR), Phylogenetic analyses

07-14

CLIMATE CHANGE AND ITS CONSEQUENCES ON ANIMAL HEALTH

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Background: As per the 2018 Global Climate Threat Report published by German Watch, India is the 12th most insecure country to climate change. Many of the animal owners involve peasants who are vulnerable to poverty, social inequality, or animal diseases. The constantly changing climatic situation is likely to impact these disadvantaged individuals more often than the common man because their survival relies directly on it.

Method: In October 2019, an online questionnaire was sent to 450 veterinarians randomly, who worked across 7 districts in Kerala to assess if their practices have seen the environmental impacts of climate change. The response rate was 15.33%(n=69).

Results: Over 49.3% were certain that climate change is relevant to direct patient care and 55. % seriously felt that climate change is adversely affecting the health of the patients frequently reported ill-effects were *vector borne infection (92.8%),heat related effects (89. %), Diarrhoea from food or/and waterborne illnesses (84.1%).*Most participants in the study endorsed veterinary medical training, customer and public education about the consequences of climate change on animal health, and outreach from their professional societies.

Conclusion: These results indicate that veterinarians in Kerala and their clients alike are currently experiencing theill effects of climate change in their clients and patients alike, and they are advocating a range of responses from the veterinary profession and policy makers to deter additional damage.

Keywords: Climate Change, Health Impacts, Veterinary Practice, Vulnerable Population

07-15

SCREENING FOR SUB-CLINICAL MASTITIS WITH TANUCHEK SCC KIT

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Background: Mastitis in dairy cows is the most economically important disease and contributes to substantial losses to the farmers due to reduced milk production and high treatment costs. Mastitis was found to be the most persistent and important problem faced by the dairy farmers across the State. It is always better to prevent mastitis rather than treating it which involves huge cost. Regular screening of cows for sub-clinical mastitis is

better to prevent and combat mastitis at an early stage.

Method: TheTANUCHEK SCC Kit of TRPVB, TANUVAS were procured for this study to identify the sub clinical and clinical mastitis based on somatic cell count in milk. A total of 280 milk samples were collected from quarters of 70 cows at 10 different small dairy farms of Erode District, and were examined using the TANUCHEK SCC KIT and interpreted the infection with guidelines prescribed in TANUVAS SCC KIT score card.

Results: Out of 280 samples, 60 samples were identified positive for sub clinical mastitis (21.42%) and 52 samples identified positive for clinical mastitis (18.57%). A 280 samples from same milch animals were collected, after one month period. This one period teats were cleaned properly and sprayed with germicidal solutions. Out of this 280 samples, 35 samples were identified positive for sub clinical mastitis (12.5%) and 20 samples identified positive for clinical mastitis (7.14%).

Conclusions: The study reveals that 40% of animals prone to mastitis. This Field level Demonstration enlightened the farmers on the effect of the screening, early detection and treatment of sub-clinical mastitis.

Keywords: Cow, Mastitis, TANUCHEK

07-16

EFFECT OF DIETARY INCORPORATION OF KSHEERABALA RESIDUE ON GROWTH PERFORMANCE IN WISTAR RATS

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Abstract: Ksheerabala residue is a by-productobtained during the preparation of ksheerabala oil which is made by incorporating bala (*Sida cordifolia*), cow milk and gingelly oil (*Sesamum indicum*). This residue is available in considerable quantity and many of the farmers are using this byproduct for feeding livestock. But the level of incorporation and the effect of Ksheerabala residue on growth in rats are not yet wellstudied. Hence, the present study is planned to evaluate the effect of dietary incorporation of Ksheerabala residue as a feed resource in the diet of Wistar rats on their performance. Twenty four male Wistar albino rats weighing 80 ± 5 grams were used as experimental animals and were allotted randomly to two treatments of six replicate each. Group 1 wasfed with basal diet as per BIS specification (control-T_1) and other groupwas fed with diet containing five per cent ksheerabala residue (T2). The average body weight, body weight gain, dry matter intake, haematological and biochemical parameters were found to be similar in both the groups ($p>0.05$). The results of the present study indicated that Ksheerabala residue can be included in the rat ration up to five per cent level without any adverse effect on their growth performance.

Keywords: Ksheerabala residue, Rat, Blood, Growth

07-17

MOLECULAR CHARACTERIZATION& PHYLOGENETIC ANALYSISOF DEFENSIN ANTIMICROBIAL PEPTIDE FROM GENETICALLY IMPROVED FARMED TILAPIA (GIFT)

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Background: Antimicrobial peptides are an ancient system innate immunity and have developed to be a growing class of natural and synthetic peptides with a wide spectrum of targets. Fishes are proven to be a prospective source of AMPs. Defensins are an evolutionarily ancient family of cationic AMPs, characterized by the presence of six or eight cysteyl residues.

Methods: Total RNA was isolated from the gills of GIFT using TRI reagent according to the manufacturer's protocol. PCR amplification was performed and the product was cloned into pGEM-T vector and transformed into DH5α *E.coli* competent cells. Positive recombinant clones were selected for plasmid isolation. Recombinant plasmids were sequenced and *in silico* analyses were done.
Results: GIFTβ-defensin (GIFT-BD) nucleotide sequence consisted of 128nucleotides encoding 39 amino acids. BLAST analysis of the nucleotide and amino acid sequence revealed 97.95% similarity to β-defensin from *Siniperca chuatsi*.GIFT-BD possessed a molecular weight of 4.75 kDa and a pI of 9.33. The bootstrap distance tree calculated for the resulting β-defensin sequence showed a strong relationship with other fish β-defensins.
Conclusion: Physicochemical properties of GIFT-BD are in agreement with the characteristic features of antimicrobial peptides, indicating its potential role in innate immunity of the organism.
Key words: Antimicrobial peptide, β-defensin, GIFT, Aquaculture, Health Management

07-18

SYNERGISTIC ACTIVITY OF METHANOLIC EXTRACT OF *TECTONA GRANDIS* AND *BIOPHYTUMSENSITIVUM* WITH TETRACYCLINE IN BACTERIAL ISOLATES FROM BOVINE MASTITIS

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Mastitis as the multi-factorial, endemic disease of the mammary gland. Extensive and indiscriminate use of antibiotics in the treatment and control of mastitis may lead to emergence of antibiotic resistant bacteria and transfer of resistant genes. Among various pathogens *Escherichia coli* and *Staphylococcus* contributes to major occurrence of mastitis in dairy animals and also posses antimicrobial resistance. Combination of phytochemicals with antimicrobial agents shown effective measure to overcome antimicrobial resistance. Methanolic extracts of *Tectonagrandis* and *Biophytumsensitivum* are phytochemicals used in this study in combination with tetracycline in *Escherichia coli, Klebsiella sp* and *Staphylococcus aureus* isolates from mastitis. In the present study disc diffusion antimicrobial assay by Kirby Bauer assay and minimum inhibitory concentration by microdilution method was conducted in *Escherichia coli, Klebsiella sp* and *Staphylococcus aureus* isolates from mastitis with tetracycline and methanolic extracts of *Tectonagrandis* and *Biophytumsensitivum* combination at different doses and compared their efficacies. Biofilm assay was performed by Congo red method.

07-19

OCCURRENCE AND GRADING OF HEPATIC AMYLOIDOSIS IN DUCKS

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Background: Duck farming is most popular poultry farming next to chicken in Kerala and being the water fowl, gaining more importance especially in the flood threat situations in Kerala. A healthy liver is important for the maximum productivity of the duck. This study was designed to identify the occurrence of gross and microscopic lesions of liver from the duck carcasses from various parts of Kerala
Method: Detailed post-mortem examination of 112 duck carcasses from different parts of Kerala was conducted, gross lesions recorded and collected representative liver tissues in neutral buffered formalin for histopathology. The liver sections were processed and stained using haematoxylin and eosin stain by routine methods. Congo red special staining were employed for confirmation of amyloid depositions in the tissues. A

histological grading pattern for amyloidosis of liver, such as mild, moderate and severe were made.

Results: Liver lesions noticed were enlargement, discolouration, friable consistency and nodule formation. Histologically amyloidosis was noticed in 61.61 per cent (69/112)cases. A correlation could be observed with histological grading and gross findings of the liver. Histologically mild amyloidosis had no gross liver lesions, while, moderate had pale pink gross appearance and severe amyloidosis had deep yellow discoloration. Pododermatitis was found to be a constantly associated lesion in amyloidosis identified ducks. All the amyloidosis cases were identified in intensively reared ducks.

Conclusions: A high occurrence of amyloidosis identified in this study especially in intensively reared ducks indicates the possibility of chronic disease condition and / or possibility of underlying mycotoxin problems. The study helps to identify the severity of amyloidosis by the gross colouration of the liver. The zoonotic implications by possible consumption of amyloid affected duck liver needed to be further explored

Keywords: duck, Kerala, amyloidosis, histological grading

07-20

CHARACTERIZATION OF LACTOFERRIN ISOLATED AND PURIFIED FROM MALABARI GOAT COLOSTRUM

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Lactoferrin, an iron-binding glycoprotein, present primarily in milk as well as in most of the secretions of the body, has been shown to have great importance in practical medicine due to various physiological and protective functions including roles in iron homeostasis, cell proliferation, antibacterial, antifungal, antiviral, antioxidant, immunomodulatory and anticancer activities. The present study focused on the isolation, purification and characterization of lactoferrin of Malabari goats, an indigenous goat breed of Kerala. Lactoferrin was isolated from colostrum samples by cation exchange chromatography using CM Sephadex C-50 column.The isolated protein was confirmed as lactoferrin by SDS-PAGE in terms of its molecular weight wherein a single 80 kDa Coomassie Brilliant Blue-stained band could be observed ensuring the purity of the protein. The identity of the protein was further confirmed by Western blotting. The concentration of lactoferrin as estimated by Lowry's method was found to be 15.103 mg/L of colostrum. The total iron content in the undigested and digested lactoferrinwas estimated to be 230 ppm and 600 ppm respectively by atomic absorption spectrophotometry. The total carbohydrate content in the isolated lactoferrin as estimated by phenol-sulphuric acid method was 9.3 per cent. The results of this study point out to a single-step method for the purification of lactoferrin from colostrum.

Keywords: Lactoferrin, Malabari goats, Colostrum, Cation exchange chromatography, SDS-PAGE, Western blotting

07-21

REPORT OF *TRYPANOSOMA THEILERI*LAVERAN, 1902, IN CATTLE FROM THRISSUR, KERALA, INDIA

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Blood smears from adult cattle brought to the clinical laboratory, University Veterinary Hospital, Thrissur, with symptoms of pyrexia for detection of haemoparasites were fixed and stained with Field's stain. *Trypanosome theileri* could be identified by its long and pointed posterior end,well developed undulating membrane and well defined free flagellum in two cases. It measured about 65 microns in length. Kinetoplast, from where the flagella originates could be observed subterminally, near to the nucleus. *Trypanosome theileri*

was a non pathogenic extracellular haemoprotozoan. Animals understress were only positive for the species. This protozoan was much larger than the common trypanosome, *Trypanosome evansi* in cattle. It was rare, even though reported from various states of India and many parts of the world. This is also transmitted by large biting flies, the tabanid flies which share the common vector with the smaller *T. evansi*. On perusal of available literature it was found that this is the first report from Kerala. The prevalence of *T.evansi* was also studied for a period of two years.

08- HEALTH SCIENCES

08-01
CHARACTERIZATION OF CARBOMER GEL TO MIMIC SOFT-TISSUE UNDER DIAGNOSTIC ULTRASOUND

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Objective: Materials with acoustic quantities similar to soft-tissue are known as tissue-mimicking materials (TMMs) under ultrasound (US). TMMs are used in manufacturing US phantoms for quality assurance of an US equipment or US guided biopsytraining. Acoustic quantities are a set of quantities primarily, the velocity of US (c_{us}) in the material, and Acoustic Impedance (AI). In this work, the acoustic quantities of water-based gel (hydrogel) was determined and evaluated for its ability to represent soft-tissue under diagnostic US scanner.
Methods: Hydrogel using carbomer-940 was prepared.The sample underwent computerized tomography (CT) to determine its mass density and US scan to assess its ability to represent a soft-tissue background. Experimentally, the c_{us} was measured and the AI was calculated from the product of density and c_{us}. Results were compared to the reference values, based on the ICRU Report 61. Finally, the CT and US scan images of carbomer gel (C-gel) were compared to the respective images of the human liver (a clinical soft-tissue), to estimate the diagnostic significance of the results.
Results: In C-gel the density, c_{us}, and AI were within 1.3 %, 5.7 %, and 4.3 %, compared to the reference values. The CT and US images of C-gel displayed a homogenous soft-tissue background that could efficiently mimic the liver images.
Conclusions: In this novel study, the acoustic quantities of C-gel are explored. Experimental results of C-gel were acceptable and it could resemble soft-tissue in the scan images. This gel contains more than 90% water, is effortless to prepare, and can provide a low-cost alternative to a commercial TMM. C-gel can support in developing a phantom for periodic performance evaluation of US scanners, contributing to reliable patient scans.
Keywords: Acoustic quantities, tissue-mimicking materials, velocity of ultrasound, ultrasound phantom material.

08-02

EFFECTS OF ARTIFACTS WITH ONYX EMBOLIZATION MATERIAL IN CLINICAL PRACTICE DURING STEREOTACTIC RADIOTHERAPY PLANNING

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Purpose: The aim of the study was to evaluate the effect of artifacts generated by the onyx embolization material during Stereotactic Radiosurgery/Radiotherapy (SRS/SRT) planning. An in-house made novel Polymethyl Methacrylate (PMMA) head phantom was used for this purpose. The head phantom was validated using SRT plans using a small field detector A14SL. **Methods and materials:** The designed phantom can incorporate different ionization chambers, radio-chromic films and gel dosimeters. For this study we have made cuboid adaptor for placing the onyx material inside the phantom and its solid counterpart to compare. For the evaluation process, we have created concentric ring structures around the central onyx materials on both the CT images (with and without onyx material) and calculated the integral dose variations. The verification plans were calculated on these two sets of CT data using different algorithms such as Analytical Anisotropic Algorithm (AAA), Acuros and Monaco based Monte Carlo.
Results and Discussions: In the phantom validation process we found the percentage dose variations were ranges from 0.76 to -1.01 with a mean variation of -0.17%. For the effect of onyx generated artifacts in dose calculations for fixed jaw (5×5 cm^2) full arc technique, all three algorithms overestimate the dose. Among, Monte Carlo showed a higher deviation in integral dose of >5.7% for the proximal ring structure to the embedded onyx material. It was noticed that in the CT images with onyx materials shows a variation in Hounsfield (HU) profile because of the artifact generated heterogeneity. This could lead to a variation in dose calculations nearby the embolic material. The more variations mean the better accounting of the artifact related heterogeneity and hence the false dose estimation. The results shows the integral dose deviations were -5.718%, -3.655% and -1.318% for Monte Carlo, Acuros XB and AAA were and respectively. This implies that in real situation, the results of AAA gives better correlation with the actual treatment scenario. However, when the heterogeneity arises not from the artifacts, Monte Carlo and Acuros XB gives better results. Therefore, cases like Cerebral Arteriovenous Malformations (AVM's), there exists artifacts related heterogeneity only in planning CT images and a higher dose per fraction is to be delivered, special cares are to be taken while choosing the calculation algorithms as it impact the results of treatment outcome.
Conclusion: Indigenously made PMMA head phantom is a novel, versatile and economical (by 6 to 8 times less) when compared to the commercially available phantoms. The design could overcome the body irregularity and couch attenuation factor while performing the quality assurance. It is found to be novel, versatile and cost effective when compared to other phantoms (patent has been provisionally filed with reference number 201941035043). Study shows a significant variation in calculated integral dose proximal to the onyx material due to the heterogeneity in CT images. Study also suggests an extended CT scale technique (ECTS) to reduce the artifacts due to the introduction of Onyx material of the phantom while taking the CT images.

08-03

GLUTAMATE MEDIATED EXCITOTOXICITY IN THE CEREBRAL CORTEX BY NEONATAL HYPOGLYCAEMIC INSULT AND ITS LONG TERM CONSEQUENCES.

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Background: Low blood glucose level in newborn period, in isolation as well as when associated with other

morbidities, predisposes to long term neurological damages. Animal studies suggest that hypoglycemia causes brain injury via multiple mechanisms which include excess glutamate, an excitatory amino acid neurotransmitter, free fatty acid release and increased mitochondrial free radicals.

Methods: The current study was focused on evaluating the long term consequences of neonatal hypoglycemia in cerebral cortical functions by studying the alterations in glutametergicpathways at the level of neurotransmitters and receptors along with the antioxidant enzyme kinetics in one month old rats exposed to neonatal hypoglycemia. Glutamate receptor subtypes expression was studied by radio receptor assay, Real Time PCR and confocal imaging.

Results: We observed a significant reduction in antioxidant enzyme kinetics indicating reduced free radical scavenging capability. The increased glutamate content and GDH expression with down regulated GLAST and GAD expression points to glutamate mediated excitotoxicity in the cerebral cortex of one month old rats exposed to neonatal hypoglycaemia. The receptor binding studies and gene expression of total glutametergic receptors and inotropic glutamate receptors- NMDA and AMPA receptor subtypes also showed an elevated glutamate concentration in the cortical tissue. The localisation of NMDA subtypes R1 and 2B in the cerebral region also showed a significant increase in confocal imaging.

Conclusion: The alteration in the crucial signaling pathways in a later stage of life induced by an early life stress is to be considered with great care as this may trigger the onset of many disease conditions in the adult stage.

Keywords: Oxidate stress, neurotransmitter regulation, glutamate firing.

08-04

POLYANILINE - COATED CONDUCTIVE POLY (HYDROXYETHYL METHACRYLATE- CO-STYRENE) HYDROGEL FOR NEURAL CELL REGENERATION

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Background: Neural diseases such as Parkinson's disease, Huntington's disease, Alzheimer's disease and so on are found to affect thousands of patients' every year and thereby making inconvenience in their normal lives. Conducting polymers (polyaniline (PANI), polypyrroleetc.) in particular support the regeneration of neuronal cells by providing electrical stimuli in addition to the cues present in the microenvironment.

Methods: In the present study, poly (2-hydroxyethyl methacrylate-co-styrene) copolymers were synthesized by varying the ratio (80:20 and 90:10) and made into conductive by coating with polyaniline (PAHS8020 and PAHS9010). The physicochemical characterization of the films were performed by ATR spectroscopy, Scanning Electron Microscopy, conductivity measurements, contact angle, swelling and *in vitro* degradation behaviour studies. The neural stem cells (sub ventricular zone (SVZ) neural stem cells) from mice were cultured on the PAHS9010 in order to identify the potential of the film in neural cell attachment.

Results: The films exhibited significant conductivity which is highly preferred for neuronal cell regeneration. In addition, maximum water absorption capability has been attained within 2h which is best suitable for cell adhesion. Moreover, PAHS9010 exhibited a degradation of 8.43 ± 3.2 % within one week, which is greater than PAHS8020. The contact angle values corroborate these findings. The PAHS9010 film with good water absorption and *in vitro* degradation capability along with better conductivity has been selected for neural cell adherence study. The results indicate certain degree of neuronal stem cell attachment on the film, PAHS9010, suggesting the cell adherence potential for the sample.

Conclusions: The present investigation has revealed that the conductive PANI coated poly (Hydroxyethyl methacrylate-co-Styrene) copolymer film (PAHS9010) is suitable for neural cell regeneration studies. Further bio-functional studies need to be validated.

Keywords: Bio-interfaces, Neuronal regeneration, Bioelectricity, Proliferation, SVZ neural stem cells

08-05

PORCINE CHOLECYST DERIVED EXTRACELLULAR MATRIX-SCAFFOLD AS A POTENTIAL CARDIAC-PATCH FOR MYOCARDIAL REPAIR

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Background: Myocardial infarction occurs when there is a reduction in myocardial perfusion, which is sufficient to cause cell necrosis. The myocardium has limitted potential for regeneration and therefore, unassisted healing is not possible. The present study explores the potential of an epicardial-graft (EG) fabricated out of decellularised porcine cholecyst to heal induced myocardial infarction in a rat model.
Method: Porcine cholecystic extracellular matrix (C-ECM) scaffolds were prepared by a non-enzymatic/ non-detergent method and modified by coating with gold nanoparticle as reported earlier. Lyophilized sheets of C-ECM and modified C-ECM were cut into 8 to 10 mm diameter and used as EG for assisted healing of experimental sub-fatal myocardial infarction in Sprague Dawley rats induced by ligating the left anterior descending coronary artery. Clinical monitoring of MI induction and the functional recovery in the experimental rats were carried out by serum biochemical analysis, electrocardiogram and echocardiography. Tissues were collected from animals after 4 weeks and sections were stained using Hematoxylin and eosin, Masson's trichrome and immunostains.
Results: The elevation of serum cardiac biomarkers, deviations in the electrocardiogram and echocardiography indicated the successful induction of MI in all animals. Histomorphologically the graft-assisted healing was characterised by minimal collagen deposition and increased angiogenisis.
Conclusions: This study revealed that the decellularised porcine cholecyst is a potential biomaterial for fabricating EG for assisted healing of infarcted myocardium.
Keywords: Myocardial infarction, coronary artery ligation, electrocardiogram

08-06

INHERENTLY RADIOPAQUE MAGNETIC TERNARY SYSTEMS WITH HYPERTHERMIA POTENTIAL FOR CANCER THERAPEUTICS

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Background: Magnetic hyperthermia is a gold standard among various conventional cancer therapeutic strategies. This treatment technique specifically deals with extirpating tumour cells while keeping normal cells intact thereby producing lower side effects to the patient. Magnetic nanoparticles like magnetite, maghemite or metal ferrites dispersed in a suitable carrier solvent are the widely used hyperthermic agents.
Method: Inherently radiopaque magnetic ternary system consisting of magnetite, hydroxyapatite and silica nanoparticles was initially synthesized by sol-gel technique. The as-synthesized system was further stabilized by NR latex exploiting its binding capability and biocompatibility by a controlled step wise sintering process. Various physicochemical characterizations, biological evaluations and biofunctional studies were performed.

Results: XRD confirmed the presence of magnetite and hydroxyapatite. Presence of silica and phosphate groups was confirmed from FT-IR spectra. The capability of NR latex to bind magnetic nanoparticles is well evident from TEM microstructures. LTS 10 sample with a magnetization value of 12.34 emu/g acquired hyperthermia temperature of 41˚C within a shortest time interval of 6.6 minutes. It also exhibited good radiopacity comparable to a 4mm thick aluminum step-wedge under X-ray irradiation. All the LTS formulations were found to have good compatibility with MG-63 osteosarcoma cell lines. Prussian blue stains visualized inside the cells are a clear indication of internalization of magnetic nanoparticles.

Conclusions: The inherent potential of NR latex to bind the magnetic nanoparticles has been utilized to prepare a colloidally stable system for magnetic hyperthermia cancer therapeutics. The as-developed system also exhibited good X-ray attenuation comparable to a 4mm thick aluminum step-wedge proving its relevance while visualizing the intra operational procedures as well as post operational treatment procedures. Hence the as-synthesized latex stabilized systems with improved biocompatibility shall be proposed as promising candidates for magnetic hyperthermia treatment technique with minimal side effects.

Keywords: NR-Latex, Magnetic ternary systems, Radiopacity, Hyperthermia

08-07

EGFR MEDIATED NFκB/STAT3 SIGNALLING REGULATION REINFORCES THE USE OF COMBINATION THERAPY IN ORAL SQUAMOUS CELL CARCINOMA

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Background: The role of epidermal growth factor receptor (EGFR) in nuclear factor-kappa B (NFκB) or signal transducer and activator of transcription 3 (STAT3) signalling regulation and its therapeutic significance is a poorly studied area in oral squamous cell carcinoma (OSCC).

Method:EGFR silencing and induction studies have been carried out to elucidate the role of EGFR on NFκBor STAT3 signalling regulation. Role of NFκB or STAT3 signalling in OSCC hallmarks were analysed by gene silencing studies. Chemotherapeutic value of EGFR-NFκB or EGFR-STAT3 signalling axis in OSCC was studied using respective small molecule inhibitors.

Results:siRNA mediated EGFR silencing in OSCC cell lines exhibited reduction in NFκB or STAT3 expression and activation. Induction of EGFR signalling by EGF treatment enhanced the NFκB or STAT3 phosphorylation and subsequent nuclear accumulation. siRNA mediatedNFκB or STAT3 gene silencing reduced the proliferation, colony formation, migration/invasion, spheroid formation and also enhanced the apoptotic rate in OSCC cell lines. Combination treatment of EGFR inhibitor (Gefitinib) with NFκB inhibitor (BAY 11-7085) or STAT3 inhibitor (S3I-201) synergistically reduced cell viability and colony number compared to either agent alone in OSCC cell lines.

Conclusion: Our data demonstrated that EGFR-NFκB or EGFR-STAT3 signalling axis plays a key role in OSCC pathogenesis, and also showed that therapeutic intervention of these pathways may be a good alternative approach to improve the management of OSCC.

Keywords:OSCC,EGFR, NFκB,STAT3, Small Molecule Inhibitors

08-08

REVOLUTIONIZING PRE-SURGICAL PLANNING WITH THE POTENTIAL OF 3-DIMENSIONAL PRINTING

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Background: '3D-Printing' or 3D-Protyping is based on the principle of 'additive manufacturing' wherein, 3 dimensional physical objects can be created from digital data by computer-controlled laying down of successive layers or 'slices' of specialized materials. A large proportion of medical imaging data is made up of 3-dimensional imaging datasets acquired with CT, MRI or ultrasound scanners in the DICOM format. Using 3D Printing techniques, it is possible to convert these datasets to virtual 3D models and then print them out using 3D printers. These 3D printed anatomies can provide an accurate roadmap to doctors for planning complex operations.

Methods: This study is being conducted in the "point-of-care" Medical 3D Printing Lab at Amrita Institute Kochi. All patients who have undergone 3D-print assisted surgical decision-making and surgical planning from January 2015 till date are included in the study.Information was collected on the process of 3D printing, and the incremental benefit of using 3D printing in the clinical care.

Results: Over 70 patients underwent complex surgical procedures with the assistance of 3D-printed anatomical prototypes during the study period, including patients from a range of specialties that included pediatric cardiac surgery, orthopedics, craniomaxillofacial surgery, neurosurgery, plastic surgery, and so on.

3D printed prototypes were highly accurate in their anatomical properties and were precisely representative of the actual anatomy in all cases. They served as excellent tools for planning the precise steps of surgery, as well as for communication with other team-members. Surgical time and operative complications were significantly reduced due to meticulous planning made possible by the 3D prints.

Conclusions: Medical 3D printing is poised to change the face of healthcare, providing precise patient-specific management plans, personalized medicine and even customized implants. It is also likely to play a big role in education, training, communication and research in Medicine.

Keywords: 3D-printing in medicine, 3D surgical planning

08-09

WHAT HAPPENS TO PHYTOCHEMICAL PROFILE WHEN MEDICINAL PLANTS ARE CULTIVATED? CASE STUDIES ON *SIDA ALNIFOLIA* L. AND *RAUVOLFIA SERPENTINA* (L.) BENTH. EX KURZ IN KERALA

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Background: When the requirement was low, medicinal plants were sourced from the wild and natural habitats. This scenario started off the process of cultivation of medicinal plants. Currently we are sourcing these plants from a diverse array of natural settings and also from cultivated fields. In this context that the question of how stable the phytochemical profile is in these variety of growing conditions become important.

Method: Medicinal plant samples were collected from Wild (five distinct geographical zones in Kerala– Coastal plains, Midland laterites, Foothills, High hills and Palakkad plains) and those Commercially (commercial plot of SMPB) and Experimentally (Forest nursery of KFRI) cultivated– *Sidaalnifolia*and*Rauvolfiaserpentina*. Phytochemical analysis of Alkaloids, Flavonoids, Phenols, Tannins, Starch and the active ingredients –

Ephedrine and Reserpine was conducted respectively. Comparative analysis was done using post-hoc tests and Hierarchical Clustering on Principal Components.

Results: The results indicate that the content of active ingredient in *S. alnifolia* was not related to site characteristics and could be determined by diverse genotypes of the species having potential for producing varied quantities of Ephedrine. However, in the case of *R. serpentina*, the lack of correlation between content of active ingredient and site characteristics was not consistent as in the case of *S. alnifolia*.

Conclusions: The study conclusively proved that while *S. alnifolia* can be safely cultivated without losing its medicinal quality, caution should be taken while cultivating *R. serpentina*with high inputs. In new cultivation sites phytochemical analysis has to be made mandatory in the case of *R. serpentina* so as to ensure content of critical phytochemicals.

Keywords: Medicinal plants, phytochemical profiles, wild and cultivated, *Sidaalnifolia,Rauvolfiaserpentina.*

08-10

IMPROVING THE QUALITY OF LIFE DURING THORACIC RADIATION-INDUCED ESOPHAGITIS USING NATURAL PRODUCTS FROM MARINE MANGROVES - AN *IN VIVO* STUDY

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Background: Radiation-induced esophagitis is most common local acute toxicity of radiotherapy. Pyrazole or 1,2-Diazole, abundant in the mangrove plant *Rhizophoraapiculata*, is of immense significance in pharmacological research. The current study evaluates the efficiency of Pyrazole (1,2 Diazole) in the mitigation of radiation-induced esophagitis.

Method: C57BL/6 mice were divided into 5 groups (n=18/group)- Group I (Sham Control; UTR), Group II (Radiation alone at 25 Gy), Group III (Radiation at 25 Gy + Methanol extract of *Rhizophoraapiculata*; Dose: 10mg/kg BW for 10 consecutive days after irradiation), Group IV (Radiation at 25 Gy+ Pyrazole; Dose: 10mg/kg BW for 10 consecutive days after irradiation) and Group V (Radiation at 25 Gy+ Amifostine; Single dose of 400mg/kgBW). Histopathology analysis and immunohistochemistry (IHC) analysis using CD-45, Ki-67 and α-SMA antibodies were carried out in esophageal tissue from animals dissected at 4th, 10th and 16th weeks after irradiation.

Results: Esophageal tissue obtained from pyrazole treated groups exhibited reduced edema and immune cell infiltration in epithelium, mucosa and submucosa, when compared with radiation treated control. The expression levels of CD45, Ki-67 and α-SMA were reduced in MERA and pyrazole treated groups compared with radiation control group, suggesting a reduction in inflammatory cell infiltration, infiltrating cell proliferative activity and fibroblast levels.

Conclusions: Pyrazole, from the marine mangrove *Rhizophoraapiculata* mitigate radiation-induced esophagitis in C57BL/6 experimental mouse models. The reduced expression levels of CD45, Ki-67 and α-SMA markers reinstates the result.

Keywords: Radiation-induced esophagitis, Pyrazole, *Rhizophoraapiculata*, Histopathology, Immunohistochemistry

08-11

PROGNOSTIC IMPACT OF FLT3-ITD MUTATIONS IN DE NOVO ACUTE MYELOID LEUKEMIA PATIENTS

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Background: Acute MyelogenousLeukemia(AML) is the second most common type of leukemia and is highly heterogeneous hematological malignancy. Heterogeneity is may be due to chromosomal abnormalities, aberrant gene expressions and mutations which interfere with the survival of AML patients. FMS-like tyrosine kinase 3 including internal tandem duplications (FLT 3-ITD) mutation is one of the major risk factor for relapse in AML patients.
Methods: Conventional and molecular cytogenetic analysis was performed to rule out chromosomal abnormalities. Harvesting and GTG banding were performed as per the standard procedure.FISH analysis was done using locus specific probes AML- ETO,RUNX1/RUNX1T1,BCR/ABL,PML-RARA and CBFB. DNA isolated from bone marrow sample which were quantified and conducted Polymerized chain reaction (PCR). Gel images viewed in gel doc system. For confirming mutation, the PCR products further subjected to sanger sequencing (Agregenome,Kochi).
Results: Among 30 cytopathologically confirmed AML patients 19 cases showed normal karyotype, two cases were identified with t(8:21)and one among them had monosomy 22 (- 22).One case associated with an abnormality of monosomy 13 and found to have t(8;13), while subjected to spectral karyotyping(SKY). inv(16), trisomy 9 (+9) and polyploidy (4n) were observed in one case each. Five cases showed karyotype failure due to poor quality metaphases or unavailability of metaphases and one from these case showed t(15:17) in FISH analysis. Among the study subjects FLT3-ITD mutations were detected in fourcases.
Conclusion: Cytogenetic findings and FLT3-ITD mutation results helps in the risk stratification of AML patients. FLT3-ITD mutation profiling may shift the risk group and alter treatment strategies.
Keywords: Acute Myeloid Leukemia, FMS-like tyrosine kinase 3 including internal tandem duplications

08-12

ROLE OF CIRCULATING CELL FREE DNA AS A PREDICTIVE BIOMARKER FOR OVARIAN CANCER PATIENTS

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Background: Ovarian cancer is a leading cause of mortality in developed and developing countries. The aim of debulking surgery (primary or interval) in ovarian cancer is optimal cytoreduction. Predicting operability with CA-125 and CT scans have limitations.Efforts are underway to find a test that is more sensitive and specific for the monitoring disease progression and response. Cell free DNA (cfDNA) can be used for screening, therapeutic decision making, prognostication and to predict resistance mechanisms of therapy of cancer patients. The present study evaluated the role of circulating cell free DNA in predicting operability during interval cytoreduction in advanced epithelial ovarian cancers.
Methods: Circulating cfDNA was isolated using a commercially available kit from blood samples collected from patients who were diagnosed with advanced epithelial ovarian cancer and planned for neo adjuvant chemotherapy (NACT) followed by interval cytoreduction.
Results: 24 patients were included in the study. Baseline CA-125, cfDNA levels and Contrast Enhanced Computed Tomography (CECT) were evaluated. All patients received 3 cycles of NACT. Patients were reassessed with CA-125, cfDNA levels and CECT two weeks after 3rd chemotherapy. When CT response was

considered along with biomarkers, cfDNA + CT response had better sensitivity and specificity for prediction of OCR compared to CA-125 + CT response

Conclusion: Our data suggests that cfDNA can be used as a biomarker along with CT response for the prediction of operability during interval cytoreduction for advanced epithelial ovarian cancer. This study also proves that evaluation of cfDNA can be used as a clinical marker enabling repeated sampling possible for monitoring disease progression, drug response and prognostic tracking of the disease.

Keywords: Cell-free DNA, Ovarian cancer, tumor biomarker

08-13

MULTIFUNCTIONAL DENDRIMERS: A COMBINATORIAL DRUG DELIVERY SYSTEM

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Background: Docetaxel is the first line therapy for castration resistant prostate cancer (CRPC). However, the cancer cells can develop resistance to docetaxel (DTX) by different cellular mechanisms that developed during CRPC progression.This study expound polyamidoamine(*PAMAM*) dendrimer based therapeutics for the co-administration of eukaryotic translation initiation factor 4E targeted siRNA (eIF4E siRNA) and docetaxel (DTX) for an effective therapeutic regimen in prostate cancer therapy by overcoming DTX resistance in prostate cancer cells.

Methods: Docitaxelhemisuccinate were synthesized and conjugated onto PAMAM dendrimer via carbodiimide chemistry. Then eIF4E siRNA was complexed into the surface of docetaxel conjugated PAMAM at different N/P ratio and characterized for its particle size, zeta potential, siRNAcomplexation efficacy, *in vitro* drug release studies, cellular uptake, cytotoxicity assay..

Results: The resulting dendriplexes form stable and uniform nanoparticles in aqueous solution. Drug release studies showed that ~ 87% of DTX was released within 72 hrsfrom PAMAM-DTX-siRNA in cell culture media. PAMAM dendrimer significantly enhanced the cell uptake of eIF4E siRNA in both PC3and docetaxel resistant PC_3 cells (PC_3dR). The IC_{50} value for PC_3dR cells in the combination treatment was comparable to IC_{50} value of drug sensitive PC_3cells, signifying the reversal of DTX resistance in PC_3dR cells.

Conclusion: These results suggest that PAMAM-DTX-siRNA with the ability to co-deliver eIF4E siRNA and DTX may significantly improve the anticancer efficacy by effective cellular uptake and overcoming DTX resistance in PC_3dR cells.

Keywords: PAMAM dendrimer, eIF4E, siRNA complex, combination therapy, drug resistance

08-14

AN INJECTABLE HYDROGEL FORMULATION OF PORCINE CHOLECYSTIC EXTRACELLULAR MATRIX

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Background: Hydrogels are getting popular in the field of tissue engineering (TE) due to the ease of tunablity of biomaterial properties and easy clinical applications. The tunability of hydrogels into injectable preparation, as drug delivery system and as bioink for 3D bioprinting have found several scientific and clinical uses. Synthetic and natural polymers are widely used cross linkers of hydrogels. The stability and the key biomaterial properties

of hydrogels can be retained by careful selection of the polymers used for cross linking.Hybrid hydrogels containing natural biomolecules have great potential especially in several clinical applications including topical wound care. We report the development of a hybrid hydrogel derived from porcine cholecystic extracellular matrix (C-ECM).

Methods: In this study,porcine C-ECM was recovered by a non-detergent and non-enzymatic method and crosslinked with polyethylene glycol methacrylate (PEGMA) by free radical polymerisation using ammonium persulfate as the initiator and ascorbic acid as the activator. The physicochemical and biological properties were studied by fourier transform infrared spectroscopy(FTIR), enzymatic degradation, swelling ratio, equilibrium water content, and cytotoxicity.

Result:FTIR results indicated successful incorporation of C-ECM in the hydrogel. The enzymatic degradation by collagenase enzyme showed lower degradation rate compared to the native C-ECM. The swelling behaviour of the hydrogels were evaluated by swelling ratio as well as equilibrium water content. The cross-linked C-ECM had higher swelling as required for hydrogels used in TE applications. The results of cytotoxicity testing by direct contact test on L929 fibroblast cells showed the non-cytotoxic nature of the hydrogels.

Conclusion: The developed C-ECM-PEGMA hydrogel may have end use application as an injectable hydrogel for biomedical applications.

Keywords: Injectable, Hydrogel, Biomedical applications

08-15
EVALUATING THE DIAGNOSTIC POTENTIAL OF LIQUID BIOPSY INORAL CARCINOMA

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Oral cancer is one of the most prevalent forms of cancer in the world. In India it ranks first among all cancers in men and second in women. The poor survival of this tumour is mainly due to lack of knowledge about its molecular background and dearth of good biomarkers for early detection and prognosis. Liquid biopsy is a revolutionary technique in cancer diagnosis. It consist of isolation and detection of circulating tumour cells, circulating tumour DNA, circulating RNA and tumour-derived exosomes, as a source of genomic and proteomic information in patients with cancer. This present study was validated the potential of liquid biopsy by analysing TERT mutation in circulating tumour derived exosomes from plasma of oral cancer patient. The TERT gene mutation status was similar in two oral cancer cell lines (UM-SCC-83A (primary) and UM-SCC-83-B (metastatic)) and its secreted exosomes in conditioned media. The results suggest that mutation status in the oral cancer cells, in exosomes isolated from conditioned media and exosomes isolated from oral cancer patient's plasma are similar, so non-invasive liquid biopsy method can provide the similar information without pain and invasive procedures. TERT can be used as a circulating biomarker for oral cancer detection.

08-16
ANTI-EFFLUX PUMP, ANTI-BIOFILM AND PLASMID CURING EFFECT OF *ALLIUM SATIVUM* ON MULTIDRUG RESISTANT CLINICAL BACTERIA

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Allium sativum L., a member of the Alliaceae family, has been widely recognized as a valuable spice and a popular remedy for various disorders. It has been reported to possess blood pressure and cholesterol lowering effect, antibacterial, antifungal and anti-cancerous activities. In the present study we report its anti-

efflux pump activity, antibiofilm forming effect and plasmid curing activity using multidrug resistant clinical strains of bacteria expressing active efflux pumps, capable of forming biofilm as well as those inhabiting plasmids. Active efflux pump expressing bacteria were screened using Ethidium Bromide- Agar Cartwheel method. Biofilm positive strains were identified by crystal violet assay of organisms grown on microtitre plate. Plasmid containing isolates were selected by isolating plasmids using alakaline lysis method. An attempt has also been carried out to know the expression status of the efflux pump genes which are also involved in biofilm formation by quantitative RT- PCR. It was observed that the extract has a strong inhibitory effect on the bacterial resistance mechanisms tested. Also, it was found to exhibit a strong plasmid curing effect. Gene expression analysis identified an inhibition of the expression genes involved in biofilm formation. With respect to efflux pumps genes, some of the analysed genes were inhibited and some others were unexpectedly found to overexpress upon exposure to the extract. The reasons for the observed overexpression has been discussed in the light of the recent reports on the up regulation of certain efflux pump genes upon exposure to antimicrobials enhancing the sensitivity of the organism towards the antimicrobials.

08-17

EVALUATION OF RESVERATROL BASED COMPOUNDS FROM DIPTEROCARPACEAE FAMILY FOR ANTI-DIABETIC POTENTIAL

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Background: Type 2 Diabetes Mellitus characterized by insulin resistance has become a worldwide challenge for the forthcoming generations. Many of the Anti diabetic drugs reported so far are staggered with some adverse effects. Therefore, an exploration for alternate therapies is underway globally, including sources from natural products to regulate blood glucose levels.
Method: Many plants in Dipterocarpaceae family have been used in traditional systems of medicine and in ayurveda for various ailments. In the present study, about three resveratrol based compounds isolated from different plants of Dipterocarpaceae family were evaluated for their antidiabetic potential in terms of glucose uptake ability using skeletal muscle cell line.
Results: The concentrations of compounds with less than 20% cytotoxicity were selected for glucose uptake studies using a glucose analog 2-NBDG on a fluorescence microscope and flow cytometry. The results demonstrated that the compounds possessed significant glucose uptake potential, which is the most downstream event in the insulin signaling and AMPK pathway. To acertain, the signalling pathway responsible for the resulted glucose uptake, inhibitory studies were performed.
Conclusions: The findings from the study demonstrated the anti-diabetic potential of the compounds and its molecular mechanistic approach in stimulating glucose uptake. This would provide new insights for the therapeutic benefits.
Keywords: Diabetes, L6 myotubes, glucose uptake, resveratrol

08-18

SOYBEAN BASED MEMBRANE FOR PERIODONTAL REGENERATION – A NOVEL APPROACH

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Background: Periodontitis is one of the most destructive inflammatory diseases that affects the integrity of the periodontium and causes damage to the periodontal tissues and eventually tooth loss. Periodontal diseases are truly a 'silent' worldwide massive disease burden and socio- economic effects.Guided tissue regeneration and guided bone regeneration are the advanced treatment strategies periodontitis.
Method: Soy protein concentrate (SPC) was prepared from dried soybean seed powder by the removal of soybean oil. SPC is characterized by FT IR. Membranes were formulated from the blend of SPC and polyvinyl alcohol (PVA) in different concentrations by solvent casting. The tensile strength of the membranes was evaluated using universal testing machine and the presence of bioactive components is confirmed by FT IR analysis
Result: FT IR analysis confirmed the presence of bioactive components in the SPC and SPC-PVA blend membrane. SPC-PVA blend membranes satisfied essential strength of a periodontal GTR membrane.
Conclusion: This SPC-PVA membrane can be used as a guided tissue regeneration membrane, a promising strategy for periodontitis treatment.
Keywords: Periodontitis, Soy protein concentrate, PVA, periodontal regeneration

08-19

CORRELATION OF CARDIAC MARKERS AND ELECTROLYTES WITH MEMBRANE PEROXIDATION DURING CHEMOTHERAPEUTIC STRESS AND EUGENOL COTREATMENT

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Background: The identification of relationship among different biomarkers is much more important during pathologically stress conditions. Our hypothesis is that pharmacological modulation by eugenol co incubation decreases arsenic trioxide induced chemotherapeutic stress. Our previous study explored eletrophysiological and thiol stabilization properties of eugenol. shown that thiol stabilization and electrophysiologThus the present study was conducted to make an effort to find out interrelationship among different cardiac markers and electrolytes with lipid peroxidation level during chemotherapeutic stress and cardioprotective compound eugenol treatment.
Methods: Rats were divided in to 4 groups; control, arsenic trioxide (4 mg/kg b.wt), eugenol (5 mg/kg b.wt) and arsenic trioxide + eugenol (arsenic trioxide at 4 mg/kg b.wt and the eugenol (5 mg/kg b.wt).
Results: The results obtained from this study revealed that statistically significant correlations had shown these parameters in experimental rats. The present study revealed a strong positive correlation of cardiac markers level with MDA. Inaddtion, we observed that the process of lipid peroxidation directly linked with altered serum cardiac markers Trop-I and CRP levels. Serum electrolytes calcium and sodium level was positively correlated with MDA.
Conclusion: Our findings suggest that lipid peroxidation level in the myocardium correlate with both cardiac markers and electrolytes.
Keywords: Eugenol, Arsenic ttrioxide, Myocardium, Oxidative stress, Troponin- I

09- LIFE SCIENCES

09-01

SEED DESICCATION AND RESTORATION STUDIES OF *HYDNOCARPUS ALPINA* WIGHT.,A RARE ENDEMIC MEDICINAL TREE SPECIES OF WESTERN GHATS

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Abstract: *Hydnocarpusalpin*Wight is an evergreen medicinal tree species endemic to Western Ghats. Narrow endemism makes this species vulnerable to extinction. The seeds of this species are desiccation sensitive. Fresh seeds on harvest showed 20% moisture content with 80% germination. However, after two weeks of desiccation at open laboratory conditions (28±2°C and 65% RH) their moisture content and percentage of germination decreased to 10.2% and 20 % respectively. Complete seed viability loss was observed below 10% moisture content. So the seeds exhibit recalcitrant behaviour. Associated with the seed water stress, different biochemical parameters such as leachate conductivity, lipid peroxidation, assay of free radical scavenging enzymes, analysis of primary metabolites like total soluble sugars, starch, total and fractional proteins, amino acids, phenols etc. were recorded. The results emphasized that, sequential loss in moisture content leads to drastic change in biochemistry, resulting in the loss of seed viability. So these parameters can be considered as the markers for detecting seed viability and behaviour thereby evolve proper conservation measures for this rare endemic medicinal tree species of Western Ghats.
Keywords:*Desiccation, Recalcitrant, Tetrazolium, Leachate, Lipid peroxidation*

09-02

EVOLUTIONARY GENOMICS OF STAPHYLOCOCCUS AUREUS: INSIGHTS INTO THE RESISTANCE TRAIT

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Background: Multi-drug resistant *S. aureus* is a leading concern worldwide. Coagulase-Negative Staphylococci (CoNS) are claimed to be the reservoir and source of important resistant elements in *S. aureus*.A recent national-scale laboratory-based study (Gandra*et al.* 2016) reveals that most of the strains of *S. aureus*are showing resistance to first-line and broad spectrum of antibiotics.
Method: Here, we performed a detailed phylogenomic analysis of 152 completely sequenced *S. aureus* strains in comparison with 7,529 non-*Staphylococcus aureus* reference bacterial genomes to construct a better picture of resistance evolution in *S. aureus*. Detailed comparative genomic analysis of completely sequenced Kerala isolates with 174 reference strains circulating globally reveals its evolutionary relationship.
Results: Our results reveal that the phyletic patterns of SCCmec encoded resistant genes in *Staphylococcus* species are significantly different from that of its core genes indicating frequent exchange of these genes between *Staphylococcus* species. Our in-depth analysis of SCCmec resistant gene phylogenies reveals that genes such as *blaZ*, *ble, kmA* and *tetK* that are responsible for beta-lactam, bleomycin, kanamycin and tetracycline resistance in *S. aureus*were laterally transferred from non-*Staphylococcus* sources. In addition,at least11 non-SCCmec encoded resistant genes in *S. aureus*, mostly present in plasmid are laterally acquired from distantly related species. Clinical isolates from Kerala were identified as *Staphylococcus aureus*and the

MRSA isolates were showing resistance against broad spectrum of antibiotics such as oxacillin, penicillin-G, azithromycin, erythromycin, kanamycin, ciprofloxacin and cefoxitin

Conclusions: Our study evidently shows that gene transfers played a crucial role in shaping the evolution of antibiotic resistance in *S. aureus*.

Keywords: Microbial genome evolution, Pan-genome, Antibiotic resistance, SCCmec, Lateral/Horizontal gene transfer

09-03

ISOLATION AND PARTIAL PURIFICATION OF CATECHOL 2, 3 DIOXYGEANSE FROM ASPERGILLUS FLAVUS – AN OIL DEGRADING FUNGUS

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Due to rapid industrialization and large scale anthropogenic activities the global pollution level is increasing. Oil pollution is the resultant contamination of environment due to the introduction or the presence of oil in excess quantities. The present study is focusing on the production, purification and characterization of Catechol 2, 3 dioxygenase from oil degrading fungi. The fungus was isolated from the oil spills of Bharath Petroleum Corporation Ltd., Cochin, Kerala. The isolated fungus was subjected to various morphological and biochemical tests and identified as *Aspergillusflavus*by molecular sequencing. The identified fungus was submitted to GenBank. Degradation ability and Catechol 2, 3 dioxygenaseactivity of *Paecilomycesfumoses*was studied by growing the fungi in BH medium (medium specific for oil degrading microbes) supplemented with different carbon sources such as petrol, diesel, kerosene, and engine oil in varying concentrations (0.1%, 0.5%, 1.0%, 1.5% and 2.0%). The fungi showed maximum degradation in medium with 1.0% diesel and enzyme activity was found to be 6.98U/mL. The enzyme was partially purified and characterized, and purified enzyme showed optimum activity at pH 8.0, temperature 65°C and 20mM substrate concentration. The purity of the enzyme was further confirmed by SDS-PAGE as 25 kDa and 75 kDa.

Key words: Catechol 2,3dioxygenase, *Aspergillusflavus,* oil degrading fungi, partial purification

09-04

BACTERIAL DIVERSITY AND RESISTOME STRUCTURES IN KUTTANAD FOLLOWING THE SEVERE 2018 FLOOD

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Background: Extreme flooding is one of the major risk factors for human health, and it can significantlyinfluence the microbial communities and enhance the mobility of infectious disease agents withinthe affected areas. The flood crisis in 2018 was one of the severe natural calamities recorded in the Kerala, India that significantly affected its economy and ecological habitat.Kuttanad is one of the worst affected areas in this flood because it lies below the sea level and the stagnant flood water can cause serious health issues to the public health sector. We utilized shotgun metagenomics and bioinformatics approaches to understand the bacterial profile and resistome structure in extremely flooded sites of Kuttanad. We are also initiated a one year follow up study in the flood affected area to understand the changes in bacterial profile and effect on public health sector.

Methods: Sediment samples were collected from five flood-affected areas of Kuttanad, Kerala during August 2018. Metagenomic DNA was extracted using Power soil DNA extraction kit and whole-genomemetagenome

sequencing by HiseqXIllumina system and Confirmation of antibiotic resistant pathogenic bacteria through culture based techniques.

Results: The flooded sites were heavily contaminated fecal contamination indicatorssand multidrug-resistant strains of *Pseudomonas aeruginosa*, *Salmonella typhi/typhimurium*, *Klebsiellapneumoniae* and*Vibrio cholerae*. The resistome of the flooded sites contains 103 known resistant genes, of which 38% are plasmid-encoded, where most of them are known to be associated with pathogenic bacteria.

Conclusion: Our study will provide a better understanding of the bacterial profile of extremely flooded sites which helps in decision-making for the prevention of flood-related disease outbreaks.

Keywords:Metagenomics, Bacterial profile, antibiotic resistance

09-05

ISOLATION, CHARACTERISATIONANDPATHOGENICITY EVALUATIONOF THE CORAL PATHOGEN VIBRIO CORALLIILYTICUSFROM CORAL REEF ECOSYSTEMSOFF THE SOUTHERN COAST OF INDIA

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Background: Coral reefs are one of the most vulnerable ecosystems on our planet, currently under direct threat from human activities and microbial diseases. Novel pathologies of scleractinian corals have recently progressed in frequency and distribution which affects its total abundance and species diversity. Anthropogenic inputs as well as global climatic changes have influenced the distribution and impact of infectious diseases. *Vibrio coralliilyticus*has recently emerged as a coral pathogen of concern on reefs throughout the Indo-Pacific. First implicated as the etiological agent responsible for bleaching and tissue lysis of *Pocilloporadamicornis*corals off the coast of Zanzibar in the Indian Ocean, it was more recently identified as a possible causative agent of outbreaks of the coral disease, white syndrome at several locations throughout the Indo-Pacific. *V. coralliilyticus* is a Gram-negative, motile, rod shaped temperature dependent pathogenic bacteria.It is an emerging model pathogen for understanding the mechanisms linking bacterial infection and coral disease and therefore provides an ideal model for the development of diagnostic assays to detect coral disease.

Methods: A total of four *V. coralliilyticus*strains were isolated from the coral reef ecosystems *viz*.,K3 andK4from Kavaratiand A1 and A4 from AminiIslands. The identities of the strains were confirmed with phenotypic and molecular characterisation and phylogenetic analysis was performed. Phylogenetic marker genes and virulence genes of the strains were characterised. Pathogenicity evaluation of the strains was performed by challenge studies in live animal experiments at varying temperatures.Antibacterial susceptibility against selected coral associated bacteria were also tested employing agar-overlay bioassay at 24°C and 28°C temperatures which are relevant to known temperature-dependent virulenceof *V. coralliilyticus*. Antibiotic sensititvity of *V. coralliilyticus* strains were evaluated against selected commercial antibiotics following Kirby-Bauer disc diffusion method.

Results: All the four strains isolated were identified as *V. coralliilyticus* based on phenotypic and biochemical characteristics as well as using molecular methods by 16S rRNA gene sequence analysisand phylogenetic treewas created. The strains were found to be inhibited by a higher number of bacterial strains at 24°C compared with 27°C. Furthermore, all *V. coralliilyticus* strains tested showed multi-drug resistance to a range of commercial antibiotics tested. Presence of virulence genes were detected in all the strains. Challenge studies on live animals showed an increase in pathogenicity with rise in temperature.

Conclusion: This present study describes isolation and characterisation of the coral pathogen *V. coralliilyticus* from the Indian coast for the first time. Challenge study results demonstrated the influence of temperature on

pathogenicity of the strains.Results of the study also demonstrated multidrug resistance of the *V. coralliilyticus* strains to commercial antibiotics, which is temperature-dependent in some strains. Antibacterial susceptibility of *V. coralliilyticus* strains to coral-associated bacteria was also found to be temperature dependent.

Keywords: *Vibrio coralliilyticus,* 16S rRNA gene sequence, Antibacterialsusceptibility, Phylogenetic marker genes, Virulence genes, Pathogenicity evaluation

09-06

INHIBITION OF ROOT NODULE FORMATION IN COWPEA (VIGNAUNGUICULATA (L.) WALP) ON TREATMENT WITH PESTICIDES

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Background: Symbiotic Nitrogen fixing Bacteria together with legumes help to fix atmospheric nitrogen to soil form that can be availed by all primary producers. This knowledge was used by traditional farmers of Kerala till date. Agricultural Revolution has lead to the introduction of vast diversity of pesticides for controlling different pest. Due to the non biodegradable nature they persist in nature and adversely affect non target organisms. Pesticides applied in field can drastically affect the symbiotic bacteria and the root nodule formation by them in leguminous plants.

Method: Rhizobium isolated from wild root nodules were inoculated and incubated in laboratory conditions .seeds treated with rhizobium culture and pesticides were grown in sterile soil and root nodulation, root length were recorded. Serially diluted rhizobial broths were treated with pesticides by directly introducing pesticides into broths and subcultured in petirdishes. Flubendiamide, Tag folder, Lambda Cyhalothrinand Oberon were the pesticides selected.

Result: Pesticides caused complete inhibition of root nodulation. There was decrease in root length in plants sprouted from seeds treated with pesticides. Maximum effect was observed in pesticides of yellow category-Lambda cyhalothrin. While all the pesticides caused completed inhibition of root nodule formation , root length also showed a similar decrease in length based on the category of pesticide used. Direct application of pesticide in to rhizobial broth showed drastic decrease in the number of viable rhizobium. The least number was 6 colonies in lambda cyhalothrin while 254 colonies were recorded in control .

Conclusion: pesticides can affect non target group like rhizobium, which in turn can affect all the organisms that relay on the symbiotic relation of rhizobium and leguminous plants. Biodegradable pesticides has to be used to reduce the adverse effect of pesticides on nontarget organisms and our ecosystem.

Keywords: Rhizobium, Cow Pea, Root Nodule, Flubendiamide, Tag folder, Lambda Cyhalothrinand Oberon, Inhibition

09-07

CHEMOSENSITIZATION OF CANCER CELLS USING FOLIC ACID CONJUGATED CURCUMIN-LOADED PLGA NANOPARTICLES

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Background: Chemoresistance is a critical issue impeding the success of chemotherapy. Dose escalation can cause severe side-effects as well as patient compliance issues. Chemosensitization using compounds isolated from natural sources is therapeutically effective apart from being cost-effective and less side-effects generating. However most of the phytochemicals are hydrophobic in nature which limits their translation from bench to bed-side. Nanoencapsulation has been found to be an effective strategy to overcome the limitations of phytochemicals.
Method: Curcumin-loaded PLGA-PEG nanoparticles conjugated to folic acid (PPF-curcumin) were prepared using a micro-emulsion method and size of the nanoparticles was studied using TEM. Chemosenstization efficacy of PPF-curcuminHeLa cervical cancer cells was studied using MTT and clonogenic assay. Western blot analysis showed the expression of markers of apoptosis. Uptake of the nanoparticles was studied using confocal microscopy. Pharmacological safety of the combination was assessed in healthy *Swiss albino* mice. *In vivo* tumor reduction studies were carried out using NOD-SCID mice bearing HeLaxenografts.
Results: Encapsulation of curcumin in folic acid conjugated PLGA-PEG nanoparticles significantly improved its efficacy in chemosensitizingHeLa cells towards paclitaxel chemotherapy. Folate receptor specific curcumin delivery using PPF significantly improved the cellular uptake of curcumin, with down-regulation of NF-κB, Akt and MAPK activated by paclitaxel. PPF-curcumin was found to be pharmacologically safe in healthy *Swiss albino* mice. PPF-curcumin showed enhanced tissue retention and serum concentration compared to free curcumin. There was significant reduction of tumor growth *in vivo* with reduction in NF-κB and AP-1 nuclear translocation.
Conclusions: The current study gains immense significance in the scenario of accumulating evidences of chemoresistance and toxic side-effects induced by prolonged exposure of cancer cells to chemotherapeutics.
Keywords: Chemosensitization, Curcumin; Bioavailability; Folate receptor; PLGA nanoparticles

09-08

ANTIBACTERIAL AND ANTHELMINTIC ACTIVITIES OF *KAEMPFERIA ROTUNDA* ENDOPHYTES

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Abstract: Increased resistance of many bacterial strains and parasitic nematodes to the current drugs are a major problem now-a-days.*Kaempferia rotunda*, a well-known plant with ethno-pharmacological importance, has been extensively used in Indian traditional medicine without proper scientific validation. Plants show symbiotic association with endophytes and they produce bioactive compounds same as the host plant. It is easy to extract these bioactive compounds from endophytes than from the plants. The present study was an attempt to isolate, identify, and evaluate the antibacterial and anthelmintic potentials of endophytic fungi from roots and rhizomes of *K. rotunda*. We have obtained different isolates separately from roots and rhizomes and identified using morphological observations and D1-D2 gene sequence. Then the antibacterial activity of fermented medium from endophytic fungi was tested against four bacterial strains. Among the four bacterial strains, two were Gram-positive bacteria and the rest two were Gram-negative strains. Two isolates named as KMPR02 and KMPRH1 showed effective growth inhibition against gram positive and negative bacterial strains. The other two, namely, KMPR01 and KMPR03 showed activity only against gram positive strains. The anthelmintic potentials of endophytic fungi from roots and rhizomes of *K. rotunda* were also studied against strongyle eggs and 1st instar *Haemonchus contortus* larvae. A concentration-dependent increase in the mortality of both egg and larvae was observable with the fermented filtrate. Studies on their potential against bacteria and parasitic nematodes may leads to the discovery of highly potent bioactive molecule.
Key words:*Kaempferia rotunda,*endophytes, antibacterial, anthelmintic, *Haemonchus*

09-09

EFFICACY OF E-BEAM IRRADIATION ON SHELF-LIFE AND ACCOMPANIED CHANGES IN MAJOR METABOLITES OF TRIBULUSTERRESTRIS FRUITS

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Background: Often the herbs are severely contaminated with microbes, fungi, pests etc. and thus the quality and safety concerns of medicinal plants are of so much important. There are several problems associated with the conventional methods of processing which demands an alternative method which leads to pay considerable attention on the utilization of high energy ionizing radiations for the purpose of processing and preservation. Microbiological studies were supplemented with biochemical analysesto evaluate whether the radiation treated products retains the quality attributes and medicinally active principles.The fruits of *T. terrestris,* a well-explored medicinal plant, were selected for the study, which grown in contact with soil due to its creeping nature.

Method:E-beam irradiation was carried out from Industrial accelerators division, RRCAT, Indore, at doses of 5 kGy, 10 kGy and 15 kGy at 8.2 MeV beam energy. The processed samples were evaluated in terms of various secondary metabolites and mineral composition and compared with that of untreated sample. Changes in phytochemicals were determined using GC-MS analysis. Microbial quality was determined during shelf-life and the optimum dose was standardized.

Results: Best preserving effect of TPC and TFC was brought with dose of 15 kGy. Also, radiation doses of 5 kGy and 10 kGy were found to be satisfactory in retaining the phenolics and flavonoids implies an efficient means of processing for long-term storage.Radiation processing does not have a significant ($p>0.05$) impact on the alkaloid content and it does not offered a preservative effect also. E-beam irradiation did not have prominent impact on the mineral composition except potassium and magnesium. GC-MS analysis revealed that sample was fairly rich in fatty acid compounds and its derivatives. Major compounds identified in both samples wereLinoleic acid, 13-Tetradecenal, Palmitic acid, Methyl palmitate, Coniferol, etc. Irradiated samples were effectively sterilized and extended the shelf-life for more than a year ensured the standard limits of microbial contamination in herbal medicines approved by WHO. At the same time the control sample was heavily loaded with microbial colonies exceeded the permitted level of $<10^5$cfu/g.

Conclusion: Although the radiation has slight impact on the metabolites, the process was found to be effective

in promoting the shelf-life with minimal quality deterioration than any other traditional methods of processing. The present study strongly recommends the use of e-beam irradiation at dose of 5 kGy for processing the fruits and its *choorn*a.

Keywords:*Tribulusterrestris*, e-beam irradiation, Phenols, Flavonoids, Alkaloids, Minerals, Phytochemicals, Microbial quality, shelf-life.

09-10

MACROCYCLIC LACTONES FROM SEAFOOD *AMPHIOCTOPUS NEGLECTUS* ATTENUATE ANGIOTENSIN-II INDUCED CARDIAC HYPERTROPHY

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Background: Marine-based functional food is attaining immense consideration in nutraceutical industries due to their protective function against various chronic diseases and availability. The search for food-based anti-hypertensive inhibitors are of immense appeal and functional food products could likely perform the necessity. Species of family Octopodidaerecognised various pharmacological properties attributed due to the presence of bioactive compounds in them.

Method: Four macrocyclic lactones were purified from the organic extract of *Amphioctopusneglectus*sequentially partitioned by column chromatographic fractionation. The compounds were characterized utilising extensive spectroscopic methods. Anti-oxidant and anti-hypertensive activities of the metabolites were performed using *in-vitro* assays. Kinetic analyses were used to assess mechanism to inhibit ACE-I by the macrocyclic lactone analogues (1-4).*In silico* molecular docking was performed against 1UZE.*Ex-vivo* study was conducted to inhibit angiotensin-II (Ag-II) induced cardiac hypertrophy on H9C2cells.

Results: The compounds exhibited potential radical-scavenging capacities (IC_{50} 0.95-1.73 mM) along with anti-hypertensive activities (IC_{50} 1.12-2.34 mM)). The optimum binding affinity of compound **2** (-9.84 kcal mol^{-1}) bearing furo[1,4,8]trioxacyclohexadecine-12,19-dione moiety with ACE, along with its permissible hydrophobic-hydrophilic balance, manifested towards its greater anti-hypertensive activity compared to other analogues. The compound **2**, with lesser values of the inhibitory constant (K_i=1.0 mM) towards ACE, was found to bind more effectively to the enzyme in a non-competitive manner, and could describe the greater inhibitory ramifications than those displayed by other compounds (K_i>1.1 mM). The ex-vivo studies revealed that compound **2** imparted protective effects against angiotensin-II induced cardiac hypertrophy at 25 µg mL^{-1} on H9C2 cell lines, wherein about 34 percent decrease in cell area with increase in viability could be attributed to anti-hypertrophic effects of the compound administrated.

Conclusion: This study reveals the promising anti-hypertensive potential of macrocyclic lactones isolated from *Amphioctopusneglectus*.The species could be utilized as functional food ingredients to combat oxidative stressand subsequently attenuates the hypertensive related disorders.

Keywords: *Amphioctopusneglectus*, macrocyclic lactone, anti-hypertension, angiotensin converting enzyme, molecular docking simulations, angiotensin-II induced cardiac hypertrophy

09-11

TAPPING THE MICROBIOME OF PITCHERS OF *NEPENTHUS HAMBLACK* FOR ORGANISMS WITH MULTI-BENEFICIAL PLANT PROBIOTIC POTENTIAL

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Background: *Nepenthes hamblack*, the pitcher plant is carnivorous has biological trap to catch the prey and acquire nutrients from them through various mechanisms. Hence the pitcher of this plant is biologically unique and is considered to harbour large number of microorganisms with dedicated plant beneficial functions.
This makes the pitcher to be a least explored source for identification of microorganisms for plant probiotic features. Hence, the present study focused on the plant beneficial and biocontrol properties of bacteria isolated from pitcher of *Nepenthes hamblack*.
Methods: In the present study, the pitcher and leaf associated bacteria were isolated from *Nepenthushamblack*and were screened for plant beneficial features and activity against *P. aphanidermatum*. The selected bacteria were further identified by 16S rDNA sequencing. The potential isolate with anti-phytopathogenic activity as confirmed by both *in vitro* and *in vivo*studies was also profiled for metabolite composition by GC-MS analysis.
Results: Among the various isolates screened, *Paraburkholderia* sp. NhPBG1 was found to hyper activity against the plant pathogen *Pythiumaphanidermatum*. The isolate was also positive for various plant growth promoting traits. The i*n vivo* disease resistance and the microscopical evaluation showed the promises of the selected isolate for plant beneficial applications. The metabolite profiling of *Paraburkholderia*sp. NhPBG1 has also revealed the presence of various bioactive compounds
Conclusions: The results of the study confirmed the isolated *Paraburkholderia* sp. NhPBG1 to have biocontrol activityalong with potential for plant growth promotion. Hence the isolated bacteria can be exploited as a broad spectrum biocontrol and plant growth promoting agent for field applications after evaluation of its toxicological or pathogenic effects.
Keywords: *Nepenthes hamblack, Pythiumaphanidermatum, Paraburkholderia*sp., plant growth promotion, Rhizome protection

09-12

PHYTOCHEMICAL PROFILING OF LEAF GALLS IN *FICUS RACEMOSA*L. INDUCED BY *PAUROPSYLLA DEPRESSA* ALONG WITH NORMAL LEAVES.

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Background: Galls represent a close relationship between plants and herbivores organisms. It is produced as a result of hypertrophy and hyperplasia, under the influence of parasitic organisms range from micro-organism like bacteria to macro-organisms like insects. Gall is composed of host plant tissue but the inducer manipulate biochemistry of host plants for benefiting their own life processes. As a result, the chemical composition of galls differ markedly from surrounding normal plant tissue. The current study envisages the comparative phytochemical evaluation of the *Pauropsylladepressa* induced leaf galls on*Ficusracemosa* L. (Family: Moraceae).
Materials and Methods: The present study aimed at phytochemical investigation, anatomy, chlorophyll content, Phenylalanine Ammonia Lyase activity (PAL), antioxidant activity and Gas Chromatography- Mass Spectroscopy (GC-MS) of galls and normal leaves of *Ficusracemosa*. Three different extracts with solvents of varying polarity such as hexane, water and methanol were used.

Results: The results of qualitative phytochemical analysis confirmed the presence of various phytochemicals. Methanol and aqueous extracts of gall showed more number of phytochemicals. Gall leaves showed a different anatomical structure when compared to normal leaves. Chlorophyll content is less in normal leaf than gall leaf. Gall leaf and gall showed higher PAL enzyme activity. The methanol extract of *F. racemosa* gall showed remarkable antioxidant activity. As per the results of GC-MS, a total of 62 compounds werepresent in gall and 57 compounds in normal leaf. About 37 unique compounds were present in galls, which may be produced due to the influence of gall inducer.

Conclusion: Medicinal properties of plants depends on the phytochemicals present in them. As per preliminary phytochemical analysis and GC-MS analysis it is revealed that gall possess more phytochemical constituents than normal plant leaves. Further bioactivity analysis may lead to the development of one or more therapeutic molecules.

Keywords: Leaf galls, Phytochemicals, Antioxidant activity, PAL enzyme and GC-MS.

09-13

ON THE ACARINE ASSOCIATES OF SELECTED INSECTS OF AGRI-HORTICULTURAL IMPORTANCE

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Abstract: Insect-mite associations are mostly opportunistic in nature, and possibly accidental. Exploration of the types and intensity of insect mite associations becomes significant, especially when the insect hosts exert great impact in agricultural and horticultural fields. The present work is unique as it reports for the first time in Kerala the association of mites (Acari) representing 12 species, under 11 genera, eight families and three orders with nine species of insects. Of these, eight species were recognized as phoretic, three are parasitic and one exhibiting facultative necromeny. A major share of the collected species of mites is kept unidentified and which will be scrutinized further for identification of their species status. The new species will be published else-where after confirmation of their identity, with adequate description and morphological drawings.

09-14

IN SILICOSTUDIES ON THE ANTIINFLAMMATORY POTENTIAL OF THE AYURVEDIC HERBAL DECOCTION KOKILAKSHAM KASHAYAM

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Background: Herbal preparations have a vital role in the treatment of human diseases. Kokilakshamkashayam, an ayurvedic herbal decoction widely recommended for the treatment of uncontrolled inflammatory responses such as Rheumatoid arthritis, lacks scientific evidence to verify its ethnomedical claims. The present work aims at indicating the bioactive molecules in the herbal preparation and evaluating its interaction with the three isoforms of nitric oxide synthase (endothelial nitric oxide synthase (eNOS), neuronal nitric oxide synthase (nNOS), inducible nitric oxide synthase (iNOS)), so as to explore the binding efficiency of the identified bioactive molecules to proteins involved in inflammatory conditions and thus validate the traditional use of the herbal decoction.

Methods: The fractions of the ayurvedic decoction were subjected to HRLCMS analysis and insilico analysis. HRLCMS analysis was done for the identification of the bioactive molecules, which were further analyzed for ADMET studies and target prediction. Autodock 4 was done to understand the binding interactions of the bioactive molecules to NOS isozymes.

Results: The HRLCMS chromatogram revealed the presence of anti-inflammatory compounds, which were checked for their pharmacokinetic properties and the swiss target prediction tool showed the accurate

prediction of the targets of bioactive molecules. Hence, they were checked for their binding efficiency to NOS isoenzymesand found to be better inhibitors of enzymes as compared to the positive controls when analyzed using the molecular docking software Autodock 4.

Conclusions: These findings are a step towards understanding the molecular mechanism underlying the bioactivity and probably will allow identifying bioactive molecules to be used as leads for the development of therapeutic agents able to scavenge and remove pathophysiological quantities of nitric oxide, a causative agent of persistent inflammation.

Keywords:Kokilakshamkashayam, HRLCMS analysis, ADMET studies, docking studies, iNOS, target prediction.

09-15

ANTI-DIABETIC POTENTIAL OF *ANACARDIUM OCCIDENTALE* (Cashew) ROOT EXTRACTS EVIDENCED BY REAL TIME PCR ANALYSIS OF INS-1 GENE EXPRESSION

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Background: Development of a side effect free and cost effective anti-diabetic drug has now become a challenge to the global health systems in order to purge the soaring metabolic as well as the endocrinal disorder, Diabetes mellitus and its related complications. The present study aims at investigating the anti-diabetic potential of *Anacardiumoccidentale* (cashew) root extracts mainly emphasising on its efficacy in promoting Insulin secretion.

Method: The anti-diabetic efficacy of the four sequentially solvent extracted fractions: Petroleum ether (PE AO), Chloroform (CH AO), Ethyl acetate (EA AO)and80% methanol (80%M AO) of *A.occidentale* roots were evaluated by its potential to stimulate insulin secretion in MIN6 pancreatic β-cell lines, quantitatively measured by Indirect ELISA and INS-gene expression analysed by Real Time PCR. The cytotoxicity of the fractions were examined by MTT Assay and anti-oxidant potential by DPPH Assay.

Results: The ELISA results revealed80%M AO at concentration 12.5µg/mL to be an effective insulin secretagogueeven at high glucose (27mM) induced oxidative stress; which is also supported by up regulation of INS-1 gene expression by qRT PCR analysis. The fraction was found to be least cytotoxic and exhibited significant anti-oxidant activity ((IC_{50}= 0.026 mg/mL).

Conclusions: The least cytotoxic, potent anti-oxidant as well as the insulin secretion stimulating efficacy of 80% methanolic extract of *A.occidentale* roots thus, offers a promising lead drug candidate in developing an anti-diabetic drug.

Keywords: Diabetes mellitus;*Anacardiumoccidentale*; INS-1; qRT PCR.

09-16

IMPAIRED WNT SIGNALING IN DEVELOPMENTAL LANGUAGE DISORDER?

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Background: Developmental language disorder (DLD) or specific language impairment is a neurodevelopmental disorder defined as the failure to develop normal speech and language skills in the absence of any environmental, medical or genetic impairments. It is the most common form of language disorder prevalent in about 7% of school-age children.Alterations in epigenetic processes such as DNA methylation and histone modification could be important in the pathogenesis of these disorders. DNA methylation plays a crucial role indifferentiation

of cells in early development when neurological pathways are being laid down.Alterations in DNA methylation could thus provide cues to the pathogenesis of neurodevelopmental disorders.

Method: We examined differential methylation of genes in individuals with DLD compared to healthy controls. 12 individuals with DLDbetween 5-10 years of ageand 12 age- and gender-matched healthy controls were recruited for the study. The participants were drug-naive and seizure-free. Genome-wide methylation analysis was done using Infinium Methylation EPIC BeadChip which covers over 850,000 genome-wide methylation sites.

Results: Among the various loci that showed differential methylation, the genes that serve as modulators of the WNT signaling pathway deserve special mention. We observed hypomethylationof the genes (*APCDD1, AMOTL1, LRP5, TMEM64, BANK1, VEPH1, WNT2B, TRABD2B*) that act as negative regulators of WNT signaling and hypermethylation of a gene (*MARK2*) that is known to positively regulate WNT signaling.

Conclusions:WNT signaling is fundamental for several neurodevelopmental and post-neurodevelopmental processes.Any perturbation in WNT signaling pathway may trigger the advent of disorders related to the structure andfunction of the CNS.

Keywords:DLD, WNT signaling, Differential methylation

09-17

MOLECULAR CHARACTERIZATION & PHYLOGENETIC ANALYSIS OF HISTONE DERIVED ANTIMICROBIAL PEPTIDE FROM THE ASIAN SEA BASS, LATES CALCARIFER

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Background: Antimicrobial peptides (AMPs) are short, amphipathic peptides that are components of many organisms innate immune response. AMPs have developed to be a growing class of natural and synthetic peptides with a wide spectrum of targets including viruses, bacteria, fungi, and parasites. Histones are group of highly alkaline protein that condense the DNA of nuclei into units called nucleosome. Histone derived peptides show antibacterial activities and are also involved in other functions such as accessibility of transcriptional regulation and apoptotic signaling pathway.

Method: Total RNA was isolated from the gills of the Asian sea bass, *Latescalcarifer* using TRI reagent according to the manufacturer's protocol. The quality and quantity was estimated and single stranded cDNA was synthesized by reverse transcription. PCR amplification was done using Hipposin specific primers. PCR products were purified, sequenced and *in silico* analyses were done. The phylogenetic analysis & evolutionary significance has also been established.

Result:*Latescalcarifer,* Histone derived AMP (Lc-HIS) nucleotide sequence consisted of 186 nucleotides encoding 61 amino acid residues. BLAST analysis of the nucleotide and amino acid sequence revealed 96 % similarity to Histone H2A from *Latescalcarifer*. Lc-HISpossessed a predicted molecular weight of 6.64 kDa and a pI of 9.47as predicted by PROTPARAM software. The phylogenetic tree confirmed that Lc-HIS possessed more similarity to that of other Histone H2A from *Latescalcarifer*, than to the Histone H2A of *Poeciliaformosa* and *P.mexicana*.

Conclusions: Hipposin is cationic, amphiphilic AMP derived from histone protein H2A. Histones are group of highly alkaline protein that condense the DNA of nuclei into units called nucleosome, which form the structural unit of chromatin in eukaryotic cell. Major role of histone protein includes DNA stabilization and regulation of gene expression.Hipposin is importantly involved in antimicrobial and immunomodulatory activities and it will be an effective therapeutic agent in the field of aquaculture and pharmacology.

Key words: Antimicrobial peptide, Histone derived AMP, *Latescalcarifer,* Aquaculture, Therapeutant

09-18

EVALUATION OF ANTI-INSECT PROPERTIES OF COCCULUSLAURIFOLIUS DC. AGAINST TWO *LEPIDOPTERAN* PESTS

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Background: Pests are severe problem in several vegetables and economically important crops. It was reported that due to the attack of pests, yield of many of the major crops reduced significantly. Hence controlling the pests is one of the very crucial steps in increasing crop yield. Currently used chemical pesticides have far reaching adverse environmental and ecological impacts. Hence developing alternative eco-friendly pest management methods are in high demand. Biopesticides derived from plants or animal origin were considered to be an eco-friendly viable alternative to chemical pesticides. *Cocculuslaurifoilus*DC locally known as 'aadukolli' belongs to the family Menispermaceae and the name emerged from folklore as the leaves of this plant is fatal to goat, which might be due to the presence of bioactive molecules. The study was carried out to understand the anti-insect properties of *C. laurifoilus* extractsagainst two economically important pests*Olepariciniand**Spodopteralitura*and to identify the compounds responsible.
Method: This work explores anti-insect activities of bark and leaf extracts of *C. laurifoilus.*The antifeedant activity, repellent activity and contact toxicity of this plant was evaluated against *O. ricini* and *S. litura*using standard protocols.The chemical compositions of the plant extracts in methanol were analyzed using GC-MS.
Results: In the present study, the bark extract of *C. laurifoilus*showed maximum antifeedant activity with 97.84 ± 1.08 and 92.18 ± 0.68 (5% extract) against *O. ricini* and *S. litura* respectively. Higher repellent index was shown by the bark extract of *C. laurifoilus*and the leaf extract showed an attractant in nature for these two pests. The bark extract of *C. laurifoilus*had shown lethal dose of 15.25 ± 0.22 µg/ml against *S. litua.* Few compounds with reported anti-insect activities were identified in GC-MS analysis.
Conclusions: The presence of bioactive molecules in the bark extract could be responsible for the noticeable amount of anti-insect properties in terms of anti-feedant, repellent and contact toxicity. These extracts could be further explored for the preparation of newer biopesticide formulations.
Keywords: Biopesticides, *Cocculuslaurifolius, Spodopteralitura, Olepariciini.*

09-19

PHARMACOGNOSTIC STUDIES AND PRELIMINARY PHYTOCHEMICAL ANALYSIS OF ROOT, STEM AND LEAVES OF *ORTHOSIPHON ARISTATUS* (BLUME) MIQ.

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Background: Medicinal plant derived compound have an important role in the development of many clinically useful agents.*O.aristatus* now appears in many commercial products in the forms of powdered herb, dried leaves, tea sachets, drinks, extracts, tablets and capsules. There are no reports onthepharmacognostical studies. Hence, the present work is an attempt to standardize by pharmacognostic studies and phytochemical analysis, as these studies stand as evident proof for confirming its identity, authenticity and purity of the plant.
Methods: Macroscopic and microscopic studies, physicochemical parameters,fluorescence analysis, powder analysis and phytochemical screening were done according to standard protocols.
Results: All the parameters to be evaluated in pharmacognostic study are enlisted along with their importance. Phytochemicalanalysis of root, stem and leaves of *O.aristatus* shows the secondary metabolites like cardiac

glycoside , flavanoid , phenols, saponin, alkaloid , steroid , tannin and coumarin.

Conclusion: The present study provides the information regarding standardization parameters which will help in identification of plant material. These parameters will be helpful for authentication of drug and also differentiation from substitutes or adulterants.

Keywords: *Orthosiphonaristatus,*macroscopic, microscopic studies, physicochemicalparameters,fluorescenceanalysis,Powder analysis, phytochemical screening.

09-20

NUTRITIONAL AND ANTI-NUTRITIONAL PROPERTIES OF BAMBOO SHOOTSFROM KERALA PART OF WESTERN GHATS

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Background: Bamboos are perennial arborescent grasses belonging to the family of *Poaceae*under the sub family *Bambusoideae.* The emerging fresh bamboo shoots are reported to be rich in nutrients and minerals. Besides nutrients, bamboo shoots also contain anti-nutrient cyanogenic glycosides that need to be removed before consumption. The lack of proper methods for quick and successful processing, storage and presence of cyanogenic glycosides are the major interferences in its regular use. The present work aimed to evaluate the nutritional and anti-nutritional levels in ninebamboo species from the Kerala part of Western Ghats to evaluate its potential as a sustainable food source.

Method: Bamboo shoots from nine bamboo shoots belonging to the species BambusabalcooaRoxb.,Bambusabambos(L.)Voss,Bambusa vulgaris Schrad(Green&Yellow), BambusawaminE.G.Camus,CephalostachyumpergracileMunro,DendrocalamusgiganteusMunro,Dendrocalamusstrictus(Roxb.)Nees,Gigantochloaatroviolacea Widjaja and Gigantochloamanggong Widjajawere collected from KFRI Field Research Centre, Velupadam, during July –September of 2019 and analyzed for nutrient and anti-nutrient parameters using standard protocols. In order to assess the cyanogen removal during processing, total cyanogen content (TCC) was estimated before and after processing in Dendrocalamusasper(Schult.) Backer and Dendrocalamusbrandissi(Munro) Kurzspecies.

Results: From the present study, moisture content was found to be highest in B.bambos (92.06%) and the lowest in D.strictus(87.48%). D.giganteus was found to have maximum ash content (1.13%) and B.balcooahas the lowest (0.43%). Among the species D. giganteusand G.atroviolacea, the carbohydrate value was found to be 30.6 and 11.8 mg/100g respectively. Protein and fat content were found more in D.strictus with 32.31mg/g and 0.31g/100g respectively. Least protein and fat content were found in B.balcooa(8.9mg/g and 0.05g/100g). The fiber content was found to be more in C.pergracile(8.2 g/100g) and found least in B. vulgaris (Yellow) (2.8 g/100g). G.atroviolaceahad shown higher vitamin C content of 7.41 mg/100g and lowest value of 3.42 mg/100g was observed in B. vulgaris (Yellow). Among 10 species checked for TCC value, it was found that more cyanogen content was observed in the apex region of C.pergracile(2891.98 ppm) and no TCC was observed in the base region of B.bambos. On comparing TCC values of D. asperand D.brandissi before and after boiling,it was observed that the TCC levels were reduced significantly after the processing.

Conclusion: This is the first report on the nutritional evaluation of bamboo shoots from the southern Western Ghats. Since it is predominantlyavailable in the region, developing it as a suitable food source would be ideal. Distribution of cyanogen content is a delimiting factor; however suitable processing methodscould be adopted for the removal of cyanogens. Further studies might be required to develop suitable processing and storage protocols.

Keywords: Poaceae, bamboo shoots, nutritional parameters, cyanogenic glycosides

09-21

STUDIES ON THE EFFECT OF DIFFERENT HERBS IN THE GROWTH OF *LACTOBACILLUS* IN HERBAL PROBIOTIC MIXTURES

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Background: *Ayurveda* is the most popular Indian traditional health care system, and approximately 80 % of people in India use *Ayurveda.*Thakrarishta is an *Ayurvedic* classical formulation based on buttermilk. Thakrarishta increases digestive juices secretion and stimulates appetite. In the present work, studies on the effect of different herbs in the growth of *Lactobacillus* in herbal probiotic mixtures were evaluated.
Method: The probiotic and antimicrobial activity of Thakrarishtachoorna and the growth of *Lactobacillus* in different salt concentrations (2 %, 4 % and 6 %) were checked. Antimicrobial activity of Thakrarishtachoornam was checked against *Staphylococcus aureus* (*S. aureus*), *Escherichia coli (E. coli), Pseudomonas aeruginosa (P. aeruginosa), Salmonellaabony (S. abony)*. The physicochemical parameters including ash test, acid insoluble ash, sulphated ash and water insoluble were also checked in the Thakrarishtachoornam. Comparative chemical profiling of various herbal extracts and Thakrarishtachoornamwere done by HPTLC.
Results: Thakrarishtachoornawas effective against *S. aureus*, and *E. coli*. The greatest zone of inhibition had shown against *S. aureus*. About, 3000 *lactobacillus* bacteria were isolated from Thakrarishtachoornam. In the present study 2 % of salt concentration gave more *Lactobacillus* bacteria in the product. HPTLC analysis had revealed the various chemical compounds present in the Choornam.
Conclusions: This result can be used to develop a new product for the treatment of Irritable Bowel Syndrome (IBS) and also used a good probiotic supplement in *Ayurveda*.
Keywords: Thakrarishtachoorna, Probiotic activity, Antimicrobial activity, HPTLC Chemical profiling.

09-22

METAGENOMIC PROFILING OF FLOOD-AFFECTED AREAS IN KUTTANAD

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Background: The devastated flood in the Kerala during August 2018 was declared as a “calamity of severe nature”, leaving 23 million people affected. Previous studies suggests that floods are positively associated with increased risk of water-borne and vector-borne diseases such as skin infection, typhoid fever etc.Theimpact of flooding on environmentalmicrobiomedisruption and its role in thedissimilation of pathogenic and antibiotic resistant bacteria from various sources need detailed investigation.
Method: We utilized a combination of high-throughput metagenomicDNAsequencing technology and bioinformatics procedures for studying microbiome of flooded environments in comparison with non-flooded mangrove settings.
Results: Here we report, altered bacterial profiles at the flooded sites having 77 significantly different bacterial genera in comparison with non-flooded mangrove settings.The flooded regions were heavily contaminated with faecal contamination indicators such as *E.coli* and *E.faecalis* and resistant strains of *P.aeruginosa, Salmonella* Typhi/Typhimurium*, K.pneumoniae, V.cholerae* and *S.aureus*. The resistome of the flooded sites contains 103 resistant genes, of which 38% are encoded in plasmids, where most of them are associated with pathogens.
Conclusions: Our results reveal the bacterial profile following a devastating flood event with elevated levels

of both faecal contamination indicators and resistant strains of pathogenic bacteria. The circulation of raw sewage from waste treatment settings and urban area might facilitate the spreading of pathogenic bacteria and resistant genes.

Keywords: metagenomics, flood, antibiotic resistance, bacterial diversity

09-23

DE NOVO MUTATIONS OF OLFACTORY RECEPTOR GENES IN AUTISM SPECTRUM DISORDERS

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Background: Autism spectrum disorders (ASD) are a group of complex neurodevelopmental disorders characterized by impaired social interaction, communication deficits, and restricted and repetitive behaviors. This childhood-onset disorder has a prevalence rate of 1 in59. In spite of being a highly heritable disorder, the genetic architecture of ASD is highly complicated owing to its clinical heterogeneity. In a family-based twin study, we attempted to identify the genetic variants of ASD by whole exome sequencing (WES).
Method: Five twin families, which includes three monozygotic and two dizygotic twins were recruited for this study. Among the monozygotic twins, two were concordant and one was discordant for ASD, while both the dizygotic twins were discordant for ASD. WES was done using SureSelectXT Human All Exon v5+UTRs kit on IlluminaHiSeq 2500 to generate 2x100 bp sequence reads at 100x sequencing depth (~9Gb). Then the reads were mapped onto a reference genome, followed by variant calling (SNPs, indels) and annotation.
Results: One of the most important findings in this study is the *de novo* mutations in olfactory receptor genes observed in four out of five twins. Different types of mutations were identified in the *OR1D5, OR2T7, OR2T27, OR2T29* and *OR51A2* genes
Conclusions: Studies have demonstrated that olfactory communication plays an important role in establishing normal social behaviors and functions. Detailed studies to assess the role of the olfactory system in social disorders such as ASD are warranted.

Keywords: ASD, Whole exome sequencing, Olfactory, Social communication.

09-24

ACUTE AND SUB-ACUTE ORAL TOXICITY STUDY OF ESSENTIAL OILS (EOS) FROM POGOSTEMONBENGHALENSIS AND P. CABLININ WISTAR RATS

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Background: Herbal extracts form of health care known to mankind from time immemorial. *Pogostemonbenghalensis* and *P. cablin* has a long history of use as remedies for curing many ailments such as dysentery, diarrhea, and hypertension. Mostly, herbal medicines and related products are introduced into the market without safety or toxicological validation.
Method: The aim of this study was to investigate the effect of Essential oils (EOs) extract from *Pogostemonbenghalensis* and *P. cablin* on liver and kidney and blood parameters of rats. For acute toxicity study, rats were randomly divided into groups. The control group received distilled water and tween-20, while the experimental groups received a single dose of 500, 1000, 1500 and 2000 mg/kg extract per oral. For sub-acute toxicity study, the rats were randomly divided into groups. The control group received tween-20, while the experimental groups received 500, 1000, 1500 and 2000 mg/kg extract orally for 28 days. At the end of the

experiment, blood samples were collected for hematology and clinical chemistry evaluations.

Results: In the acute toxicity study, rats treated with 500, 1000, 1500 and 2000 mg/kg showed no toxicological signs observed on behavior, gross pathology, and body weight of rats. In the sub-acute toxicity study rats have showed no significant changes on behavior, gross pathology, body weight, and hematological and biochemical parameters, whereas both experimental groups had a lower blood glucose level compared with the control group (p<0.05).

Conclusion: The Essential oils (EOs) from *Pogostemonbenghalensis* and *P. cablin* does not produce adverse effects in rats after acute and sub-acute treatment. Before marketing a drug based remedy, subchronic and chronic toxicity evaluations need to be done.

Keywords: Sub-chronic, acute toxicity, *Pogostemonbenghalensis,P. cablin,* hematological and biochemical parameters

09-25

SYNTHESIS AND CHARACTERISATION OF ALUMINIUM COBALT OXIDE NANOCOMPOSITES AND ITS TOXICITY STUDIES

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This investigation focuses on the development of novel antimicrobial metal oxide nanocomposites against multidrug-resistant organisms. Aluminum cobalt oxide nanocomposites were synthesized and optimized by using solution combustion process followed by calcination. Morphological characterization and phase transformation of the nanocomposites was studied by using UV-Vis, DLS, FTIR, XRD, SEM-EDX, Raman spectroscopy, and photoluminescence spectroscopy. In this study, aluminum-cobalt oxide nanoparticles successfully evaluated against methicillin-resistant *staphylococcus aureus* and MIC, MBC and FICI were determined. ROS generation and blood compatibility of synthesized nanoparticles were studied with RBC. Moreover, the antioxidant and anti-biofilm activity of the aluminum cobalt oxide nanocomposites increased proportionally with the rise in concentration and the present study conclude synthesized nanomaterials stable under the presence of biological fluids and cell viability studies demonstrated as less toxic.

09-26

UTTROSIDE B AS A NOVEL DRUG CANDIDATE AGAINST HEPATOCELLULAR CARCINOMA

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Background: Hepatocellular carcinoma (HCC) is associated with a high rate of mortality and exhibits inherent resistance to conventional chemotherapeutics. Our team has isolated a furostanolsaponin, uttroside B, from the leaves of *Solanumnigrum* Linn, which exhibits exceptional cytotoxicity towards liver cancer cells, compared to sorafenib, the only FDA approved drug against HCC.

Methods: Solvent extraction of S*olanumnigrum*Linnleaves; MTT assay, Western blotting, EMSA, histopathology, immunohistochemistry, Anti-tumor studies in NOD-SCID mice; Toxicological studies in *Swiss albino* mice, Hemolysis, Transfection.

Results: Uttroside B was isolatedfrom the methanolic extract of the leaves of *Solanumnigrum* Linn. The compound is more cytotoxic (IC50: 500 nM) than sorafenib (IC50: 5.6 µM) in the HepG2 cell line, and induces apoptosis. Uttroside B drastically inhibited the growth of HepG2 liver cancer xenografts in NOD-SCID mice and also exhibits better anti-tumor efficacy than sorafenib as indicated by our *in vivo* studies. It activates autophagy. Beclin-siRNA transfection illustrated that inhibition of autophagy enhances uttroside B-mediated apoptosis.
Conclusions: The mechanistic evaluation revealed that uttroside B inhibits mTOR and activates AMPK, two crucial signaling pathways regulating progression of HCC. The study attests uttroside B as a promising drug candidate against HCC.
Key words: Uttroside B; HCC;Autophagy; mTOR; AMPK.

09-27

A STUDY ON THE WING SCALE POLYMORPHISM IN THE SWALLOW TAIL BUTTERFLY PAPILIOPOLYTES

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Background: Wing scales have so far been investigated in the Indian Common Mormon Swallow Tail butterfly *Papiliopolytes*which belongs to the female form 'romulus' that comes under the family Papilionidae. Scales enable the development of vivid or indistinct patterns which helps the organism to protect itself by concealment and camouflage, mimicry and warning.Wing scales play an important part in the natural history of Lepidoptera.
Method: The wing scales of butterfly are isolated from the wing substrate as per the standard method of Grodnitsky and Kozlov (1991). Several hundreds of scales were scrapped off from each region of wing separately that shows varied colors into a glass slide. A drop of xylene is poured into the glass slide. After xylene has been evaporated, the samples were studied under the light microscope.
Results: The wings of butterflies are covered with numerous tiny scales. The study exhibits that the wings of *Papiliopolytes* contains morphologically wide variety of scales which are numerous in number. A total of 221 morphologically different polymorphic forms of wing scales was analyzed. The typical structure of wing scale consists of upper lamina (abwing), lower lamina (adwing) and a stalk. Several black, brown, white and reddish brown colored scales have been identified. The dimension of the scales ranges between 86.68µ-130.02µ in length and 48.58µ-78.8µ in width. The wing scales appears to be with different shape, size and color and the presence of these scales beautifies the butterfly.
Conclusions:*Papiliopolytes* exhibit wide variety of scales with varied shape and color. A total of 221 morphologically different types of scales were identified. Most of the scales show dentations on the upper lamina and slight variations have been observed. Several black, brown, white and reddish brown colored scales have been identified from the various differently colored regions of wing substrate. Scales of butterflies can be used as a taxonomic aid for identifying the butterfly species.
Keywords: Wing scales, Butterfly, Swallow tail, Micrometry.

09-28

BIOCHEMICAL CHARACTERISATION OF PESTICIDE DEGRADING ENDOSYMBIOTIC BACTERIA OF *SITOPHILUS ORYZAE* COLLECTED FROM PALAKKAD, KERALA.

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Background: Pesticides pollute the soil, air and even the groundwater. Pesticide residues may cause serious health hazards and there is a huge demand worldwide to find a solution to manage the problems with pesticides.

Studies are needed to explore new microorganisms which can degrade the insecticides contaminating our environment. Endosymbiotic microorganisms may have the potential to degrade the pesticides entering the body of host insect and exploring such pesticide degrading endosymbionts can be used as a future bioremediation tool.

Method: In this work, we isolated gut bacteria from the rice weevil *Sitophilusoryzae* collected from Palakkad, the granary of Kerala, which are resistant to particular concentration of selected pesticides and tested for their ability to grow in the pesticide based selective media, for the capacity to degrade particular insecticide. The bacteria able to grow in the selective media containing different concentrations of Cypermethrin and Malathion are isolated and identified.

Results: The identified strains of bacteria of rice weevil, *Sitophilusoryzae* belongs to the genus *Bacillus*and *Staphylococcus* were able to grow in selective medium containing Cypermethrin and Malathion thereby prove their ability to degrade particular pesticides.

Conclusions: Some of the insecticide tolerant endosymbionts may help the host insects to survive in an environment contaminated with pesticide.Pesticide degrading bacteria of insecticide resistant strains of *Sitophilusoryzae* can be used in future for the purpose of bioremediation.

Keywords: Pesticides, Endosymbionts, Cypermethrin, Malathion.

09-29

PRELIMINARY PHYTOCHEMICAL ANALYSIS IN THE METHANOLIC WOOD EXTRACTS OF ANODENDRON PANICULATUM (ROXB.)A. DC.

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Background: Phytochemicals present in plant systems have some defense mechanisms which protect them from its natural enemies and pathogenic organisms. Because of this property, majority of them having some kind of therapeutic value and hence it is relevant in evaluating the pharmacological properties of these available compounds. The present investigation was carried out for the preliminary qualitative detection of major phytochemical groups and for preparing the profile of specific bioactive principles present in the methanolic wood extracts of *Anodendronpaniculatum*(Roxb.)A.Dc. belonging to the family Apocyanceae.

Methodology: Various qualitative biochemical tests are carried out to detectdifferent phytochemical groups present in the wood component of *Anodendronpaniculatum* using the standard procedures described in Experimental Phytopharmacognosy (Khadabadi*et al*., 2013). GC-MS screening is carried out to prepare a profile of various specific bioactive compounds in the wood extracts using GC Agilent Technologies system interfaced to a mass spectrometer instrument.

Results and discussion: Qualitative phytochemical screening revealed the presence of major phytochemical groups like flavonoids, triterpenoids, alkaloids, phenolics, glycosides, tannins, saponins, carbohydrates, proteins and amino acids. The GC-MS analysis revealed the presence of 10 bioactive compounds with different peak area percentage and retention time. The major specific bioactive compounds detected include squalene, campesterol, stigmasterol and γ-Sitosterol,N-Hexadecanoicacid,Asarone etc. Many compounds detected in the study is previously confirmed as having medicinal value and hence a valuable plant resource.

Conclusion: Detection of specific bioactive principles of pharmacological values in the wood component of*Anodendronpaniculatum* indicates a good plant source for future therapeutic industry.

Keywords: *Anodendronpaniculatum,* methanolic wood extract, qualitative phytochemical screening,GC-MS analysis, bioactivity

09-30
ARSENIC INDUCED ALTERATIONS IN PHOTOCHEMISTRY AND ASSOCIATED CHANGES IN ACANTHUSILICIFOLIUSL

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Heavy metal pollution is regarded as one of the major concerns for soil and water, causing varieties of toxic and stress effects on plants and ecosystems. It has become one of the important limiting factors to crop productivity and quality. The aim of the present investigation was to evaluate the effect of arsenic on photochemistry and associated changes in *Acanthus ilicifolius* L. by using various parameters like Chl*a*fluorescenceparameter,leafpigment composition and membrane damage. When plantlets were exposed to different concentrations of sodium arsenate dibasic heptahydrate ($Na_2AsO_4.7H_2O$) (0, 60, 70, 80 and 90 µM), those grown in 90 µM showed maximum reduction in Chl*a* fluorescence parameter such as Fv/Fm, Fv/Fo, RC/CS_m, TRo/CS_m, ETo/$CS_m$and an increase in the Fo, DI/CS_m. Leaf pigment composition (Chl*a* andChl*b*) showed a sharp reduction upon increasing the arsenic concentration. Arsenic induced membrane damage was maximum in *Acanthus ilicifolius* grown in 90 µM and these plants also showed lower membrane stability. These results indicate that, the mangrove *Acanthus ilicifolius* shows toxicity towards $Na_2AsO_4.7H_2O$ of concentrations above 80 µM.

Keywords: Phytoremediation, *Acanthus ilicifolius*, arsenic, Chl*a*fluorescence, membrane damage.

09-31
DISTRIBUTION AND SEASONAL VARIATION OF BIOACTIVE POTENTIAL YEAST STRAINS IN THE MANGROVE SEDIMENTS OF NORTH KERALA

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Background: Mangroves are unique marine ecosystems with detritus based sediments. These sediments harbor large number of microorganisms which play a major role in ecosystem functioning and services. Marine yeasts which are present in the extreme environment like mangrove sediments are ecologically significant due to their involvement in various ecological transformational processes and synthesis of biologically active compounds. Due to their properties, yeasts can be not only exploited for its applications in food, agricultural, chemical and pharmaceutical industries but also for the process of bioremediation which helps in the conservation and management of the ecosystem.
Method: Sediment samples were collected from the mangroves of the five districts along North Kerala coast in eight sites during two periods of the year viz., monsoon and post monsoon. Physico chemical characteristics of the sediments like pH, temperature and salinity were noted during the time of collection. The organic matter and sediment texture were analysed using standard protocols. Yeast colonies were isolated on Wickerham media, purified by quadrant streaking and transferred to malt extract agar slants for further studies. The isolates were tested for the production of hydrolytic enzymes like protease, amylase, lipase, chitinase, cellulose, pectinase, ligninase and urease using standard protocols. Presence of clearance zone or halozone was noted as positive and the diameter of the zone was recorded.
Results: A total of 233 yeast isolates were obtained, studied and stored during the collection period. pH of the sediments varied between 6.4 – 7, temperature of the sediments varied between 21°C - 29°C and Organic matter content of the sediment varied between 1.7% -4.2%. The number of colony forming units per millilitre (CFU/ml) of the diluted sediment sample was calculated which showed significant difference between the sampling

periods. The CFU/ ml of yeast increased during monsoon and decreased drastically during post monsoon period. As the monsoon receded, the organic matter and the moisture content of the soil also decreased which might have caused for the reduction in the number of cultivable yeast colonies in our study. Genus level identification of the yeast strains showed that majority of them belonged to the genus *Candida.*82% of the isolates showed various hydrolytic enzyme activities during monsoon while 89% of them in post monsoon. The number of yeast isolates showing various enzymatic activities was higher during post monsoon despite the reduction in number of cultivable colonies. As the moisture content and the organic matter of the sediment decreased, the number of potent isolates with hydrolytic enzyme activity increased. Significant changes were also found in the pattern of enzymatic activity between two seasons. The order of enzymatic activity during monsoon was found to be Lipase >Ligninase> Urease > Amylase >Cellulase>DNase> Protease >Chitinase> Pectinase and that of post monsoon was Lipase >Ligninase> Pectinase > Urease >Cellulase>Protease >DNase> Amylase >Chitinase Majority of the yeast isolates from the mangrove sediments under the study were lipolytic and ligninolytic.

Conclusions: Mangroves, due to their extreme sediment characteristics and varied ecological behavior are considered to be unique from other ecosystems. Hence the yeasts harbored in these sediments are believed to produce significant bioactive compounds and possess unique enzymatic properties. This area has received a little attention till date and needs intensive research to explore novel bioactive compounds which can be applied in industries and also in the management of mangrove ecosystem. Hence, the present work is an attempt to identify and study potent yeast strains from mangrove sediments of North Kerala.

Keywords: Mangrove sediments, yeast, hydrolytic enzymes, industrial applications, monsoon

09-32

FUNCTIONAL CHARACTERIZATIONOF BACTERIAL ISOLATES FROM THE MANGROVE SEDIMENTS OF NORTHERN KERALA

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Abstract: Mangroves belong to intertidal wetlandecosystem rich in microbial diversity. The microbes play a key role in conservation and recovery of this ecosystem. Due to mobilization of different nutrients and substrates, they are potential source of hydrolytic enzymes. Mangrove sediments were collected during three seasons (monsoon, post monsoon & pre monsoon)from 8 stations along the coastal belt of Northern Kerala by hand core collection method. Microbial analysis (spread plate) and organic matter analysis were performed. The pure colonies were checked for extra cellular enzyme production. Rich microbial count was obtained from mangroves during three seasons. It was found that premonsoon season favoursmaximum bacterial population than other seasons. Organic matter content also influenced microbial population mainly in Kasaragod, Chettuva and Ponnani. The bacterial isolates are rich source of extracellular enzymes such as amylase, protease, lipase, DNase, chitinase,cellulase, ligninase&laccase. None of them showed pectinase activity. Seasonal wise analysis showed that amylase, lipase, DNase and cellulase are the enzymes that maximum isolates produced.The study shows that mangrove ecosystem harbour rich bacterial diversity. The organic matter variation influences microbial count apparently. Mangrove microflora iscapable of producing wide varieties of extracellular enzymes such as protease, amylase, lipase, chitinase, cellulase, ligninase, laccase&DNAse.The enzymes can be utilized for various industrial applications.

Keywords: *Mangroves, Kerala, Bacteria, Enzymes, Microbes, Sediments*

09-33

FROM WHERE DID GIANT AFRICAN SNAIL COME TO INDIA? A WORLDWIDE ANALYSIS WITH16SRRNA AND COI GENES

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Background: The tropical invasive pest Giant African Snail *Lissachatinafulica*(Bowdich, 1822) is listed as one of the worst 100 invasive species in the world by IUCN. The snail also acts as an intermediate host of the rat lung worm *Angiostrongyluscantonensis* causing Eosinophilic meningitis in children. The snail reached India during 1847 in Calcutta from Mauritius. The snail has reached South India during the British period and reached Kerala during 1950s. Till 2019 thirteen out of fourteen districts in Kerala is affected with Giant African Snail.
Method: Extensive field surveys were conducted in Kerala and molecular analysis were carried out using the 16s rRNA gene and Cytochrome Oxidase subunit I gene to track the invasion routes of the snail to identify weather the invasion into India is through a single introduction or through multiple introductions. Wood import data was collected from Cochin port and Eosinophilic meningitis case reports were collected from various hospitals in Kerala.
Results: A total of 290 snail infested localities from South India and West Bengal were identified from this study. From these, 230 sequences of 16s rRNA gene sequences and 70 COI gene sequences were obtained. Twelve distinct haplotypes of COI gene and 18 distinct haplotypes of 16s rRNA gene was identified from this study. Network analysis of all the COI haplotypes in the world indicate that the most common haplotype in India is haplotype E and was identified from Abu Dhabi and which is directly linked to the African haplotype D and the haplotype J is found to be present in both Kerala and Abu Dhabi. All the remaining haplotypes are related to the African haplotype D. Network analysis of the 16s rRNA gene identified haplotype 'H' from Ottappalam in Palakkad, which was globally present in Mayotte and Mauritius. Identified the 22 major wood importing countries to Cochin port and their Giant African Snail infestation status. Eosinophilic meningitis cases collected from hospitals were directly linked to the snail infested localities.
Conclusions: The molecular data and the analysis of the haplotypes of the COI gene and the 16s rRNA gene points out to the multiple invasion events of the snail into India. The relatively high haplotype and nucleotide diversities in invaded areas also suggests high propagule pressure and multiple invasion. The occurrence of meningitis cases in a higher frequency from snail infested localities shows the role of the snail in spreading the rat lung worm. The wood import data from the Cochin port in Kerala, India also suggests large quantities of wood is being imported from the native range of the snail and also from the highly infested localities. The genetic analysis and the wood import data proves the multiple origins of invasion of the snail into India other than Mauritius.
Key words: Lissachatinafulica, Mitochondrial markers, multiple invasion.

09-34

CHANGES IN PER CAPITA INTERACTION STRENGTH BETWEEN SPIDER AND GRASSHOPPER DURING ANOMALOUS TEMPERATURE RISE IN SUMMER SEASON

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Abstract: Projected ramifications of Climate change includes exacerbated scarcity of water, one of the most critical resource that sustain planet earth. Predicting the impact of climate change on species interactions and

other ecological processes help to extrapolate its effects on ecosystem as a whole. Here the changes in interaction strength between the spider *Pardosasumatrana* (Thorell 1890) and its prey was observed under altered water availability conditions. Experimental setup in the field consisted of four pairs of water supplemented and drought plots. Independent sample t-test was conducted to compare the interaction strength in two conditions. The interaction strength was found to be strong in both water supplemented and drought plots. This may be due to the anomalous increase in temperature that occurred during the experiment.

Keywords: Climate change, Grasshopper, Interaction strength, Spider, Water scarcity

09-35

SCREENING OF ANTIBACTERIAL PROPERTIES OF PURIFIED TERPENOIDS FROM KAPPAPHYCUS ALVAREZII, HYPNEA MUSCIFORMIS AND GRACILARIA DURAAND ITS MODE OF ACTION

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Background: Sea weeds are used as curative from time immemorial. This work aims to screen the antibacterial properties of purified terpenoids from the red alga *Kappaphycusalvarezii, Hypneamusciformis*and *Gracilariadura* and its mechanism of action.

Methods: Fractionation of the crude methanolic algal extract was done by silica gel Column chromatography. The eluted fractions were subjected to TLC and further fractionated by GC-MS. Disc diffusion assay has been used todetermine the antibacterial activities followed by minimum inhibitory concentrations (MIC) and minimum bactericidal concentration (MBC) assay against Gram-positive bacteria (*Staphylococcus aureus*), Gram-negative bacteria (*Escherichia coli* and *Pseudomonas aeruginosa*). Finally,the effects of terpenoid extracts on cytoplasmic pHint, membrane potential, protein leakage and scanning electron microscopic analysis of cell surface of selected strains were evaluated.

Results: The purified terpenoid fractions revealed a pool of terpenoids from the algae. Remarkable bactericidal activities were displayed by terpenoids of *H.musciformis*and *G.dura*against *Staphylococcus aureus* and *Pseudomonas aeruginosa*($P< 0.05$), while less inhibitory effect on *E. coli*. The inhibition zones ranged from 15 to0.12 mm. *P.aeruginosa*appears to be the most sensitive strainwith remarkable MIC, MBC and MIC index values. To validatethe knowledge of bactericidal mechanism of terpenoids, the changes in internal pH(pHint), and membrane potential were measured in *S. aureus* and*P.aeruginosa*cells after exposure to terpenoid extracts. The results indicatedthat the terpenoidextracts significantly affected the cell membrane of Gram-positive andGram-negative bacteria, as demonstrated by the decline in pHintand cellmembrane hyperpolarization. Similarly the protein leakage assay and electron microscopic visuals further substantiated the membrane damages accounted in the cells.

Conclusion: Terpenoid extracts are of immense value as natural bactericidal and can use safely as curative.

Keywords: Terpenoids, bactericidal properties, internal pH (pHint), membranepotential, protein leakage

09-36

FUNCTIONAL CHARACTERIZATION OF A PUTATIVE ACETYLTRANSFERASE FROM MYCOBACTERIUM TUBERCULOSIS, AND ELUCIDATION OF ITS ROLE IN INACTIVATING ISONIAZID

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Background: The KatG enzyme of *Mycobacterium tuberculosis* (MTB) activates the first-line anti-TB drug isoniazid(INH) and the activated drug inhibits InhA protein leading to the prevention of cell wall biosynthesis. INH resistant MTB strains are reported to have mutations in *katG*, *inhA*, *ahpC*, *kasA*, and *ndh* genes. Interestingly, INH resistant strains without any mutations in these genes are also identified suggesting that these strains acquire INH resistance by some other mechanism.In this study we characterized Rv2170, a putative acetyltransferasefrom MTB, and showed its role in inactivating isoniazid.

Method: Acetylation efficacy was determined by fluorometric assay and confirmed by LC-MS and HPLC analyses. Drug susceptibility was checked by resazurinmicrotiter assay and confocal analysis. The colony-forming units were counted to determine the survival of bacteria in macrophages.

Results: Rv2170 mediates transfer of acetyl group to INH molecule in the presence of acetyl CoA *in vitro*. LC-MS and HPLC analyses showed that after acetylation INH gets converted into isonicotinic acid and acetylhydrazine. *M. smegmatis* and *M. tuberculosis* H37Ra overexpressing *Rv2170*resist INH toxicity. Recombinant *M. tuberculosis* H37Ra survive better in macrophages treated with INH.

Conclusion: The results from our study indicate that INH acetylation by Rv2170 could be one of the strategies used by at least some of the INH resistant MTB strains.

Key words:*Mycobacterium tuberculosis*, isoniazid resistance, drug acetylation, acetyltransferase

09-37

ENDEMIC AND RET ANGIOSPERMS IN SKY ISLANDS ACROSS PALGHAT GAP

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Background: Sky islands is a multifactor interpretation and its concept was formulated from several parameters. It is a biodiversity-rich core zone known for its great endemic status, speciation and species richness, genotypic variation, unique habitat and climatic variations. The elevation is a major parameter that isolates these islands like an oceanic island and thereby makes it a unique habitat with unique climate, which prevents migration from non- Sky island habitats. These attributes make it an inevitable part in harbouring Biodiversity.

Materials: This work enumerates the diversity, endemism and RET status of plants in Sky Islands across Palghat Gap, Western Ghats. The area under this investigation was the high-altitude range with a minimum of 3280 ft above MSL. Sky islands can never be defined by a single factor, although altitudes an inevitable and relevant parameter. Based on the mountain range the altitude varies for each unique habitats of Sky islands. The current study area includes Nelliyampathy and Kollengode range of Nelliyampathi division, Agali range of Mannarkkad division.

Results: Out of 137 angiosperms documented in the current study, 49 were found to be endemic. In the endemic taxa, 23 were found to be endemic to Southern Western Ghats, 17 to the Western Ghats, 4 endemic to Peninsular India, 1 to Southern Western Ghats Kerala, 2 to South India and 1 to Central and Peninsular India. Comparing the Sky islands on the southern and northern side of Palghat gap, 17 species were found to be common on both sides, 43 were restricted to Sky islands on the northern side of Palghat Gap and 77 towards southern Sky islands. According to IUCN red list 2019, 109 species out of 137 were under the Not Evaluated

category. Only 16% of their conservation status were available, of which 5 were under endangered category and 2 were vulnerable.

Conclusion: This work lead to enumeration of the endemic status of the selected Sky islands across Palghat Gap. Each Sky islands are unique habitats with high endemic and RET taxa. In the present study, 5 of the collected ones were under endangered category. Accordance to IUCN Red list 2019, the conservation status of the species collected were data deficient i.e. about 78% data not found. The data deficiency in Conservation and endemic and RET status makes these habits unique and an inevitable part in biodiversity conservation.

Keywords: Sky islands, Endemism, RET, Palghat Gap, Speciation.

09-38

IN VITRO CULTURE OF BRACHYTHECIUMBUCHANANII(HOOK.) A. JAEGER AND THUIDIUMTAMARISCELLUM(C.MUELL.) BOSCH. &SANDE-LAC, ISOLATION OF TERPENOIDS AND STUDY OF ITS ANTIMICROBIAL POTENTIALITY

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Background: Bryophytes are primitive non vascular plants containing pool of secondary metabolites. However, little is known regarding the therapeutic effects of terpenoids from bryophytes on microbicidal activities.

Methods: An attempt was made to establish the *in vitro* culture of the moss species*Brachytheciumbuchananii* and *Thuidiumtamariscellum*. The antimicrobial activities of the purified terpenoid extracts from the *in vitro* cultured moss species were studied in terms of disc diffusion assay, bacterial membrane permeability, nucleic acid and protein leakage and inhibition of fungal spore assay.

Results: This study successfully established the *in vitro* culture of the moss species *Brachytheciumbuchananii* and *Thuidiumtamariscellum*from the shoot tip and capsules on half strength MS medium supplemented with 3 % sucrose. The terpenoid extracts obtained from *in vitro* cultured mosses displayed an optimal microbicidal activity against *S. aureus*and *E. coli.* The mode of action may be membrane break through the permeability of cell membrane and then led to the leakage of electrolytes, proteins and DNA.

Conclusions: Thus, the overall results confirmed that the terpenoid extracts obtained from the moss species possess potent antimicrobial potentiality.

Keywords:*Brachytheciumbuchananii,Thuidiumtamariscellum,* Moss, MS medium, terpenoid extracts, microbicidal

09-39

NOVEL REPORT OF Hb D PUNJAB FROM AN ETHNIC SOUTH INDIAN COMMUNITY

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Background: Badagas, an indigenous community inhabits in the high altitude of Nilgiris, Tamil Nadu, India is an anthropologically significant population. Sickle cell disease is the only haemoglobin disorder previously reported from this community, though it is having diverse forms of haemoglobinopathies. Molecular analysis conducted to clarify the accidental observation of unknown peaks in the microcapillaryelectrophorogram identified a rare and un common haemoglobin variant, Hb D (Hb D) Punjab) from this population.

Method: Routine survey was undertaken to screen the sickle cell disease and the foetalhaemoglobin level in Badaga community. Some cases found to be positive to Haemoglobinopathies, but not having sickle anaemia cell or thalassemia. Hence, the various cell indices were analysed using an automated cell counter in suspected haemoglobinopathic cases. These blood samples were analysed using micro capillary electrophoresis for the confirmation of various haemoglobin variants including unknown fractions. RFLP analysis was also conducted using *Eco*RI in these cases and sequencing was done for conformation.
Results: Hb D Punjab is observed to co-exist with sickle cell traits belongs to Badaga community from the Nilgiris in a double heterozygous form. Studies using microcapillary electrophoresis also revealed the existence of Hb D in the total haemoglobin fraction. The genomic sequence data shows that the initial G in codon 121 is substituted by C altering the *Eco*RI splicing site. All these evidences confirm the existence of Hb D Punjab from the Nilgiris.
Conclusion: Hb D Punjab (Hb D Los Angeles) is existing in a native south Indian population, Badagas. It may reduce the disease severity of SCD along with the elevated foetalhaemoglobin in this phenotype.
Keywords: Hb D Punjab,Sickle cell anaemia, Foetalhaemoglobin, Badagas

10-MATHEMATICAL & STATISTICAL SCIENCES

10-01

IDENTIFICATION AND RANKING OF DIFFERENTIALLY EXPRESSED GENES IN MICROARRAY STUDIES

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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 present paper we propose empirical Bayes (Efron et al. (2002), Smyth (2004)) modified generalized p-value technique by for identifying differentially expressed genes. For ranking the differentially expressed genes we developed empirical Bayes approach using mixed Laplace distribution and illustrate the proposed methods with real microarray datasets.
Materials & Methods
Modified generalized p-value
For general setup of the concepts of generalized confidence intervals and generalized p-values see Weerahandi(1993). Let $\widehat{\mu_{0i}}$ and $\widehat{\sigma^2_{0i}}$ be the observed values of $\hat{\mu}_i$and $\hat{\sigma}_i$respectively. Then the generalize pivotal variable for μ_i is given by

$$T_{\mu_{gi}} = \widehat{\mu_{0i}} - \frac{2n(\bar{\mu}_i - \mu_i)}{2n\sigma_i}\frac{\sigma}{\widehat{\sigma_i}}\widehat{\sigma_{gi}} \quad (3)$$

Where $\widehat{\sigma_{gi}}^2 = \frac{n_{0i}{}^2\sigma_{0i}{}^2 + d_{gi}{}^2\sigma_{gi}{}^2}{n_{0i}+n_i}, i = 1, 2.$
Then the generalized pivotal variable for the difference of means of two exponential distributions is $T_{\mu_g}{}^* = T_{\mu_{g1}} - T_{\mu_{g2}}$.

Hence the empirical Bayes modified generalized p-value for the two sided test can be obtained as: $2\,min\left\{p\left(T_{\mu_g}{}^* \le 0\right), p\left(T_{\mu_g}{}^* \ge 0\right)\right\}$.

Results and conclusions: In this study the concept of modified generalized p–value method has been applied for the selection of differentially expressed gene and Bayesian methods using the mixed Laplace, is helpful in finding and ranking the differentially expressed genes. This will help better drug discovery or disease diagnosis.

We identified 100 differentially expressed genes from breast cancer microarray data and top 10 ranked genes were identified using empirical Bayes approach using mixed Laplace distribution.

Keywords: Empirical Bayes method, Generalized p value, modified generalized p value, microarray

10-02

TIME SERIES AND FFT ANALYSIS OF MITRAL REGURGITATION

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Background: The application of mathematics is gaining momentum in a number of important fields in physical, chemical, biological, social, and life sciences. Mathematics is a powerful tool that can unveil the hidden complexities in nature. The most important application of the mathematical tools in the medical filed lies in the non-invasive diagnosis of diseases.From the health statistical datait is evident that the death due to cardiac problems is increasing day by day with Kerala ranked first. This points to the need and necessity of a cost-effective technique which can be practiced even in a primary health centre or at home. With this intention we propose a simple cost-effective method for the preliminarydiagnosis of valve related cardiac problems, taking mitral regurgitation as an example, from the recorded sound signal of heart murmur.

Method: Fast Fourier Transform (FFT), wavelet, and non-linear time series analyses are powerful mathematical tools that can analyse a time varying signal more accurately from the spectrum. In the present study, the recorded murmur sound of healthy and defective (with MR) heart are subjected to analyses. The multi-dimensional phase space representation of the normal and MR murmur is do ne by finding the time delay coordinates and embedding dimension. Themulti-fractal analysis of the phase portrait is also employed in distinguishing healthy and defective heart.

Result: (i)The FFT analysis of normal heart shows two frequencies corresponding to lub and dub sounds whereas the heart murmur with MR shows multiple frequency components. The frequency spread can be taken as a preliminary signature of MR. (ii) The wavelet analysis gives information about the duration of persistence of a particular frequency component throwing light into the severity of defective nature of the valve.(iii) The xn-xn+1 plot for the normal and defective heart shows clear distinction. When this plot for the normal heart is a straight line that for the defective one is scattered.(iv) The fractal analysis of thex_n-x_{n+1} plot gives a 1.64 for the box counting dimension, 1.55 for the information dimension and 1.56 for the correlation dimension, suggesting the higher degree of complexity compared to the non-fractal nature for the normal heart. Thus the deviation from the non-fractal to fractal suggests the origin of defect in the heart. (v) Thephase portrait constructed using the time delay coordinates and embedding dimension reveals the dissipative nature of lub and dub sounds pointing its potential in defect identification.

Conclusion: The study reveals that the analysis of heart murmurs using these mathematical tools can give vitalinformation regarding the defect in the heart. The analysis of MR heart murmur through FFT, wavelet, and time seriesoffers a sensitive, inexpensive, and non-invasive technique for earlier identification of cardiac disorder even at primary health centres.

Keywords: Heart murmur, Mitral Regurgitation, Time series, FFT

10-03

ANOMALOUS WEATHER PREDICTION IN KERALA USING MACHINE LEARNING TECHNIQUES

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Background: Kerala being is one of the best places for livelihood, agriculture and marine activities. Agriculture and Fisheries serve as an important source of occupation for the state. But the drastic climatic changes effectedin Kerala with destructions of lives and agricultural activities. Therefore, there is a requirement of highly accurate computational models to predict anomalous weather conditions and provide warnings beforehand for weather conditions deviating from normal ranges.
Method: Our work focus to construct a weather prediction model for Kerala, using machine learning techniques including Multiple Linear Regression and Artificial Neural Network over the weather data procured from the central region of Kerala. The prediction can aid to inform the deviations of weather parameters from normal conditions that be frightful. For this study we utilize five weather parameters, Humidity, Pressure, Wind Speed, Wind Direction and Temperature.
Results: The experiments are evaluated using the error metrics of Mean Absolute Error and Root Mean Square Error. We obtain an average Mean Absolute Error of 0.1143 and 0.1446 and average Root Mean Square Error of 0.0149 and 0.0189 for Multiple Linear Regression and Artificial Neural Network respectively. The error values indicate that among the two learning models Multiple Linear Regression performs better than Artificial Neural Network.
Conclusions: Our machine learning model for weather prediction can be very well utilised for predicting anomalous weather conditions and even to help plan the agricultural and fisheries activities that depends on different weather patterns. The results illustrate scope for further improvements in prediction accuracy by using hybrid approaches, and the recent Deep Neural Network (DNN) with huge weather data.
Keywords: Anomalous Weather prediction; Machine learning, Multiple Linear Prediction, Artificial Neural Networks

11- PHYSICAL SCIENCES

11-01

INTERFACE ENGINEERED $CAFE_2O_4$-PVDF-HFP FLEXIBLE NANOFIBERS - A PROMISING CANDIDATE FOR THE DEVELOPMENT OF PIEZOELECTRIC/MAGNETOELECTRIC IMPLANTABLE ENERGY GENERATOR

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Abstract: Smart piezoelectric/ magnetoelectric composites systems are gained considerable attention among the scientific community because of its exciting multifunctional properties. In line with this, we have

developed novel Calcium Ferrite- Polyvinyledene Fluoride-HexaFluoroPropylene(CFO-PVDF-HFP) flexible nanofibers were prepared by electrospinning method. Prepared nanofibers possess excellent piezoelectric (~ 10V) and magnetoelectric response at room temperature (44.2mV/cm. Oe). A part from these, CFO-PVDF-HFP composite system possess better biocompatibility, so that the present composite systems with excellent magnetoelectric and piezoelectric properties can be used for the fabrication of implantable energy generators

Keywords-Piezoelectrics, Magnetoelectrics, Biocompatible, Nanoenergy generator

11-02

OIL RECOVERY FROM WATER USING MAGNETIC GRAPHENE NANOSCROLLS

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Background: The oil pollution has emerged as a widespread and extensive concern as it causes severe damages to marine and aquatic ecosystems. The technological use of nanoparticles has emerged as a novel solution for removing oil from spills and oil Graphene oxide can be hybridised with magnetic nanoparticles which improves both adsorption capacity as well as recovery.

Method: In this study we have prepared iron oxide decorated graphenenanoscrolls and graphenenano sheets via hydrothermal method. Both scrolls and sheets were then subjected to oil adsorption studies.

Results: The graphenenanoscrolls showed 96% diesel oil removal

Conclusion: Diesel adsorption studies were done with iron oxide decorated graphenenanoscrolls and graphenenanosheets. Although this method requires more scale up of the sample for large scale use, for small scale oil spills, this method can be employed.

Keywords: Graphenenanoscrolls, hydrothermal, magnetite, adsorption

11-03

DESIGN AND FABRICATION OF MICRO-TRANSFORMER BASED ON FERROFLUIDS

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Background: The microminiaturization techniques such as CMOS and MEMS/NEMS fabrication technology paved the way of on-chip transformers on a silicon wafer. Therefore realization of micro-transformers on a chip which can be fully integrated with other electronic circuits such as, DC/DC converters, signal isolators, radio frequency micro electromechanical systems (RF MEMS), biosensors and mobile power delivery applications are crucial. Also miniaturization of switched mode power supplies (SMPS) has become the main focus for developing future generation power supplies, which uses micro transformers, also known as power supply in package (PSiP) and power supply on chip (PwrSoC). This investigation is an attempt to fabricate on-chip ferrofluid core transformers without using conventional electroplating and wire bonding used for the construction of coils in micro transformers.

Method: micro-transformers are designed and fabricated using ultraviolet lithography. The transformer design adopted consists of two overlapped coils on top of each other around a hollow core chamber. In the middle of the internal coil, there is a thin hollow chamber core of thickness 0.5µm sandwiched between two insulation layers for encapsulating ferrofluids.

Results: The transformer performance with an aqueous ferrofluid, synthesized in the lab, is evaluated and

compared with that of a transformer with an air core. The inductance and quality factor measurement is done in the low frequency regime using a precision impedance analyzer. The details involving the fabrication steps along with initial results will be presented here.

Conclusions: Micro-transformers with stacked double coil structure on highly resistive silicon wafer with inbuilt hollow channel have been fabricated. The advantage of such an on-chip transformer is that the composition of ferrofluid can be tailored to suit the application requirement and easily injected into the core.

Keywords: Lithography, Micro-transformer, On-chip transformer, Ferrofluid.

11-04

CIR – STAR FORMATION CONNECTION IN EARLY TYPE GALAXIES

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Background: Photometric and spectroscopic observations reveal that, early type galaxies obey some tight scaling relations. Recent observations of these galaxies give the idea that, many contain small stellar discs at their centres with ongoing star formation. The central intensity ratio (CIR :Aswathy and Ravikumar 2018) of these galaxies possess a strong correlation with the mass of the super massive black hole present in the host galaxy.

Method: A sample of 26 early type galaxies within 30 Mpc distance is constructed using catalogue from Swartz et al. (2004, 2011). Optical images taken using Hubble space telescope are used for the analysis. The CIR for the sample galaxies is calculated using SExtractor (Bertin&Arnouts 1996).

Results: CIR is found to be strongly correlated with the central Mg_2 index adopted from HyperLEDA with a linear correlation coefficient -0.82, significance > 99.99 %. Also CIR shows good negative correlation with absolute B band magnitude of the host galaxy taken from HyperLEDA with linear correlation coefficient r = -0.76, significance = 99.99 %. Low CIR galaxies possess high metallicity at their centres and they are luminous in B band. The results hint at the presence of young, metal rich stellar population at the centres of these galaxies.

Conclusions: CIR is found to be correlated with the host galaxy properties.CIR, a simple photometric tool can provide vital information in the study of formation and evolution of galaxies.

Keywords: Galaxies, photometry, metallicity

11-05

INVESTIGATION OF THERMOPHORESIS INDUCED STOCHASTICITY IN THERMAL LENS SIGNAL

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Background: Thermal lens spectroscopy is a nondestructive technique to study the thermal and optical properties of materials. The formation of the thermal lens signal is due to the refractive index gradient developed by the heat deposited as a result of nonradiativedeexcitation and thermophoresis. The thermal lens signal contains information about the particle dynamics of the system under the investigation. Time series analysis is a powerful technique to study the underlying dynamics from the time series data like the thermal lens signal.

Method: Single beam thermal lens technique is used to obtain the thermal lens signal of the magnetite (Fe_3O_4) ferrofluid prepared by solution combustion method. An equation is developed to measure and simulate the refractive index gradient within the sample. The time series analysis is done by dividing the thermal lens signal into three regions. The self-affinity and degree of complexity of the thermal lens signal are studied by

finding the fractal dimension and sample entropy. The nature of the randomness of the signal is investigated by estimating the Hurst exponent. The complexity of the time series can be visualized by drawing the phase portrait.

Results: The refractive index gradient is simulated for the three regions by using the parameters obtained from the thermal lens signal. The refractive index gradient increases with region and time due to the rise in temperature caused by the heat deposit inside the sample. The fractal dimension and sample entropy for both the signals are increasing from region 1 to region 3 due to the increase in randomness of particle motion. The value of Hurst exponent is less than 0.5 for all regions, which shows the antipersistent and stochastic character of the signal. The phase portrait becomes more complex and random along the region.

Conclusions: The time series analysis by estimating the fractal dimension, Hurst exponent, sample entropy and phase portrait of the thermal lens signal reveals that the particle dynamics become more and more complex and random along with the signal. This increase is due to an increase in heat deposits in the system with time causing a change in temperature, density, and refractive index. The refractive index gradient simulated also increases with time along with the thermal lens signal which reveals the increase in heat deposit. Thus the time series analysis is a powerful tool for studying the particle dynamics from the thermal lens signal.

Keywords: Thermal lens technique, fractal dimension, Hurst exponent, sample entropy, phase portrait

11-06

SIDE CHAIN DEPENDENCE ON THERMOELECTRIC PROPERTIES OF THIENOTHIOPHENE BASED CONJUGATED POLYMERS

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Background: Electronic thermoelectric (TE) materials based on organic conjugated polymers have attracted considerable interest due to their advantages of easy processing, lower weight, cost-effectiveness, high flexibility along with their inherently low thermal conductivity.Conjugated polymers based on thienothiophene units have been intensively studied as photovoltaic materials, due to their good planarity of the conjugated backbone and high carrier mobility. However, thermoelectric properties have rarely been explored.

Method: This work explores the effect of side-chain on the TE properties of one-dimensional (1-D) and two-dimensional (2-D) thienothiophene based conjugated polymers nanocomposite with multi-walled carbon nanotubes (MWCNT). A nanocomposite of polymers was prepared by mixing the polymers with MWCNT, followed by doping with ferric chloride solution and TE properties were studied.

Results: The electrical conductivity and Seebeck coefficient of doped 2-D polymer nanocomposite films (192.28 Scm^{-1} and 43.54 μV/K) is significantly larger than that of doped 1-D polymer nanocomposite films (31.25 Scm^{-1} and 26.12 μV/K) at around 35 wt% of MWCNT loading. This could be attributed to the strong interchain interactions that facilitate the transport of charge carriers and improve the TE properties of conjugated polymers.

Conclusions: This study confirm the unique electronic and thermoelectric properties of thienothiophene based two- dimensional conjugated polymer nanocomposite with MWCNT and has opened a large potential to broaden the research scope of composite TE materials.

Keywords: thermoelectric, conjugated polymer, carbon nanotubes, composite film, doping

11-07

PREPARATION OF HIGHLY RETAINABLE SELF CLEANING MICROSPHERE COATINGS OF POLYMER INCORPORATED TIO_2-ZRO_2 COMPOSITES WITH ANTIBACTERIAL PROPERTIES BY ELECTROSPRAYING TECHNIQUE

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Background: Advances in scalable methods for the preparation of durable self-cleaning surfaces bare considerable commercial impact. The motivating strength in development of such coating technologies is the incessant demand for better performance, increasing product lifetimes and as a result significant fall in maintenance cost. New microspheres synthesized from organically modified inorganic composites offer various advantages such as low effective density, large internal volume and high specific surface area. Previous works on the formation of microspheres are mainly based on polymers whereas, only limited reports on inorganic microspheres are available. Electrospinning, a technique that is mainly used for the fabrication of polymer nanofibers may sometimes produce peculiar structures such as spheres, necklace, ribbon-like and branched jet particles, etc. However, so far, this is the first report on the fabrication of inorganic microspheres via electrospraying. Microsphere surfaces engineered with self cleaning property captured wide attention in scientific as well as industrial arenas recently.

Method: Herein, we developed self cleaning microsphere coatings with prolonged lifetime using sol-gel assisted electro spraying approach which can deposits on a vast area at very low cost.

Results: TiO_2-ZrO_2-Poly (methyl methacrylate)-Pluronic composite microspheres so deposited are found to be homogeneous and porous with an average diameter of 25 μm. Modulating surfaces by addition of tri-block co-polymer provides swapping of superhydrophobic nature to superhydrophilic nature. The photocatalytic degradation of Rhodamine dye has been also observed to the highest in these microspheres compared to that in pure TiO_2-ZrO_2-Poly (methyl methacrylate) and TiO_2-ZrO_2-Pluronic microspheres prepared by the same technique.

Conclusion: The prepared superhydrophobic as well as superhydrophilic self cleaning surfaces integrated with photocatalytic and antibacterial property enable the quick cleaning of dirt even bonded chemically enables it as a promising one for practical applications.

Keywords: Self-Cleaning Materials, Sol-gel materials, Electrospraying, Microspheres, Antibacterial activity, Photodegradation

11-08

EFFECT OF SINTERING AID ON BROADBAND ELECTROMAGNETIC PROPERTIES OF $MGFE_{1.98}O_4$

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Background: Materials having both magnetic and dielectric properties are called as magneto-dielectric materials. Such materials are not readily available in nature. $MgFe_{1.98}O_4$ is one such material which can play an inevitable role in reducing the size of the antenna, advanced internal diagnostic techniques, EMI shielding applications, etc. So the synthesis and methods to improve its properties are important. In that sense, here the effect of usage of sintering aids on pure $MgFe_{1.98}O_4$ was investigated

Method: In this work the method adopted for synthesis of $MgFe_{1.98}O_4$ was solid state reaction route. The effect of various sintering aids such as B_2O_3, Sb_2O_3, LiF and TeO_2 on densification was investigated. The broadband electromagnetic studies of the samples, showing better densification at a lower sintering temperature has been

carried out

Results: Among the various sintering aids used, the sintering action of B_2O_3 on $MgFe_{1.98}O_4$ was effective. From the broadband electromagnetic studies it's found that the permittivity and permeability values of $MgFe_{1.98}O_4$ sintered using B_2O_3 have improved from that of pure $MgFe_{1.98}O_4$. But the losses in the sintered $MgFe_{1.98}O_4$ were higher than that of pure $MgFe_{1.98}O_4$.

Conclusions: Through this work the sintering action of B_2O_3 on $MgFe_{1.98}O_4$ was investigated and found that B_2O_3 is one of the best sintering aids in improving the properties of $MgFe_{1.98}O_4$.

Keywords: Broadband electromagnetic properties, Magnesium ferrite, Densification

11-09

STUDIES ON BINARY AND MULTICLUSTER FISSION

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Background: Pioneering studies on nuclear fission has played a key role in understanding the nuclear phenomena and related properties. The low energy fission of heavy elements (Z > 90) was one of the most complex phenomena of nuclear reactions. Most of the nuclear reactions take place through the binary fission process, a low energy fission, where the fissioning nucleus ends up in two fission fragments and the fragments were formed after overcoming the fission barrier. Usually fission of actinide nuclei proceeds by decay into two fragments of comparable size. There is a possibility for two light charged particles formed along with the two main fission fragments, can be termed as a quaternary fission. The theoretical studies on the basis of quaternary fission has been found to be noteworthy, as this type of decay process takes place with probabilities of 10^{-7} per binary fission.

Method: The Coulomb and proximity potential is taken as the interacting barrier to study the binary fission of even-even $^{244-258}$Cf isotopes, even-even $^{238-248}$Pu isotopes, even-even $^{230-250}$U isotopes and quaternary fission of $^{244-254}$Cf isotopes.

Results: We identified the probable fragments for the binary and quaternary fission through the cold reaction valley plots. The barrier penetrability for each fragment combinations found in the cold valley are calculated using Coulomb and proximity potential. The most favorable fragment combinations are obtained by calculating their relative yields.

Conclusions: The double magicity and near double magicity of the predicted heavy fragment (of ^{206,208}Pb, ^{206}Hg, ^{204}Pt, ^{200,202}Os and ^{130,132}Sn) are found to play a key role for the most favorable fragment combinations.

Keywords: Cold binary fission, Spontaneous fission, Quaternary fission.

11-10

AEROSOL OPTICAL DEPTH AND AEROSOL FORCING OVER MAJOR CITIES IN KERALA

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Background: The aerosol particles have strong influence on the climate system by reflecting, Absorbing and scattering radiation. Aerosol optical depth (AOD)is a measure of the extinction of the solar beam by aerosols. In this study, we show the trend of AOD using TOMS data over major cities in Kerala and also the characteristics of aerosol optical depth in recent years (2000–2004) using MODIS data over Kerala and its annual variability.

Method: The aerosol concentration retrieved in terms of aerosol index (AI) from TOMS (Total Ozon Mapping Spectrometer) and MODIS (Moderate Resolution Imaging Spectro Radiometer) data are analysed over various cities in Kerala. The present study is based on 46months of AOD data from MODIS from March, 2000 to

December, 2003 which are downloaded from EOS (Earth Observing System) Gateway.

Results: Variation of AI over some of industrial and populated cities in the northern and Southern part of Kerala for 12 years from 1982 to 1993 shows that all these cities show substantial increasing trend in AI compared to cities located in the northern part of Kerala. Seasonal variations show that the AOD is found to increase from the month of March with maxima peak in the month of June over the main land India and it is the highest during the summer season.

Conclusions: The results clearly show that the aerosol loading over the major cities in Kerala has increased significantly in the recent years. Due to increasing population, urbanization and Industrialization, the AOD over the southern part of Kerala is higher compared to northern part of Kerala.

Keywords: Aerosol index, TOMS, MODIS

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11-11

TUNING THE MORPHOLOGY OF BORON CARBIDE THROUGH EXFOLIATION

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Background: Morphological tuning of materials has a significant interest due to its applications in the field of optical, electrical, medical, and catalysis. The production of particles as individual units with the same function and form has a leading attention owing to its properties like high surface area, narrow size distribution, porosity, and shell thickness. The enhancement of surface area dependent properties of the third hardest material, boron carbide, by tailoring the morphology has a great influence in supercapacitor and neutron absorber applications. Of different techniques for morphological modifications, liquid-phase exfoliation is a simple, cost-effective method for separating laminar structures and turning them into beautiful structures.

Method: The work describes low-temperature, green synthesis of multi-layered boron carbide spheres by the refluxion of boric acid with castor oil at a constant temperature. On cooling, the transparent product obtained is changed into a white solid which is then heat-treated to 300 °C and subjected to structural and morphological characterizations. The microstructural modifications of the sample are done by ultrasonication in the ethanol-water mixture by considering two factors: sample concentration and the auxiliary agent. The morphological modifications of the samples are analyzed using field emission scanning electron microscope.

Results: The ultrasonication of the multilayered hollow microspheres of boron carbide synthesized separates the layers which depend on the concentration of the sample and the auxiliary agent, NaOH. The exfoliation seems to be more effective for lower sample concentration than for higher concentration. The addition of NaOH as auxiliary agent enhances the dispersion ability of the material and results a flower-like morphology. The evolution of flower-like morphology is found to be from a spindle structure and can be seen in the FESEM image.

Conclusions: The application dependent morphology demands the development of different morphologies of the same material. In this work, industrially significant boron carbide, synthesized at low-temperatures by refluxion method, is carved into brilliant morphologies by sonication in an alkali medium. The present study suggests the possible way of varying the surface area for potential applications in supercapacitors and neutron absorbers.

Keywords: Liquid-phase exfoliation, boron carbide, morphological tuning, sodium hydroxide

11-12

NEGATIVE X-RAY SPECTRAL CURVATURE OF PKS 2155-304: A PROBE TO ESTIMATE THE SUB-DOMINANT INVERSE COMPTON SPECTRUM

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Background: Blazars are one class of Active Galactic Nuclie (AGN) for which the relativistic jet of matter is aligned close to the line of sight. The broad band spectral energy distributions of blazars show a double peaked structure due to synchrotron emission and Inverse Compton (IC) scattering of low energy photons respectively. High sensitivity X-ray telescopes observations revealed X-ray spectra of blazars have curvature in the logarithmic scale. This curved X-ray spectrum is well explained by a log parabola function with two primary parameters, one describing the spectral slope and the other the curvature. Usually the curvature parameter is found to be positive suggesting the underlying electron distribution to be curved. Interestingly, one of the well studied blazers source PKS 2155-304 shows a mild negative curvature. Such negative curvature demands the underlying electron distribution to be negative which cannot be achieved through Fermi acceleration process. Hence it demands further investigations in detail.
Method: In this study, we study three observations of PKS 2155-304 during which a mild negative curvature is witnessed in the X-ray spectrum. We interpret this as a result of sub-dominant IC emission beneath the synchrotron spectrum. To confirm this, we fitted the 0.6-10.0 keV spectrum of this source with a double power-law which can imitate the dominant synchrotron and sub-dominant IC emission precesses.
Results: Our fit results suggest the double power-law model for 0.6-10.0 keV spectrum for 3 observations with negative curvature are fitted well with a double power-law model and the fit results are comparable with that of a log-parabola function. This suggests that the observed negative curvature can be interpreted well as a combination of synchrotron and IC emission. Correlation between the curvature and other fitting parameter reconfirms that the negative curvature can be obtained by the combination of Synchrotron and IC component in the dominant Synchrotron region.
Conclusions: This work establishes the negative curvature in the X-ray spectrum of PKS 2155-304 as an indication of IC component presence in the low energy Synchrotron region.
Keywords: relativistic processes, acceleration of particles, active BL Lacertae objects, PKS 2155−304, X-rays.

11-13

STUDY OF CONFINED QUANTUM SYSTEMS USING VIRIAL EXPANSION

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Background: In this paper we introduce the virial expansion using elementary mathematical methods. The study is done using the basic formalism of the quantum mechanics and thermodynamics including the equation of state of the ideal gas.
Methods: In this paper, we have investigated the analytical structure of the virial expansion and equation of state of ideal quantum gases.
Results: The virial coefficients of confined potential in the equation of states of quantum gases are used and the pressure is calculated. In case of bosons pressure is found to be less and for fermions greater than ideal gas.

Conclusions: The nature of equation of state is found for quantum gases. Bosons show condensation and fermions exert more pressure compared to ideal gas.
Keywords: Virialexpansion, Quantum systems and Equation of state.

11-14

REMOVAL OF PLACTICIZER FROM WATER BY POLYMER BASED NANOCOMPOSITES.

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Phthalic acid esters have been known as potent endocrine disruptors and carcinogens; and their removal from water have been of considerable importance in the present scenario. In the present study, Polypyrrole zinc oxide polymer nanocomposites are synthesized by oxidative polymerization method. Characterization of the prepared samples is carried using X-Ray diffraction technique, scanning electron microscopy and UV-Vis analysis. The adsorption efficiency on the removal of DMP from the aqueous solution is investigated from the batch sorption studies. Thus the removal of DMP from the aqueous solution by suitable polymer based adsorbate which should be cost effective, less toxic. By considering these we have prepared Polypyrrole-ZnO based polymer nanocomposites as adsorbate surface. The results show that the DMP phthalate has greater affinity to the PPZ. Within 10 minutes 91.84% of the phthalate is adsorbed on the adsorbent surface. The removal efficiency was found to be 99.15%. The adsorption process was attributed to multiple adsorbent adsorbate interaction such as H bonding and pore filling.
Key words: Adsorption, Phthalate, Removal

11-15

SATURATION DENSITY OF IMPERFECT BOSONSUSING CLUSTER EXPANSION

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Background: Bose Einstein condensation in atomic vapor provides a very successful method to understand the behavior of atoms with integral spin in very low temperatures. The quantum statistical study of this for ideal bosons is based on the distribution function of bosons. In this paper we use the Mayer's cluster expansion in new form to find the saturation density of the Bose Einstein condensate of Rubidium atomic vapor and compared with the experiment.
Method: In this paper we make use of the virial coefficients for the Bose gas interacting through a hard sphere potential is found by the use of pseudo potential method. In Mayer's theory and in its modified approach to apply for high densities, the saturation density for condensation can be found from

$$\sum_{k=1}^{\infty} k\,\beta_k(\rho_0\lambda^3)^k = 1$$

where the irreducible cluster integrals β_k can be found from the virial coefficients ρ_0 is the saturation density. Then using the values of the virialcoefficients,the saturation density for the condensation of Rb-87 is calculated. The value is compared with the experimentally observed saturation density value.
Conclusions: The saturation density of hard sphere Bose gas Rubidium-87 is found by using the new form of cluster expansion. The density at the condensation point found out using this method shows a close match with the experimental observation.
Keywords: Equation of state, Cluster expansion, Bose Einstein condensation.

11-16

WATER SECURITY AND ECOSYSTEM CONTROL MEASURES IN THE ERA OF CLIMATE CHANGE

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Background: Apart from the main proviso that temperature riseiscontained; achievement of most of the sustainable development goals (SDGs) rests directly or indirectly on the availability of fresh water. The impact of human activities on fresh water availability has so far been detrimental, even as requirements have been continually and exponentially increasing.
Method: We explore the mitigating effects of activities like the recent attempts at rainwater harvesting, and balance them against the rise in demands, reduction in availability and a few of the expected changes to the status quo with respect to the water cycle due to global warming and climate change. Projected impact, of the various deciding factors, over the next quarter of a century is made by identifying trends.
Results: From the projections it is seen that adoption of some more measures that act towards increasing storage as well as controlling the withdrawal of groundwater has potential long term benefits for the ecosystem and the water security of Kerala. Various factors that have the potential to bootstrap are identified.
Conclusions: This work establishes some of the ecosystem control measures that can mitigate the adverse effects of climate change on the water security of Kerala in particular and regions with rain drawn fresh water in general.
Keywords: Water Security, Climate Change, IFD of rain, Bootstraps

11-17

X RAY POINT SOURCES IN NGC 5813

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Ultra-luminous X-ray sources (ULXs) are non-nuclear extra-galactic point-like sources whose luminosity exceeds the Eddington luminosity of neutron stars and stellar-mass black holes, assuming that they radiate isotropically. NGC 5813 is the central dominant elliptical galaxy in the NGC 5813 group. Early-type galaxies are usually devoid of any gas/ dust and hence are expected to be devoid of recent star formation events. However, NGC 5813 reportedly hosts five Ultraluminous X-ray sources (ULXs). Spectral study of the X-ray point sources in NGC 5813 using nine *Chandra* observations (totalling 638 ks), made during 2005, 2008 and 2011, is presented. The presence of five ULXs is confirmed. The sources which shows variability in X-ray luminosity are identified. Spectral variability of the sources is also investigated.
Keywords: X-ray binaries, Ultraluminous X-ray sources, Extragalactic X-ray sources

11-18

LIGHT EXTINCTION BY ATMOSPHERIC AEROSOLS: INCOHERENT BROADBAND CAVITY ENHANCED MEASUREMENTS IN SOUTHERN CHINA PLANE

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Broadband optical cavity spectrometers are considered as a technology for trace gas detection, but recently they have been used to retrieve the extinction coefficients of aerosols. In this work, we report the study of the ambient aerosols extinction coefficients measured by an Incoherent broadband cavity enhanced spectrometer (IBBCEAS) in a polluted summer environment in continental China. Experiments were carried out as a part of an Atmospheric field measurement campaign in Changzhou, Jiangsu province, China over the period 25 May to 25 June 2019 .The extinction coefficients measured by the IBBCEAS is then compared with cavity Attenuated Phase shift PM_{ex} Monitor (CAPS) and Photo Acoustic Extinctiometer (PAX).The CAPS and PAX measured the extinction coefficients in 532 spectral region while the IBBCEAS measured it in a broad 400nm to 550nm spectral region. Despite different measurement methods, the three instruments retrieved the aerosols extinction coefficients that were in good agreement. The results of the study proves the potential of Incoherent broadband cavity enhanced spectrometer for retrieving the optical properties of atmospheric aerosols.

11-19

SYNTHESIS AND CHARACTERIZATION OF MULTILAYER ZINC OXIDE THIN FILM FOR WASTEWATER TREATMENT

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Background: In recent years, photocatalysis has gained significant research attention because of their potential applications in environmental conservation such as air and water purifications. Metal oxide photocatalysts are being considered as an effective alternative to decompose toxic organic pollutants in wastewater.
Method: For the preparation of zinc oxide (ZnO) and copper oxide (CuO) thin films, precursor solutions were prepared from zinc acetate dihydrate, 2-methoxyethanol, monoethanolamine, copper acetate, and isopropanol. The precursor solution was deposited on glass substrate by spin coating. Layered films were synthesized by depositing one layer on the other. As synthesised fims, monolayer and multilayer, were preheated at 300^0C for 10 min after each coating and finally annealed at 500^0C for 1hour.
Results: The photocatalytic activity of multilayer zinc oxide thin films were evaluated on the basis of degradation of malachite green (MG) dye under UV irradiation. The degradation efficiency of bilayer and multilayer thin film is higher than ZnO indicates that heterojunction enhances the photocatalytic activity. The formation of a p-n junction in multilayered zinc oxide thin films dissociate the excitons and this will cause the photoluminescence quenching and enhancement of degradation rate of malachite green in multilayered zinc oxide thin films.
Conclusions: The combination of p-type and n-type material reduce the recombination rate of photogenerated electrons and holes and this will enhance the photocatalytic activity in bilayer and multilayer zinc oxide thin films.The results reveal that multilayered zinc oxide thin films have application in the field of wastewater treatment
Keywords: Photoluminescence quenching, photocatalysis, zinc oxide, multilayer thin films

11-20

AN EFFICIENT FLUORESCENT PROBE BASED ON GLUTATHIONE CAPPED COPPER NANOCLUSTERS AS A TEMPERATURE SENSOR

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Background: Fluorescent metal nanoparticles-based sensors have much attention in the biomedical field. They are mainly used in the detection of heavy metal ions, proteins and aminoacids which are the biomarkers of several diseases. Although, noble metals like gold and silver-based nanoclusters are the field dominated nano sensors owing to their strong surface plasmon resonance in the visible range, efforts are in progress in fabricating cost effective metallic nanoparticles with strong optical properties in the visible range. Here, a simple method to synthesize fluorescent copper nanoclusters (Cu NCs) with strong bright red fluorescence (625nm) using glutathione (GSH).

Method: Typically, the synthesis was carried out in 10 ml of deionised water by adding 100mM reduced Glutathione and 10mM of $CuCl_2$and mixed together. The solution was stirred using magnetic stirrer at room temperature for 10 minutes, and a white hydrogel was formed. 1M NaOH solution added drop wise in to the solution and it becomes clear. The resultant solution stirred for 20 minutes.

Results: The synthesized Cu NCs system responds linearly to the temperature in the range of 5 to 80°C, projecting its potential as a temperature sensor. There is a linearity in the fluorescence spectra with temperature, both in heating and cooling mode. This property can be exploited for their employability as cellular nanothermometers and cellular heat mapping applications.

Conclusions: The proposed sensor can also find direct application as a sensor for intracellular temperature and it may give the subcellular heat map of single cells. Further studies in cellular/models with temperature can ascertain their potential as a biosensor.

Keywords: Fluorescent Cu NCs, Temperature sensor

11-21

SYNTHESIS, CHARACTERISATION AND OPTIMISATION OF TIN SULPHIDE (SnS) THIN FILMS DEPOSITED THROUGH VACUUM FREE TECHNIQUES

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Background: Tin sulphide (SnS) is a IV-VI compound semiconductor with direct band gap of 1.38 eV.It's optimum band gap as well as inexpensive and eco-friendly nature make it a good absorber material for photovoltaic devices. It is also potential candidate for application in photo catalysts, thermoelectric devices, biosensors, super capacitors, field effect transistors and much more. Preparation of phase pure SnS thin films by vacuum free techniques is therefore both scientifically and technologically important.

Method: SnS thin films were synthesized through Chemical Bath Deposition (CBD) using TEA (Triethanolamine) as complexing agent by varying the different concentrations of TEA. SnS thin films with different thicknesses were also been deposited on glass substrates through Chemical Spray Pyrolysis (CSP) technique using tin chloride and thiourea. The influence of pH of the precursor solution and the substrate temperature on the crystallisation phase and morphology of the prepared thin films were studied.

Results: X-ray diffraction analysis confirmed that the deposited films exhibited polycrystalline nature with a preferential orientation along (1 1 1) plane of the orthorhombic structure of SnS (JCPDS card number: 39-0354). FESEM micrographs showed homogeneous surface morphology with the presence of needle shaped grain structure. Prepared thin films had optical absorption coefficient > 10^4 cm^{-1}in the wavelength rage of 400-800nm. Raman studies confirm the formation of single phase SnS film. The compositional analysis is obtained from XPS (X-ray Photoelectron Spectroscopy) spectra. Optical band gap values of direct transitions is estimated as 1.32 eV.

Conclusions: Multiple Phase formation (Sn_2S_3/SnS_2/Sn_3S_4) is the major issue facing deposition of SnS films. In the present study we could optimise deposition conditions of two vacuum free techniques to get SnS with single phase

Keywords: Photovoltaic materials, Spray Pyrolysis, Echo friendly solar cell, optical band gap, Phase formation

11-22

REALISING PURCELL EFFECT IN SUPERLATTICE SYSTEMS

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Coupling of light and matter in different coupling regime have transformed several optomechanical systems, quantum computing, semiconductor polaritons. Very recently phonon analogue of photon-based phenomena is gaining attention. Owing to slower velocities and shorter wavelengths phonons are more fit for some tasks like signal processing, quantum simulation, long-range entanglement.

In this work, we designed a GaAs/AlAssuperlattice (SL) structure for generation and detection of phonon with a GaAs/AlAs double quantum well spacer layer to act as a two Level System (TLS). The energy splitting of TLS can be tuned by external bias.

An acoustic cavity of length 2 λ is enclosed between two SLs which act as Bragg mirrors for acoustic phonons of wavelength λ. Upon excitation with ultrafast laser, phonon modes could be generated in the SL. Since the cavity is designed in resonant with phonon generated in generation SL, it will be confined the cavity. This phonon remains in the cavity based on the value of quality factor Q of the cavity. By applying external electrical bias, the ground states of double quantum well split into a few meV and cavity becomes strongly coupled to TLS[3]. The intersubband electronic transition in the quantum well is strongly related to coupling constant g. It can be varied by changing the width of barrier and quantum well and thus it can effectively change the system from strong coupling to weak coupling regime. In strong coupling regime, it is theorised that analogues to polariton (entangled state of exciton and cavity photon) formation, an entangled state of matter and phonon called phoniton could be realised. We show that in weak coupling regime, acoustic analogue of Purcell Effect[1] can be achieved particularly using superlattice system have high Q – cavity with tunable two-level system.

Keywords: Purcell effect, cavity quantum electrodynamics, superlattice, phonon dynamics

11-23

A STUDY OF AOD STUDY OF BENGALURU REGION USING ANGSTROM PARAMETER

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Background: Aerosols are the minute particles of solid or liquid phase suspended in the atmosphere. Aerosols interact with earth's radiation budget and climate. The effect of aerosols on the Earth's radiation budget can be quantified using the parameter Aerosol Optical Depth(AOD). Which measures the combined effect of scattering and absorption by aerosols. AOD can vary due to prevailing winds, cloud conditions and anthropogenic

activities.

Method: The optical properties of aerosols over Bengaluru from June 2018 to May 2019 are investigated using three instruments; Multi wavelength radiometer, microtops and satellite based MODIS. The mean time variations of AOD are studied and compared.

Results: In seasonal study AOD was found to be highest during pre-monsoon summer due to abundance of coarse mode aerosols. Using Angstrom's power law, a parameter called angstrom exponent was calculated from AOD data. Quantified values of angstrom exponent showed the relative dominance of large aerosol particles over smaller ones. In Bengaluru, anthropogenic activities are significantly high, which produce carbonaceous and sulphates aerosols, this belongs to sub-micron aerosols which are emitted in to the atmosphere.

Keywords:Aerosol Optical Depth, Multi wave length radiometer,microtops

11-24

SUPERCAPACITOR APPLICATION OF NIO THIN FILMS PREPARED BY SOL-GEL SPIN COATING METHOD

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Background: Spin coating is the main technique for film deposition from liquid precursors used in the microelectronics industry. A large variety of high-performance systems, providing coatings of photoresists, polyimides and spin-on-glasses (SOG) are available from manufacturers. Other deposition techniques are practically not used in semiconductor production. Sol-gel methods are currently used for basic and applied research for producing ceramic bulk materials, thin films etc. For control the thickness of a thin film, the sol –gel spin coating method can be used. Sol-gel spin coating method was simple, inexpensive. Early reports shows that NiO thin films prepared using sol-gel method exhibited high specific capacitance. Hence in this study sol-gel spin coating method was adopted for the preparation of NiO thin films.

Method: A solution of 0.5M was prepared by dissolving nickel acetate tetrahydrate in 2-methoxy ethanol. This solution was stirred for one hour at 60^0C. Thereafter, the solution was kept at 24 hours for aging. The solution was spin coated on the glass substrate at a spin rate of 3000 rpm for 30 sec by a spin coater. Film samples were subsequently annealed at 300^0C to 600^0C for one hour. Then the prepared thin films were abbreviated as NiO 0,NiO 300.NiO 400, NiO 500 and NiO 600 for as deposited nickel oxide thin films, 300 annealed nickel oxide thin films, 400 deg annealed nickel oxide thin films, 500deg annealed nickel oxide thin films and 500 deg annealed nickel oxide thin films respectively.The structural information of thin films was studied by X-ray diffraction technique (XRD) using Brucker AXS D8 advance X-ray diffractometer equipped with Cu K^{α} radiation The surface morphology was measured using CARL ZEISS field emission scanning electron Microscopy (FE-SEM). Contact angles of NiO thin films were measured using Drop shape analyzer DSA100 and electrochemical characterization were done using potentiostat CH1620D in a conventional electrochemical cell of three electrodes, where the working electrode was NiO thin film, platinum wire was used as the counter electrode and reference electrode was Ag/AgCl. 1M KOH solution was used as electrolyte. Cyclic voltammetry was performed at a potential range from -0.1V to 0.8V and a scan rate of 20mV/s.

Results: XRD analysis shows that average crystallite size increases with increasing annealing temperature. Film annealed at 600 $^{\circ}$C has agglomerated grain growth mode with porous nature. Contact angle measurements shows hydrophilic nature of NiO thin films, which is necessary for energy storage application. Specific capacitance of NiO thin films were measured by cyclic voltammetry analysis. Annealed thin films have higher specific capacitance. Annealed films have higher crystallite size, porous nature and hydrophilic surface, which enable them for supercapcitor application.

Conclusions: Crystallinity of NiO thin films prepared by sol- gel spin coating method was improved with increasing annealing temperature. Crystallite size increased from 15nm to 19nm. Influence of annealing

temperature on structural, morphological and electrochemical properties enable NiO thin films for supercapcitor application.

Keywords: Nickel oxide, annealing temperature, sol-gel spin coating, supercapacitor.

11-25

SYSTEMATIC STUDY ON LEVEL DENSITY PARAMETER OF EVEN-EVEN ACTINIDES

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Background: Nuclear level density has significant role in the calculation of nuclear reaction cross sections in different applications in nuclear astrophysics, nuclear medicine and nuclear activation analysis etc. Nuclear level density parameter is the important ingredient for the calculation of nuclear level density. Experimental value of nuclear level density parameter is not available for the region of actinide series. Theoretical value of level density parameter can be useful for the prediction of nuclear reaction cross sections.
Method: This work is the theoretical calculation of level density parameter of different even-even nuclei in the actinide series in a wide mass range. Gilbert-Cameron model and Back Shifted Fermi Gas models are used for the calculation of level density parameter. Here we analyse the variation of level density parameter around the region of neutron magic number N=184.
Results: The level density parameters for Th, U, Pu, Cm, Cf, Fm and No are calculated around the region of closed shell. The level density parameter of Th, U, Pu and Cm decreases towards the neutron magic number N=184. In other cases, there is no deviation of level density parameter around the neutron magic number.
Conclusions: Behaviour of level density parameter is found to be not identical in the case different isotopes of even-even actinides studied here. It clearly depends on the shell correction energy.
Keywords: Level density, level density parameter, actinides.

11-26

ENSEMBLE EQUIVALENCE FOR A CHAOTIC OSCILLATOR

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Background: Statistical mechanics is a branch of physics that studies, using probability theory, the averagebehaviour of a mechanical system where the state of the system is uncertain. There are mainly three methods in statistical mechanics to study a system known as Micro canonical ensemble, Canonical ensemble and Grand canonical ensemble. In Chaos theory we study the behaviour of dynamical systems that are highly sensitive to initial conditions. Chaotic systems are studied by various methods.
Method: Chaotic systems like quartic oscillator have been studied by many. Here we used the method of statistical mechanics. We found the grand partition function and from the grand partition function we derived the equations for different thermodynamic quantities using grand canonical ensemble. We also compared the result with the other ensembles.
Results: We derived the equations for average energy and specific heat of a quartic oscillator in Grand canonical ensemble. We compared the result and proved that we will get the same result in all the three ensembles.
Conclusions: From the above results, we can expect that statistical mechanics of finite dimensional systems could be a very good method for the description of the developed chaos in small dimensional Hamiltonian systems. We also proved that one can study the system in any of the three ensemble methods of statistical mechanics.
Keywords: Statistical Mechanics, Quartic oscillator, Grand canonical ensemble, Partition function

11-27

REMOVAL OF DETERERGENT CONTENTS FROM WATER USING CuS

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Back ground: Sodium Dodecyl Sulfate (SDS) is a common component of domestic cleaning, personal hygiene products and is identified as one of the toxic pollutants present in waste water and discharged into the environment[1]. Adsorption technique is one of the ideal methods for the removal of SDS from water because of its efficiency and low cost[2]. A variety of metal oxides and metal chalcogenides have been tried as an absorbent for the removal of SDS. CuS is chosen as an absorbent and aimed to investigate its maximum adsorption capacity towards SDS from its synthetic stock solutions.
Method: CuSnanosheets were successfully synthesized at room temperature via a quick, simple, and efficient grinding approach.Batch experiments were conducted to study the influence of the different parameters such as pH, adsorbent dosage, contact time and concentration of SDS on the adsorption process. The kinetic data were fitted with pseudo-first order, pseudo-second order and Elovich models.In addition, the adsorption isotherms of SDS from aqueous solutions on the CuS were investigated.
Results: CuS shows better adsorption capacity towards SDS and we obtained S type isotherm. The optimum pH, adsorbent dosage and contact time were found to be 4, 12.5mg and 3 hrs respectively. The adsorption kinetics of SDS with CuS was found to follow the pseudo-second-order reaction model. Fowler-Guggenhiem model described better adsorption data. Analysis shows that the interaction between adsorbent and adsorbate is physisorption.Gibbs free energy of the reaction is negative, indicates it is thermodynamically feasible.
Keywords: Sodium Dodecyl Sulfate (SDS), Adsorption, adsorption isotherm, Physisorption, Gibbs free energy.
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11-28

AN INVESTIGATION OF THE HARMONIC NATURE OF EDAKKA

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Background: The musical drum Edakka is unique in its tonal quality and tonal range. The harmonic nature of drums can be studied with spectral analysis. The frequency spectrum, waveform and attack, decay parameters are some parameters used for the purpose.
Method: The sound samples of Edakka strokes were collected and studied using MIR toolbox. The effect of wooden sticks (termed jeevakol) on the pitch of the drum was also studied from the sound samples.
Results: The frequency spectrum of fixed notes Sa and Pa on Edakka shows sharp peaks and the obtained values of attack, decay parameters show the harmonic nature of Edakka. The study on effect of jeevakol showed that dominant peak gets increased with number of jeevakol.
Conclusion: The Edakka strokes have good harmonic content. When wooden jeevakols were placed on the wooden ropes of Edakka it creates a tension variation on the drum head. This variation causes the drum to

change the pitch and hence when number of jeevakol increases the pitch of the drum increases.
Keywords: Spectral analysis, Edakka, Harmonics, Musical drum

11-29

PROBING THE PHYSICAL CONDITIONS OF 6.7 GHz METHANOL MASER HOSTS

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Abstract: The process of massive star formation is still poorly understood, in part due to the difficulty in identifying massive star-forming regions in early phases. One of the signposts of the early phases of massive star formation is the presence of the $5_1 - 6_0 A^+$ maser line of methanol at 6.7 GHz. We have carried out observations of thermal lines of methanol at 96 and 241 GHz using the MOPRA and APEX telescopes respectively towards a sample of 6.7 GHz methanol masers detected by the Arecibo Methanol Maser Galactic Plane Survey. The physical conditions in the 6.7 GHz methanol maser hosts can be studied by modelling these lines. Here, we present results of spectral line modelling of the sources under the assumption of local thermodynamic equilibrium. The results will be compared with theoretical models for excitation of 6.7 GHz methanol masers. The results are also expected to provide insight on the evolutionary state of the maser hosts in the context of massive star formation.
Keywords: Massive stars, Methanol Masers, Interstellar medium

11-30

CENTRAL LIGHT DISTRIBUTION IN TYPE 1 ACTIVE GALAXIES

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Background: Active galactic nucleus (AGN) is one of the most luminous objects in the universe, believed to be powered by accretion of matter on to the central super-massive blackhole (SMBH). Galaxies, which hosts AGN are known as Active galaxies. The evidences of strong correlations between the SMBH mass and the host galaxy properties suggests a common evolutionary path for both. In this paper, we report the results of a pilot study of central intensity ratio (CIR) in Type 1 Seyfert galaxies.
Method: We determine central light concentration for a sample of 20 Type 1 Seyfert galaxies having redshift, $z < 0.1$ using the Sloan Digital Sky Survey (SDSS) images in different bands. We used aperture photometry at the center of galaxy with two concentric apertures of 1.5 and 3 arcsecs.
Results: The CIR in z-band shows strong linear positive correlation with the optical luminosity of AGN, the linear correlation coefficient being 0.81 with a significance of 99.9%. The linear correlation coefficient is 0.76 with a significance of 99.9% for UV luminosity.
Conclusions: The dominance of IR emission from the dust torus at the center of galaxy, could be driving the correlation, making the CIR more connected to the central super-massive black hole than the central light distribution arising from the stars.
Keywords: galaxies,active galaxies, active galactic nuclei, photometry

12- SCIENTIFIC SOCIAL RESPONSIBILITY

12-01

THE QUESTIONS CHILDREN ASK: AN AGE-TYPE QUESTION CORRELATION USING THE "FIRST QUESTION"DATABASE

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Background: Making use of data collected through "First Question"- an initiative of Kerala Forest Research Institute (KFRI) to receive and answer questions raised by children, this study analyses the type of questions as a function of the age of the children. Primarily, started to answer the questions asked by very young children, First Questions evolved into a large repository of questions from students across India. The hypothesis for starting the initiative was the fact that the first questions a child ask is seldom received and responded seriously and this causes the first disconnect in a person's learning process. First question was launched on National Science Day (28th February 2019).
Method: A helpline number was made available for the public to pose their questions. The questions were categorized into eight different subjects viz., Physics, Chemistry, Biology, Astronomy, History, Geography, Mathematics, Theology and the rest were grouped under the title 'Other' and the questioners were categorized into different age groups viz., 1-9, 10-12, 13-15, 16-17 and 17 above.
Results: Total number of calls attended were 1385, and the calls were received from 23 states of India out of which, most number of calls were received from Kerala (457), Rajasthan (376) and Bihar (152). Out of the total calls received, 1060 calls were by males and 325 by females. The age group 13-15 accounted for most number of calls (413), followed by 17 above (379), 10-12 (271), 1-9 (165) and 16-17 (157).Most questions were from Physics (32%), followed by Biology (24%). We also attempted to categorize the questions addressed, into 'Why', 'What', 'How' and 'Yes/No' types. The age group 13-15 had several questions from all the four question types whereas 'How' questions were received the most from children of age 1-12 and the age group above 17 had more 'what' questions than the other three types. Chi square test of independence was used to compare age group and the question types. A significant interaction was found.
Conclusions: A 'What' question arises from the sudden innate curiosity to discover an unknown thing or phenomenon whereas 'How' and 'Why' questions take it a step further by enquiring about the working of the aforementioned thing or phenomenon and the reason behind it respectively. In this way, we considered the 'how' and 'why' questions to be more inquisitive than 'what' questions. The fourth question type i.e., 'Yes/No' could indicate a person's thirst to know the truth of a particular thing/phenomenon rather than the reason or its mechanism.The study indicates that the 'How' and 'Why' questions were predominantly asked by the younger children but as they mature, information seeking is limited to factual correctness of a particular phenomenon. As hypothesised earlier, it remains that the younger kids ask the fundamental, creative and unique questions which in turn reassures the need to have facilities for them to post their questions and get scientific answers.
Keywords: First Question, kid's helpline, curiosity.

12-02

SCIENCE FOR FOOD SECURITY: A BIBLIOMETRIC ANALYSIS

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Background: Food security is a major concern all over the world today and steps need to be taken to meet the demands in future. The scientific community is expected to play key role in planning strategies and policy

making for the same. To understand the present state a bibliometric analysis of the scientific literature on food security was carried out and presented in this paper.

Method: The ISI Web of Science database was used to retrieve data on articles in the area of food security. The extracted data was analysed using three software namely Sci2, VOS viewer and Pajek.

Results: The USA was the most significant contributing nation to research in food security, both qualitatively and quantitatively. The most important areas of research were environment and agriculture followed by climate. Among authors, Zhang X had contributed the greatest number of papers and Mueller C had the highest number of citations. The main path analysis revealed the possibility of the development of diverse areas of research in food security in the coming future.

Conclusions: The scientific community was found to be contributing to the field of food security in a satisfactory manner. Almost all the continents were represented in the research data. It is expected that scientists will be able to devise measures to ensure food security for the future generation.

Keywords: Food security, climate change, agriculture, environment.

12-03

ROOF TOP RAIN WATER HARVESTING OF KOTTARAKKARA MUNICIPALITY

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Rain water harvesting is a technique for water collection and storing for future use. Rain water harvesting system began civilization period but it could not to trace which civilization used the method first. The study encourages to Kottarakkara region to help overcome water scarcity during summer season and to help to for water management system. Kottarakkara is a vast developing town and municipality in Punalur Revenue Division at Kollam distract, Kerala, India. The municipality contains 29 wards out of that 10 wards have the scarcity of water that wards are 8,11,12,1314, 16,21 and,23 The two wards have severely affected water scarcity that wards are 23 and 21. The summer seasons people depends pipe line connections from Kerala Water Authority (KWA) and transport water for drinking and domestic purposes, so that the water harvesting system most helpful for the people to overcome the water scarcity.

The Remote Sensing (RS) and Geographical Information System (GIS) is proved as a better solution for find out roof top rain water harvesting potential of the geographical region. The rain water harvesting system is highly recommended for the water scarcity problem. The present study discusses about roof top rain water harvesting system the finding of rainwater harvesting potential find out with the help GIS and RS used for roof top rain finding suitable locations for rain water harvesting. The data sets used for the purpose that data sets are Google Earth Image on 3rd February 2019, Rain fall data on January to December 2018. Thematic Layers such as land use/Land cover (LULC) and Roof tops are vectorised from google earth imagery. Softwares named ARC GIS 10.5, QGIS 2.18 Las Palms and Erdas Imagine were used for the study. The analysis performed in studies that are The Remote Sensing (RS) and Geographical Information System (GIS) software's is help to find out the potential of roof top rain water harvesting. Potential of roof top rainwater harvesting refers to the capability of individual roof tops water holding capability during the water falls on particular roof tops. Potential of roof top rain water harvesting calculated by using Gould and Nissen formula (1999). According to the result around 1291928.0925 (Sq. m) area used for rain water harvesting and they will produce 208876076.79 litter of water otherwise 208876.07679 cubic meter of water. Total population of area is 31310 is and the water consumption of the area is approximately 2661350 litters.

Keywords: Rain water harvesting system, Remote Sensing, GIS, Google Earth

12-04

DESIGNING NEWTON'S DISC AND DEMONSTRATING THE BLUE COLOR OF THE SKY USING MODIFIED NEWTON'S DISC

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Background: Newton's disc is used throughout school laboratories to explain the seven color composition of white light. It is observed that many of the discs available in the open market does not give white light and if some them give white light when spun, they have some portions painted with white color. So we give the theory behind the design of Newtons disc which is not reported earlier. We also use the same principle of persistence of vision to design a new disc to explain the blue color of sky
Methods: Using the intensity plot of black body radiations[BBR], the intensity of different colors in white light spectra is found. A ratio of the intensities is taken and is mapped to angular distribution of a disc. The portions of the disc are painted noting the exact colors of different wavelengths in the actual spectrum.
Similarly using Rayleigh scattering equation the intensity of the scattered radiations are measured and the intensity ratio is used for constructing a disc to explain the blue color of the sky.
Results: Instead of taking equal ratios of six colors in a Newtons disc, as usually done, we used BBR intensity to find the angular spread of colors and when rotated they give white colored disc. Using Rayleigh scattering equation the scattered intensity is found to be having a ratio given below

Violet	Blue	Green	Yellow	Orange	Red
10	6	3	2.5	2	1

When a disc is made with angular spread in the above ratio and painted with the corresponding colors and spun we get a blue colored disc which beautifully explain the blue color of the sky.
Conclusions: This work establishes the use of simple spinning discs to explain accurately the nature of white light and why the sky is blue in color. Both these concepts are taught in higher secondary classes in wrong perspectives.
Keywords: Optics, Scattering of light, Refraction

12-05

A NEW THEORY OF FORCE OF REPULSION AND ENERGY WAVES

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Background: For the movement of a body, a force must be applied to make a change in its natural motion.In order to obtain this force, a certain amount of force must be placed against the direction of the object need to move. It is proposed that a certain kinds of energy waves are the result and these waves return back towards the body. It is assume that the nascent energy waves originate by the repulsion of electrons from the surface on where the opposite force is applied. These energy waves act on the space field of the body and make flexible the space wrap so as to enable the body from inertial stage to a non inertial stage. The object in stationary is in inertial frame. Movement requires a non inertial stage. In this paper we try to explain how the energy waves are formulated and acts on an object to make it move.
Method and result: Any object with mass is composed of billions of atoms. More atoms mean more space

fields. Inertia also increases with the increasing of space fields in a mass. The inertia of an object prevents its motion: When the inertia become flexible, then only motion is possible. The energy waves that created due to the repulsion of electrons, travels towards the body through a channel and act on the space field of the body and minimize the impact of space wrap and thus the inertia of the body reduces. As space wrap becomes more flexible, speed of the travel increases, by applying more force against the direction of motion.

The main hypotheses are:

- To every action there are opposite energy waves come towards the body and direction of motion.
- Space wrap or space fields are the cause of inertia and inertia prevents a mass to move.
- Nascent energy waves created from repulsion are capable to interfere on space field of the column of movement, to reduce the inertia of the moving column.

Conclusion: The amount of force exerted by a moving body on a fixed area, becomes an energy wave undergoing repulsion of surfaces interacts and that waves react on the space field and lift the object into a non inertial phase. If we can propose this function as an equation, we can write it as below:

$$\mathbf{F} = \boldsymbol{f}_a \, \mathrm{A} \, \mathbf{n}_e \ddot{\boldsymbol{e}}$$

Where **F** is the total work done by the force of repulsion in the form of energy waves $\boldsymbol{f}_a$ is the backward force; $\boldsymbol{A}$ is the area in which the driving force is concentrated, $\mathbf{n}_e$ is the number of electrons in the repulsive group at a given surface *(closely face to face*) area, and $\ddot{\boldsymbol{e}}$ is the force of repulsion between two electrons.

Key words: Energy waves, Force of repulsion, Inertia, Space field. Space wrap.