Our environment
Our future
Science and technology for
Rebuilding Kerala

31st KERALA SCIENCE CONGRESS

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

Abstracts

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ABSTRACTS

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Editor -in- Chief

Dr. S. Pradeep Kumar

Organized by

KSCSTE - JNTBGRI

31ST KERALA SCIENCE CONGRESS - ABSTRACTS

Focal Theme
Our Environment – Our Future: Science and Technology for Rebuilding Kerala

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MESSAGE

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

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

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

Pinarayi Vijayan

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Kerala State Council for Science, Technology and Environment

FOREWARD

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

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

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

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

Dr. S. Pradeep Kumar
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01 - AGRICULTURE & FOOD SCIENCE

01-01

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

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

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

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

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

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

01-02

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

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Background: Plant growth promoting rhizobacteria (PGPR) are recently identified to have remarkable applications as biofertilizer and biocontrol agents. Hence there is an increasing demand to isolate indigenous rhizobacteria to explore its plant probiotic potential for agricultural applications.
Method: In the study, various PGPR isolated from *Clerodendrum infortunatum* (L.) were evaluated for plant growth promoting properties and *in vivo* plant probiotic performance.
Results: From these, two *Bacillus* spp. were identified to have both plant growth enhancement and antifungal properties. Both the *Bacillus* spp. were observed to have volatile organic compounds (VOCs) mediated plant growth enhancement and antifungal activity. Hence the isolates were subjected to metabolite profiling by GC-MS analysis.
Conclusions: The ability of the selected *Bacillus* spp. to promote plant growth through direct and VOC mediated mechanisms indicate its multimechanistic impact on plants, which makes the study unique and significant.
Keywords: Rhizobacteria, Volatile organic compounds, *Bacillus* spp., Plant probiotics

01-03

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

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Background: Yogurt is one of the most popular fermented milk products worldwide and has gained widespread consumer acceptance as a healthy food. Fermented milk products have probiotic effect that exerts benefits in the balanced intestinal micro flora and health, beyond basic nutrition. In this backdrop standardization of rice based yogurt enriched with fruit as probiotic food having medicinal importance is attempted.
Method: Plain yogurt and Rice based yogurt was prepared. Microbial analysis and oganoleptic analysis was done and selected the best scored. Fruit enrichment was done and the best combination was selected by microbial analysis and organoleptic assessment. Cost analysis was done
Results: Rice based yogurt containing 25%milk and 75% rice slurry scored best in microbial analysis where as the one with 75% milk and 25% slurry scored best in organoleptic analysis. Hence the 2nd one was selected and fruit enrichment was done. The one with 20% annona fruit pulp and one with 5% papaya fruit pulp were selected as the best one. Microbial analysis shows that fruit enrichment doesn't affect the bacteria in the yogurt. Cost analysis proved that when fruits are collected from wild, we can make available these yogurts in low cost than market price.
Conclusion: The rice based yogurt containing 25% rice slurry and 75% milk enriched with 20% annona fruit pulp and the one with 5%papaya fruit pulp was selected as the final product. So we can make available the fruits, which are medicinally very important, in the form of probiotic yogurt to normal people in a tastier way and also in a lower cost.
Keywords: Yogurt, Probiotc, Annona, Papaya

01-04

BIOEFFICACY AND SOIL HEALTH IMPACT OF FLUCETOSULFURON IN WET SEEDED RICE

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Background: Flucetosulfuron is a new generation, pyrimidinyl sulfonylurea, broad spectrum herbicide used for weed control in rice. Identification of its optimum dose and most ideal time of application for season long weed control in wet seeded rice under Kerala conditions require field investigation.
Methods: The investigation was carried out at College of Agriculture, Vellayani, Thiruvananthapuram during the peri-

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

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

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

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

01-05

GENE PYRAMIDING FOR BACTERIAL BLIGHT RESISTANCE IN RICE VARIETY UMA

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Background: As in other rice growing locales around the world, bacterial blight (BB) disease caused by *Xanthomonasoryzaepv.oryzae(Xoo*) assumes a huge role in deciding rice profitability among the elite rice varieties PTB 39 (Jyothi) and Mo 16 (Uma) of Kerala. Among the various management tactics, host-plant resistance is advocated as the most effective breeding strategy to combat the disease. Considering this, efforts were taken to introgress three R-genes (*xa5, xa13* and *Xa21*) into the variety Uma from donor parent Improved Samba Mahsuri (ISM) through Marker Assisted Selection (MAS). Further, backcrossing to Uma (recurrent parent) and advancing the resultant BC_1F_1s have resulted in production of BC_2F_1 generation (21 Nos.).

Method: The present study aimed to identify BC_2F_1 plants pyramided with genes (*xa5, xa13* and *Xa21*) conferring resistance to bacterial blight using molecular markers. Hence foreground selection of the BC_2F_1 individuals was carried out using STS markers RG 556, RG136 and pTA248 for the genes *xa5, xa13* and *Xa21* respectively. Further confirmation for the presence of xa5 and xa13 genes were also done by using functional marker xa5 SR and xa13 promoter. The identified three R-gene pyramided plant is then subjected to background selection for identifying the recurrent parent genome recovery.

Results: Results obtained revealed that, of the 21 BC_2F_1s subjected to foreground selection, BC_2F_1 Plant No. 8.3.9.10 was the only 3-R-gene introgressed pyramid (*xa5xa5* + *Xa13xa13* + *Xa21xa21*). While all other BC_2F_1s including the recurrent parent was confirmed to have the presence of only one R-gene (*xa5xa5*). Background profiling using 22 rice microsatellite (RM) markers revealed that the 3-R-gene introgressed BC_2F_1 Plant No. 8.3.9.10 was more similar to recurrent parent Uma with its genome recovery of 81.82 per cent. The identified 3-R-gene pyramid plant was advanced for further evaluation.

Conclusion: MAS has enabled identification of a 3-R-gene introgressed BC_2F_1 Plant No. 8.3.9.10. (*xa5xa5* + *Xa13xa13* + *Xa21xa21*), with high recovery of recurrent parent background in the early backcross generations. The novel gene combinations arising in the backcross generations of R-gene pyramids can serve as base population in future breeding programmes for BB resistance.

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

01-06

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

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Background: The sandy plain region of Kerala comprises a unique agro ecological unit designated as Onattukara sandy plain (AEU 3). These soils are very young soils and are classified under Mixed, isohyperthermicTypicUsipsamments.Micronutrients are important for maintaining soil health and soil must supply micronutrients for desired growth and productivity of plants. Now problems due to micronutrient deficiencies have been reported from many parts of this region. The supplementation of micronutrients under such situation becomes more important to provide balanced nutrition to crops. Hence a study was undertaken at College of Agriculture, Vellayani, Kerala Agricultural University, to assess the micronutrient status of the onattukara sandy plain and to study the response of crops to micronutrient application in this sandy tract.
Method: Data on available nutrient status of two hundred georeferenced soil samples collected from twenty soil series covering the onattukara region was used for assessing the status of micronutrients. Based on the results a trial was undertaken in the onattukara sandy plain at eighteen different locations to study the response of the crops to micronutrient application in this sandy tract. Okra variety VarshaUphar was taken as the test crop. Adhoc recommendation of micronutrients proposed by Kerala Agricultural University viz. ZnSO4 @ 20 kg ha^{-1}, CuSO4 @ 1.5 kg ha^{-1} and borax @ 10 kg ha^{-1} was applied in the okra crop and it was compared with the package of practices recommendations. Observations on yield and yield attributes were recorded and analyzed statistically using paired't' test.
Results: The study revealed that the Onattukara sandy plain suffers from severe micronutrient deficiencies of Zinc, Copper and Boron and Adhoc recommendation of these micronutrients proposed by Kerala Agricultural University was applied in okra to study the response of the crop to micronutrient application. The results from 18 different locations revealed that there was significant difference in yield and soil micronutrient status due to micronutrient application. Application of micronutrients significantly increased the yield of okra compared to the package of practices recommendation of NPK alone . Maximum yield recorded in POP was 5.2 t ha^{-1} and that in package of practices recommendation of NPK + adhoc recommendation of micronutrient was 9.4 t ha^{-1}. Micronutrient application increased the yield up to eighty percent.
Conclusions: Increased yield due to micronutrient confirm the need for including micronutrients in the regular fertilizer application schedule in this region. Therefore, it is very important to take necessary steps to apply the required amount of micronutrients for enhancing and sustaining crop production in the sandy plain.
Keywords: Micronutrients, okra, sandy plain, ustipsamments

01-07

IN VITRO EVALUATION OF PLANT BENEFICIAL ATTRIBUTES OF TOMATO-ASSOSCIATED RHIZOBACTERIA

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Background: The present study focuses on to the characterization of two rhizobacterial isolates; *Bacillus sp*. PKDL10 and *Bacillus sp.* PKDL14 obtained from tomato rhizosphere and analysis of their plant growth promoting ability by seedling vigour assay
Method: Rhizobacterial isolates were screened for IAA production, Phosphate solubilisation, Acc deaminase Production, Siderophore production, HCN production, Nirogen fixation, Ammonia production. Moreover lytic enzyme production such as amylase, protease, lipase and pectinase. In addition seedling vigour assay was also tested.
Result: *Bacillus sp*. PKDL10 showed IAA (10µg/ml). And Siderophore (PSU 13.73), Nitrogen fixation, Ammonia (0.162 mg/ml) and HCN production (1.584 ppm). In addition it showed the presence of lytic enzymes such as amylase, protease, lipase, pectinase. Whereas the isolate *Bacillus sp.* PKDL14 was positive for ACC deaminase ,Siderophore (PSU 22.60), Ammonia (0.10mg/ml), HCN (0.396 ppm) and amylase enzyme production. Highest germination % and

vigour index was given by isolate treated with the organism *Bacillus sp*. PKDL10. Combination of our isolates has given better germination % and vigour index compared to the uninoculated control.
Conclusion: Production of growth enhancing molecules, increased germination, vigour index, were shown by our isolates. This study suggests the prominency of using bacterial consortium is highlighted, as the lack of one growth promoting activity is substituted by another. Consortium biofertilizers can be more effective and can be more economical, eco-friendly and sustainable method for tomato cultivation.
Keywords: Rhizobacteria , Tomato, Plant growth promotion , *Bacillus*

01-08

NUTRIENT STICK – A COMPLETE CROP FERTILIZER FOR FUTURE

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Background: Fertilizer stick, a slow releasing fertilizer is also referred to as fertilizer spike or stakes, is a complete fertilizer composition that is formulated in stick form and contains ten essential nutrients. The nutrients are embedded in a suitable matrix, selected after lab trials. It ensures a constant supply of nutrient, as we irrigate the plants the stick will gradually dissolve and release nutrient into the soil, from where they are taken up by the roots.
Method: The experiment was carried out in a randomized block design with nine treatments and three replications. Growth and yield parameters observed were days to harvest, the number of fruits per plant, average fruit weight, fruit length, total fruit yield and shelf life of the fruit. The data were subjected to analysis of variance for randomized block design.
Results: The present investigation indicates improvement in different characters under study with treatment application in oriental pickling melon. Days to fruit harvest in nutrient stick and the fertigated field was 59 to 62 days respectively and in the conventional method of irrigation plus fertilizer application (KAU POP recommendation) was 64 days. The number of fruits per plant and total fruit yield was increased significantly with treatment application. The highest number of fruit per plant and total fruit yield per plot were recorded with drip irrigation + nutrient stick + potassium silicate spray @ 0.25 per cent. Foliar spray of silicon recorded the maximum shelf life of more than six months.
Conclusions: The nutrient stick is a complete fertilizer composite that is formulated in a solid form containing ten essential nutrients. The present investigation indicates days to harvest, the number of fruits per plant, average fruit weight, fruit length; total fruit yield and shelf life of the fruit were improved with treatment application in oriental pickling melon. As it is an efficient slow releasing fertilizer, it can support plants by providing essential nutrients for its growth in a steady manner for more days.
Keywords: Nutrient stick, Fertigation, Oriental pickling melon, Silicon nutrition

01-09

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

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Background: Climate change is an important issue that faces by the planet earth. Agriculture sector is most vulnerable to climate change because the changes in rainfall pattern and rise in temperature affect agriculture production. Changes in weather conditions can reduce the production by 67 per cent.
Method: The impact of projected climate changes on water balance and water requirements of major cropping systems in Kole lands were analysed using CROPWAT. The ensembled mean weather data generated from seventeen models in Representative Concentration Pathways 4.5 and 8.5 was used to analyse future climatic conditions (2030 and2050).
Results: Rainfall was found to be important weather parameters that decide the crop production particularly under rain fed conditions. The monthly rainfall of Kole lands indicated an increasing trend during the months June, July and August in projected climate scenarios both RCP 4.5 and 8.5. Based on the projected climates the potential evapotranspiration would be higher than the present condition and that during the months of January to April and November to

December there would be no water surplus in Kole lands.
Conclusions: This work establishes importance of water balance and water requirements of major cropping systems in Kole lands for attaining the better yield throughout the production period.
Keywords: Climate change, CROPWAT, Kole lands, water requirement

01-10

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

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Background: Papaya is an important tropical fruit crop which is mainly grown in the homesteads of Kerala. Papaya being heavy feeder in nature judicious fertilizer application is necessary to meet the nutrient requirement of the crop. For sustainable crop production, it is necessary to improve the soil health and maintain a healthy ecosystem. Application of large quantities of chemical fertilizers can have a negative impact on the physical properties of the soil health and productivity. Increased awareness consequent negative effect on human health has led way for the building up of organic farming within the country.
Method: The present experiment was conducted at College of Agriculture, Vellayani during 2016-2018, for studying the effect of organic manures and biofertilizers on plant and soil nutrient status before and after the cultivation of papaya (cv. Surya). The experiment was carried out with 11 treatments replicated three times using randomised block design. Different doses of organic manures and bio fertilizers were applied to the plant.
Results: Soil nutrient status was analysed before and after the experiment and the study revealed that application of 75% recommended dose of Nitrogen as organic along with AMF to papaya plants significantly increased the nitrogen, phosphorus and potassium content in the soil. The micronutrient content (Cu, Fe, Mn, Zn) and microbial count (bacteria, fungi and actinomycetes) were found to be highest with the application of 100% recommended dose of nitrogen as organic along with AMF. The statistical report on plant analysis of papaya revealed that the phosphorus, potassium and micronutrient content of the leaf petiole was found to be maximum with the application of 100% recommended dose of nitrogen as organic along with PGPR Mix-1 and AMF.
Conclusion: Application of 75% recommended dose of Nitrogen as organic along with AMF to papaya plants significantly increased the nitrogen, phosphorus and potassium content in the soil. Phosphorus, potassium and micronutrient content of the leaf petiole was found to be maximum with the application of 100% recommended dose of nitrogen as organic along with PGPR Mix-1 and AMF.
Keywords: AMF, PGPR MIX-1, biofertilizers.

01-11

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

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Background: Kerala accounts for a major share of area under spice cultivation. Plant parasitic nematodes are one of the constraints in spice production. Chances of presence of terminal residues in the harvested produce are more in the case of chemical interventions of nematode management especially in pepper. Therefore the present study is undertaken to document the nematodes associated with pepper and to evolve management strategies using botanical pesticides.
Methods: Survey was conducted to document the distribution of nematodes in the rhizhosphere of pepper. Nematode population was estimated by Cobb's sieving and decanting technique followed by modified Baermann's funnel technique. *In vitro* screening studies were conducted to evaluate the nematicidal property of aqueous extracts of weed plants and selected palnt materials were subjected to solvent extraction. Pot culture experiments were conducted to standardize the appropriate preparation and method of application. Micro plot studies were conducted to evaluate the efficacy of the botanical identified in comparison with bio agent, chemical and organic amendment. The data generated were subjected to analysis of variance (ANOVA) technique.

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

01-12

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

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Background: Livestock rearing is an integral part of the various farming systems and has been a major source of employment in rural areas for centuries. Its share is 4.4 per cent to the Gross Value Added of the agriculture and allied sector. Stagnation in the availability of green fodder and its increasing deficit over the years is a major concern. Along with productivity enhancement, it becomes all the more essential for ensuring the availability of quality feed and fodder to sustain higher productivity in animals. Hedge lucerne, being a perennial fodder legume can be also used as a protein supplement for the livestock. Multilocation trials of hedge lucerne genotypes were conducted across four locations in Kerala *viz.,* Trivandrum, Kollam, Thrissur and Wayanad for yield and quality parameters in the view of assessing the stability of genotypes.
Method: In this study eight hedge lucerne genotypes were evaluated. The biometric, yield and quality characters of the genotypes were recorded at the time of each harvest. Four harvests were taken in a year. Analysis of Variance (ANOVA), mean performance of genotypes, stability analysis using Eberhart and Russell model, pooled analysis of variance for the genotypes were done for different characters over four locations.
Results: The genotype T_8 (Thumburmuzhi local) recorded the maximum green fodder yield, dry matter production, crude protein and crude fibre content. Stability analysis revealed that the genotype T_1 (IC 345276) was stable over all locations for different characters such as plant height, number of branches, green fodder yield, dry matter production and crude fibre. The genotype T_8 (Thumburmuzhi local) was stable in favourable environment for length of branches, green fodder yield, dry fodder yield and dry matter production.
Conclusions: Genotype-environment interaction is one of the basic reasons for the difference in high performance in genotype for the yield and other essential agronomic traits.
Keywords: Hedge lucerne, Stability, Biometric characters, Yield

01-13

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

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

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

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

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

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

Keywords: Papaya, nutrition, Nitrogen, Phosphorus, Potassium

01-14

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

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

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

01-15

STANDARDISATION OF PROCESS PROTOCOL FOR OSMO-CONVECTIVE DRIED PINEAPPLE

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

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

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

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

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

Keywords: Osmo-convective drying, pineapple, quality parameters

01-16

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

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

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

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

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

Keywords: Entomopathogenic Nematodes (EPN), Termites, DauerJuveniles (DJs), Mortality

01-17

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

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

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

01-18

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

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

01-19

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

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Background: Plant mediated synthesis or green synthesis of zinc oxide nanoparticles (ZnO NPs) is gaining importance due to the disadvantages associated with chemical synthesis. The chemical synthesis followed by stabilization of synthesized ZnO NPs cause release of toxic by-products which are harmful to the ecosystem. Green synthesis has emerged as the best alternative to chemical synthesis of nanoparticles due to its simplicity, rapid rate of synthesis, cheapness and eco-friendly nature. Zinc is an essential element and has become the fourth important yield limiting nutrient after NPK. Zinc application to crop plants in the form of nanoparticles will serve as an efficient nutrient source which reduces the quantity of nutrient required and increase the effectiveness of applied nutrients
Method: ZnO NPs were green synthesized using calotropis leaf extract and characterized for its size and shape using scanning electron microscopy (SEM). The chemical composition of green synthesized nanoparticles were determined using energy dispersive atomic X-ray analysis (EDAX).This was followed by a pot culture study with maize plants in calcareous black soil, supplying with different concentrations of green synthesized ZnO nanoparticles (50 ppm to 2000 ppm) to study its effect as a nutrient source.
Result: Plant received nano ZnO @ 250 ppm showed enhanced growth and at higher concentrations (> 1000 ppm) plant growth decreased due to zinc toxicity
Conclusion: ZnO NPs at lower concentrations are very effective in enhancing growth as well as nutrients uptake of maize plants than the conventional zinc sulphate spray. But at higher concentrations, nano ZnO caused toxicity in plants due the higher bioavailability of zinc nutrient.
Key words: Green synthesis, calotropis, maize, nanoparticles, zinc oxide

01-20

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

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

01-21

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

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Background: *Bacopa monnieri* is a traditional medicinal plant in ayurveda used for enhancement of intelligence and memory and revitalization of vital organs. Standardization of good agricultural practices is essential for organised cultivation of the plant to ensure availability of sufficient quantity of good quality raw drug for medicine manufacturers.
Methods: Natural habitats of the plant in Kerala were explored and accessions collected from different agro ecological situations were evaluated. Field and laboratory experiments were carried out to standardise water management, nutrient requirement, harvest interval and storage methods. Quality evaluation of the raw drug was carried out by estimation of the pharmacologically active glycoside Bacoside A.
Results: Survey of the natural habitats showed that brahmi is found naturally in ill drained soils. Analysis of plant and soil samples revealed the presence of excessive levels of toxic heavy metals in certain locations. The accessions collected from different locations showed wide variation in vine yield and Bacoside A content. Yield varied from 132.2 g/pot to 260.5 g/pot; Accession 39 from Kakkenchery, Kozhikode registered highest yield. Wide variation (0.87 to 4.71%) was noticed in Bacoside A content. Accession 11 from Vellanikkara and Accession 42 from Alappuzha showed exceptionally high Bacoside A content of 3.88% and 4.71% respectively.
Shallow submergence of 1cm was found to favour growth and yield of brahmi. The plant was found to respond well to organic manuring. Basal application of FYM-10 t/ha followed by groundnut cake slurry application @ 2 t/ha after each cut was found to give higher yield. The best harvesting interval for higher vine yield of brahmi is 60- 80 days. Among the containers tested for storage of dried brahmi, sealed polythene cover was found superior to cloth bag or gunny bag. Quality of the crude drug was found to decline after six months of storage. It is also observed that Bacoside A content is 2.14% in shade dried samples, whereas it is 1.83% in sundried condition.
Conclusion: Brahmi accessions collected from different locations showed variations in yield and Bacoside A content. Agricultural practices on water management, manuring, harvesting interval and storage of brahmi were standardised. Study also showed that quality of raw drug is influenced by growing situations, drying and storage methods.
Keywords: Brahmi, *Bacopa monnieri*, Bacoside, Good Agricultural Practices, Medicinal plant

01-22

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

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Background: Zingiberales is a vital group of rhizomatous plants distributed widely in Southeast Asia and many of them are being used for treatment of various ailments. Though their free radical scavenging activity and general toxicity in different test organisms and activity against human pathogens have been widely reported, exploration of tropical Zingiberales for plant protection has not been endeavored.
Methods: Aqueous methanolic extracts of rhizomes of selected Zingiberales were evaluated for *in-vitro* antioxidant activity by DPPH assay and total phenol content was also determined using standard protocol. Antifungal activity of extract was studied by poison food technique using phytopathogenic fungi *Rhizoctonia solani*, *Fusarium oxysporum* and *Phytophthora capsici*. Cytotoxicity of extract was studied by Brine shrimp lethality assay and anthelmintic activity by using African earth worm *Eudrilus eugeniae.*
Results: *Alpinia calcararta* showed highest DPPH scavenging power with lowest IC 50 value of 14.73 ppm. The extracts of Curcuma *caesia*(58.375 ppm), *Curcuma zedoria* (61.147 ppm) and *Curcuma longa* (61.87ppm) exhibited moderate free radical scavenging capacity. Aqueous methanolic extractives of *Alpinia calcarata,Curcuma zedoaria, Curcuma longa, Hedychium coronarium, Kaempferia galanga* showed 30-77% inhibition against *Rhizoctonia solani Fusarium oxysporum* and *Phytophthora capsici* at 500 ppm concentration. Among these, extracts of *Curcuma zedoaria, Kaempferia galanga* and *Hedychium coronarium* showed significant broad spectrum antifungal activity against all the

three fungi tested.In brine shrimp lethality assay, *Kaempferia galanga* and *curcuma longa* showed highest cytotoxicity with an IC_{50} value of 8.26 **µg/ml and ٨,٥٦ µg/ml respectively.** *Hedychium coronarium* exhibited moderate anthelmintic activity with an LC_{50} of 271.63 µg/ml followed by *Curcuma caesia* (LC_{50} 330.36 µg/ml) with 100 % death within 2 hours.

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

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

01-23

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

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

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

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

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

01-24

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

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

Methods: Preparation of gold nanobiosensor includes functionalization of gold nanorod with *Banana bunchy top virus* antibody. Seed mediated growth method was followed for synthesis gold nanorod (GNR). The characterization of GNR was done by recording the absorption spectrum at the wavelength of 200nm-1100nm. The GNR biosensor for BBTV detection was tested by direct interaction with antigen and in TAS- ELISA.
Results: Development of pink color indicates the formation of GNR. The absorption spectrum of synthesized GNR was taken consecutively for seven days. Two peaks viz., longitudinal plasmon band (LPB) and transverse plasmon band (TPB) were observed in the absorption spectrum and it remained stable for seven days which shows the stability of the synthesized GNR. The GNR biosensor in direct addition could detect antigen dilution up to 1:100. It is an effective simple technique for field level detection of BBTV. In TAS- ELISA, addition of GNR probe gave positive reaction up to 1:1000 antigen dilutions where as monoclonal antibody gave only up to 1:100 antibody dilution. This shows the enhanced sensitivity by the use of GNR biosensor in TAS-ELISA.
Keywords: Banana bunchy top virus, TAS-ELISA, Gold nanobiosensor, Virus detection

01-25

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

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Background: *Dioscoreaalata* L. is an underutilized and poorly studied tuber crop cultivated by local farmers of Kerala. The present study dealt with the nutritional and antioxidant property of four selected land races of *D. alata* whose flesh color ranges from white to yellow, pink and purple.
Methodology: The total phenol, flavonoid, anthocyanins and carotenoids were estimated from the tuber flesh as per standardized protocols. DPPH and FRAP assay were performed to evaluate the antioxidant property of the tubers. The results obtained were statistically tested using correlation coefficient analysis.
Results: Yellow and purple fleshed tubers contained higher amount of phenols and flavonoids compared to white and pink colored tubers. In the case of anthocyanins purple fleshed tubers showed significantly higher amounts when compared to all other tubers. Yellow tubers contained maximum carotenoids and that contributes to its characteristic colour. Purple and yellow fleshed tubers showed significantly higher antioxidant activity than all other tubers. Phenol and flavonoids revealed very high positive correlation with antioxidant properties.
Conclusion: The present investigation revealed that yellow and purple landraces of *D. alata* are nutritionally more superior to the commonly used white fleshed yams.
Key words: Antioxidant, *D. alata* , land races, phenol

01-26

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

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Background: Kerala is a rich repository of yams diversity and purple fleshed *Dioscoreaalata* .L is one among them which faces gradual loss of diversity due to underutilization. Different landracesof purple yams with distinct gradation in purple colour are available in Kerala. Being a source of acylated anthocyanin they can be considered as a potential alternative source of natural food colourant.
Methodology: Total anthocyanin content of purple yams and their colour characteristics were quantified by spectroscopy. Identification of anthocyanins in purple yam was done by LC-MS analysis. Influence of temperature and pH on anthocyanin stability wasalso studied. Colour characteristics of food products with purple yam anthocyanin were quantified using CIE L a* b* coordinates.
Results: An efficient solvent system was standardized for the isolation of anthocyanins from purple yams. Among three landraces of purple yams 'Chorakachil' showed higher total anthocyanin content and five distinct acylated anthocyaninswere identified from it. At boiling temperatures purple yam anthocyanin showed higher pigment retention percentage.According to the shift in pH, colour characteristics of yam anthocyanins changes from red to yellow. Colour

characteristics of food products coloured with yam anthocyanin was comparable to the synthetic food colourant.
Conclusions: The present investigation establishedisolation, colour characteristics and applications of an anthocyanin rich food colourant equivalent toFD&C Red No. 3, from purple yam landrace 'Chorakachil'.
Keywords: Purple yam, Anthocyanin, colour quantification, food colorant

01-27

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

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Background: Drought is one of the major limiting factors in crop production, and will become increasingly important due to the global climate changes.Water greatly influences the yield and quality of vegetables, which are more sensitive to water stress as compared to other crops. Production of water stress tolerant crops becomes more important to sustain the food security in the world. The main objectives of the experiment are to evaluate performance of amaranthus genotypes under waters stress and its adaptation mechanisms.
Method: The ten red amaranthus (*Amaranthus tricolor* L.) genotypes were used for the study. The biometric characters and physiological characters of the genotypes were recorded at the time of harvest. Analysis of Variance (ANOVA) was done for different characters to know the variation between the characters.
Results: The genotype A22 (Madhur local) also recorded the maximum yield, stem girth, number of branches, length of leaf lamina, leaf to stem ratio, membrane integrity, relative water content and proline content of leaves. Presence of proline in the leaves might be considered as an important water stress tolerance mechanism.
Conclusions: high yielding genotype showed maximum membrane integrity, relative water content and proline content of leaves which might be the yield contributing characters under water stressed condition in red amaranthus.
Keywords: Red amaranthus, Water stress, Biometric characters, Physiological characters, Yield

01-28

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

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Background: Plants and pathogens communicate with each other through reactive oxygen species (ROS) signalling network. Induction of ROS is one of the earliest observable manifestations of a plant defence strategy orchestrated by ROS gene network. So the ROS cycle seems to have an increasing importance. The leaf spot disease caused by *Alternariasesami* is one of the major single threat to sesame. In this scenario, the present study aims to unravel the biochemistry of ROS cycle and to formulate an eco- friendly control measure against the disease.
Methods: Leaf tissues of sesame from 1, 3, 5, 7, 9, 11 and 13 days after infection were subjected to biochemical studies and compared with respective controls and also evaluate the tolerance mechanism using plant based fungicide and bio-control agent.
Results: The superoxide anion and hydrogen peroxide (H_2O_2) concentrations remarkably increased in diseased plants compared with the control.H_2O_2 can be detoxified via the ascorbate–glutathione cycle. Ascorbate, glutathione content and the related key enzymes of ascorbate-glutathione cycle showed high activities up to 9th day followed by a decrease. A lower induction of antioxidant defense system in turn leads to oxidative damage in sesame. The application of plant extract or microbial antagonists to sesame initiated a series of biochemical changes in the plants as part of the plant defense response.
Conclusion: The present study outlines defense mechanisms of sesame Thilaraniagainst *A. sesami* by activating antioxidant enzymes to an extent and the disease management strategies are trialed by antagonistic microorganisms and plant extract based control.
Keywords: Sesame, *Alternariasesami,* ROS Cycle, Ascorbate-Glutathione cycle

01-29

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

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A present study was conducted at College of Agriculture, Vellayani, Thiruvananthapuram, Kerala University to standardize the nutrient management involving farmyard manure, poultry manure, green manuring *in situ* and chemical fertilizers for higher profitability of cassava cultivation in lowlands. The field experiment was conducted in the lowlands at Integrated Farming System Research Station, Karamana, Thiruvananthapuram from September 2017 to February 2018. The treatments consisted of three sources of organic manure (m_1 - FYM @ 12.5 t ha^{-1}, m_2 - FYM @ 6.25 t ha^{-1} + green manuring *in situ* and m_3–poultry manure (PM) @ 2.5 t ha^{-1} + green manuring *in situ*), two levels of N (50 and 75 kg ha^{-1}) and two levels of P (25 and 50 kg P_2O_5 ha^{-1}) along with a uniform dose of 100 kg K_2O ha^{-1}. The experiment was laid out as 3 x 2 x 2 factorial experiment with three replications in randomized block design. Application of PM @ 2.5 t ha^{-1} + green manuring *in situ* (m_3) recorded the highest net income of ₹ 336874 ha^{-1} and BCR of 2.97 followed by the application of FYM @ 6.25 t ha^{-1} + green manuring *in situ* (m_2). Significantly higher net income of ₹ 314306 ha^{-1} and BCR of 2.87 could be obtained due to application of 75 kg N ha^{-1} (n_2). However, higher net income and BCR were registered with lower level of P (p_1 - 25 kg P_2O_5 ha^{-1}).ROI also followed the same trend due to treatments. Higher productivity and profitability could be obtained from the cultivation of cassava in lowlands with var. Vellayani Hraswa by the application of poultry manure @ 2.5 t ha^{-1} + green manuring *in situ* with cowpea + 75: 25: 100 kg N P K ha^{-1}.
Keywords: Lowland Cassava, Farmyard manure, Poultry manure, Green manuring *in situ*, Tuber Yield, Net income, Benefit cost ratio, Returns on investment

01-30

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

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The present study was conducted at College of Agriculture (KAU), Vellayani, Thiruvananthapuram to identify ideal Tillage system, Soil conditioner and Nutrient management for profitable tannia cultivation during 2015 -2016. The field experiment was laid out in split plot design with 24 treatment combinations and four replications. The main plot treatments consisted of four tillage systems (l_1- conventional tillage followed by pit system, l_2- conventional tillage followed by mound system, l_3- deep tillage followed by pit system and l_4- deep tillage followed by mound system) and sub plot treatments were combinations of two soil conditioners along with a control (s_1- control, s_2- coir pith @ 500 g $plant^{-1}$ and s_3- rice husk @ 500 g $plant^{-1}$) and two nutrient management practices (n_1- integrated nutrient management (INM) – FYM @ 25 t ha^{-1} + 80:50:150 kg NPK ha^{-1} and n_2- organic nutrition- FYM @ 37.5 t ha^{-1} + wood ash @ 2 t ha^{-1}). Deep tillage followed by pit system, produced the highest cormel yield, corm yield, net income and BCR. Coir pith as soil conditioner recorded significantly higher cormel yield and corm yield, however, thehighest net income and BCR were obtained without soil conditioner. Compared to INM, organic nutrition resulted in the highest cormel yield, corm yield, net income and BCR. Deep tillage (to depth of 30 cm) followed by pit system (size of 45 cm x 45 cm x 15 cm) and organic nutrition (FYM @37.5 t ha^{-1} + wood ash @ 2 t ha^{-1}) can be recommended for profitable tannia cultivation. Wherever coir pith or rice husk is available at a cheaper rate, it can be applied as soil conditioner @ 500 g $plant^{-1}$ for enhanced productivity of tannia.
Key words: Tania, Tillage, Soil Conditioner, Corm Yield, Cormel Yield, Net Income, Benefit Cost Ratio

01-31

VEGETABLE INTERCROPPING SYSTEM UNDER FERTIGATION

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

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

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

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

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

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

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

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

01-32

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

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

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

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

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

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

Keywords: Entrepreneurial behaviour, lease land

01-33

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

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

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

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

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

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

01-34

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

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Background: A survey conducted at IRTC on Jackfruit availability in Kerala revealed that around 2.5 million tons of jackfruit are produced in Kerala annually, around 30% of which is wasted due to various reasons like difficulty involved in plucking the fruit from tall trees and the time consumed in processing the same.Jackfruit is seasonal; however papaya is a perennial fruit.
Method: This work explores the production possibilities of value - added products from the above fruits by techniques like steam sterilization, osmotic dehydration,solar-cum-electric drying, conventional and microwave baking. Dietary fibre and calcium content of these fruits have been estimated using standard procedures (using wet chemical analysis and atomic absorption spectrophotometry)
Results: Procedures and flowsheets for the production of jackfruit powder, jackfruit based toffee, biscuits, pickle, osmotically dehydrated sweetened jackfruit and papaya snacks (tutti-frutti) have been standardised. Jackfruit powder can replace 'Atta' by 25% which makes chapati and poori extremely soft and palatable. Papaya tutti-frutti is a healthy snack for everybody-both children and elderly equally well.
Conclusion: This work established the possibility of popularising nutritive and fibre rich Jackfruit and papaya products with no added preservatives and colours.
Keywords: Jackfruit, Papaya, value –addition, osmotic dehydration, conventional andmicrowave baking.

01-35

PHYSICOCHEMICAL EVALUATION OF THE FRUITS OF CULINARY MELON AND SNAP MELON

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Cucumis melo L. commonly known as melon, is a tropical plant species belongs to the family Cucurbitaceae. Morpho metric analysis of melon landraces from Kerala revealed that the varieties showed considerable variability especially with fruit characteristics . The landraces belonged to two varieties such as *Cucumis melo* var.*acidulus* . L. Naudin (Culinary melon) and *Cucumis melo* var. *momordica* (Roxb.) Duthie&Fuller (Snapmelon). Among this var. *momordica* is an underexploited cucurbitaceous crop and the ripened fruits are consumed as dessert, whereas var. *acidulus* is a commonly used cooking type vegetable. The present investigation was carried out to understand basic principles of physicochemical properties in the fruits of the two varieties of melon in order to compare quality and nutritive value of fruit at different developmental stages. Fruits were harvested at three developmental stages and evaluated for physical and chemical parameters. Biometrical characteristics and physical characteristics of the fruits in two varieties showed significant changes during ripening. Whereas chemical characteristics such as Total Soluble Solids , Titratable acidity and Ascorbic acid concentration of the var.*acidulus* more compared to var.*momordica* at different developmental stages. Final contents of these parameters were 3.06^{0}Brix,,0.32%, 12.95mg/g tisssue in var.*acidulus* and 2.9^{0}Brix, 0.26% and 8.25 mg/100g in var.*momordica*. This can be treated as one of the reason for different mode of consumption of these varieties.

01-36

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

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Background: Ginger, a surprisingly useful plant, noted for its economic value has an important place in the spice map of Kerala. Although many varieties of ginger are grown in different parts of the country, only those varieties grown in Kerala, which are grown with low fibre and pungency are suitable for dry ginger. Ginger is a heavy feeder and it demands nutrients in large amount and use of large quantity of chemically formulated fertilizer is not feasible as it results in progressive rise in multi-nutrients deficiency, nutrient imbalance , deteriorating soil health and productivity with time. Thus organic farming is the best known alternative .
Method: Krishi Vigyan Kendra, Kollam selected four ginger varieties Athira, Karthika, Aswathy and Varada for the trial. Number of replications is ten. Organic ginger production package developed by Kerala Agricultural University is followed for its cultivation.
Results: The trial revealed that ginger variety Varada recorded highest yield (18.5 t/ha) followed by variety Aswathy (16.7 t/ha), while local variety recorded lowest yield (10.0 t/ha). Highest B:C ratio (2.63) was obtained from Varada followed by Aswathy (2.38) and Athira (2.32). Highest disease incidence (25.0%) was reported from local variety followed by Karthika (8.0%) and lowest from Varada (5.2%). Pest incidence (15.4) was highest in local variety and lowest (4.3 %) in variety Varada. The rhizomes of ginger variety Varada and Athira is bold, while that of variety Aswathy and Karthika is medium bold. Varieties Varada , Athira and Karthika can be used for fresh and dry ginger purpose while variety Aswathy is used for fresh ginger purpose.
Conclusion: It was concluded from the study that ginger performs well under organic farming. This farming method helps maintaining soil sustainability in long run. Ginger variety Varada reported highest yield and benefit cost ratio and less pest and disease incidence than other ginger varieties in Kollam district of Kerala under organic management practices. Ginger variety Varada reported highest yield and benefit cost ratio and less pest and disease incidence than other ginger varieties in Kollam district of Kerala under organic management practices.
Keywords: Ginger, Soil sustainability, Amelioration Rhizome, Organic farming

01-37

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

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Background: Nendran banana is a climacteric and tropical fruit crop with short shelf life during storage as well as export purpose. Due to its rapid ripening nature, huge amount of postharvest losses occurs and which in turn affect the farmer's benefit. To slow down the ripening process of Nendran banana, it is needed to inhibit ethylene synthesis by an ethylene inhibitor like salicylic acid.
Method: Nendran banana bunches of uniform maturity were selected, de- handed and treated with salicylic acid (SA) at three different concentrations for 10 minutes. The treatment consists of T_1- SA 1 mM, T_2- SA 1.5 mM, T_3- SA 2 mM, T_4- Distilled water (control) and T_5- Absolute control (without any treatment). Treated banana fruits were air dried and stored under room temperature in Corrugated Fiber Board Boxes till the end of shelf life. Physical parameters like pulp %, peel %, pulp to peel ratio, peel colour and fruit firmness were observed at an interval of 3 days till the end of shelf life.
Results: Nendran banana fruits treated with SA 2 mM recorded minimum pulp percentage, maximum peel percentage and minimum pulp to peel ratio after 15 days of storage. Maximum fruit firmness with good peel colour was also observed when compared to distilled water (control) and absolute control (without any treatment).
Conclusions: Postharvest treatment with SA 2 mM for 10 minutes showed better retention of physical quality attributes and delayed ripening in Nendran banana during storage period of 15 days.
Keywords: Salicylic acid, Banana, Postharvest, Physical properties

01-38

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

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

The experiment was conducted at Coconut Research Station, Balaramapuram in completely randomised block design with eleven treatments in three replications. The treatments comprised of T_1-seed priming with $ZnSO_4$ @2g kg^{-1} seed +PGPR Mix-1@10 g kg^{-1} seed,T_2 - seed priming with borax @ 0.5g kg^{-1} seed + PGPR Mix-1@10g kg^{-1} seed, T_3- T_1+ foliar spray of PGPR Mix-1@ 2 per cent at panicle initiation stage, T_4- T_2 + Foliar spray of PGPR Mix-1 @ 2 per cent at panicle initiation stage,T_5- T_1 + soil application of PGPR Mix-1@ 2 kg ha^{-1} at panicle initiation stage, T_6 -T_2 + soil application of PGPR Mix-1@ 2 kg ha^{-1}at panicle initiation stage,T_7 -T_1 + foliar spray of PGPR Mix-1@ 2 per cent at active tillering and panicle initiation stage, T_8- T_2 + foliar spray of PGPR Mix-1@ 2 per cent at active tillering and panicle initiation stage, T_9- T_1 + soil application of PGPR Mix-1@ 2 kg ha^{-1} at active tillering and panicle initiation stage, T_{10}-T_2 + soil application of PGPR Mix-1@ 2 kg ha^{-1} at active tillering and panicle initiation stage ,T_{11}-Control (NPK fertilizer alone).

Results revealed that instead of sowing dry seeds, seed priming with zinc sulphateand PGPR Mix 1 had significant effect on yield attributes, grain yield and B:C ratio. Soil and foliar application of PGPR Mix-1 also had positive effect on yield attributes and yield. Seed priming with $ZnSO_4$ @ 2 g + PGPR Mix-1 @10 g kg^{-1} seed + soil application of PGPR-Mix @ 2 kg ha^{-1}recorded the highest grain yield, gross returns and B: C ratio, but it was statistically comparable with seed priming with $ZnSO_4$ @ 2 g and PGPR Mix-1 @10 g kg^{-1} seed alone and seed priming with $ZnSO_4$ @ 2 g and PGPR Mix-1 @10 g kg^{-1} seed + foliar application of PGPR Mix-1, 2 per cent at active tillering and panicle initiation stage. These treatments also recorded comparable values for the yield attributes also. Hence it can be concluded that seed priming with $ZnSO_4$@ 2g + PGPR Mix-1@ 10 g kg $seed^{-1}$ alone or seed priming with soil application of PGPR Mix-1 @ 2 kg ha^{-1}at panicle initiation stage orfoliar application of PGPR Mix-1 at active tilleringand panicle initiation stage along with NPK @ 90:45:45 kg ha^{-1} can be recommended for higher yield and returns in upland rice.

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

01-39

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

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

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

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

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

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

01-40

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

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Background: Honey bees are important to the mankind for the bees products and also they aid in maintaining the biodiversity *via.,* pollination. The bacterial brood diseases infecting honey bees are a serious menace to the bee keeping industry of Kerala. Use of antibiotics for the management has lead to residue problem in honey and deteriorated the quality of Indian honey in the international market. Therefore, it's high time to move to the botanical means of management of the honey bee diseases.
Method: Field evaluation of botanicals *viz*., crushed garlic (0.25 % and 0.5 %), crushed leaves of *Centella asiatica* (0.05 % and 0.1 %), crushed leaves of *Ocimum* sp. (0.05 % and 0.1 %), turmeric powder 0.2 %; $CaSO_4$ (homeo medicine) along with oxytetracycline hydrochloride (40 ppm) as check and a control treatment provided through artificial feed (sugar solution 1:1). **Results:** Analysis of Co-variance study revealed a significant reduction in the disease of the colonies treated with crushed garlic 0.25 % (68.52 %) over the pre-count observation followed by the treatment with crushed leaves of *Ocimum* sp. 0.05 % with 67.57 per cent reduction in the disease in four weeks after treatment.
Conclusion: Crushed garlic 0.25 % and crushed leaves of *Ocimum* sp. 0.05 % were found effective against the brood disease with a percentage reduction of 68.52 and 67.57 respectively.
Keywords: Honey bees; *Apis cerana indica*; Kerala; Botanicals.

01-41

ENHANCING SEED LONGEVITY IN VEGETABLE SEEDS USING FILM COAT TECHNIQUE

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Background: Success of any crop production program depends on the quality of seeds own. Seeds undergo deterioration over storage and hence, maintenance of seed vigour and viability from harvest until planting is vital. Seed treatment is a common practice in agriculture for effective storage and preservation of seed. Polymer film coating is one such seed invigoration technique which is associated with chemical seed treatment.
Method: Freshly harvested and processed seeds of okra, variety Arka Anami kaand oriental pickling melon, variety Mudicode local were separately treated with polymers. The treated seeds along with the control were packedin700gauge polyethylene bags and stored under ambient conditions and observations were recorded at bi monthly intervals for a period of sixteen months.
Results: Throughout the storage period there was a decline in the seed quality parameters like germination and vigour. Inokra and OP melon Polykote(10ml)+carbendazim-mancozeb(2g)+ bifenthrin (0.1%)were found to be superior among the treatments with respect to germination(%), seeding vigour indices and other seed quality parameters.
Conclusions: The results indicated that seed treatment with polymers was highly effective for enhancing the storage life of okra and OP melon. The polymers along with plant protection chemicals help to retain viability and storability of seeds. Among the treatments, polykote (10ml) +carbendazim- mancozeb (2g) + bifenthrin (0.1%) showed best results which may be recommended for pre storage seed treatment. Seed treatment with polymers therefore provides a cheaper and safe method to enhance seed viability and seedling performance under ambient storage condition
Keywords: Polymers, Seed coating

01-42

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

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Background: Increased interests in healthy diets that prevent diseases have led to the development of new functional foods. Probiotic products, a functional food, have always been associated with diary foods. Innovative pairing of probiotics with plant foods and prebiotics have given way to a wider range of products with specific focus on health and environment.
Method: The suitability of selected indigenous plant foods as substrates for probiotic L.casei isolated from fermented milk beverage was explored to identify ideal substrates. Probiotic characterisation was done to assess its probiotic potential and was confirmed by DNA sequencing. A fermented probiotic beverage using indigenous plant foods was formulated by optimising the processing conditions. The nutrient content and composition of organic acids formed during fermentation was measured. The acceptability of the product was analysed in terms of physico- chemical, microbial and sensory parameters to evaluate the shelf life. Biological study was conducted on rats to evaluate its effect in altering the gut microflora.
Results: The isolated organism displayed good probiotic properties. DNA sequencing confirmed the culture to be L.casei. Plant substrates that demonstrated good prebiotic potential towards L.casei was chosen for preparation of the probiotic product. The beverage prepared under optimised conditions was found to have a high viability and acceptable physico chemical and sensory attributes necessary for a probiotic product. The consumption of probiotic product improved Lactobacillus count in the faeces of rats.
Conclusion: This work establishes a novel way of utilising indigenous plant foods along with the probiotic bacteria. Being plant based, such a product could greatly benefit both man and the environment.
Key words: probiotic, cereal based, fermentation, *L.casei*

01-43

A REFINED MEDIUM FOR RAPID MULTIPLICATION OF *DENDROBIUM* HYBRIDS

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Background: Developing climate resilient varieties and timely availability of quality planting materials are need of the hour to meet the challenges of ensuing climatic changes. The sympodial orchid *Dendrobium* is of great demand in Kerala. But there is dearth of quality planting material. To tackle this problem, several indigenous *Dendrobium* hybrids have been developed under the DBT project in the Department of Plant Breeding and Genetics, College of Agriculture, Vellayani. For rapidly multiplying these hybrids attempts were made to refine the tissue culture protocol for *Dendrobium* hybrids using *in vitro* leaf.
Method: The young leaf segments derived from *in vitro* established *Dendrobium* hybrids were used as explant. Leaf segments of 1.5 to 2.0 mm^2 size were inoculated into the medium. The cultures were then incubated in a culture room with controlled conditions of light, temperature and humidity.
Results: Callus initiation studies were conducted with two levels of casein hydrolysate (CH) (500 mg l^{-1} and 250 mg l^{-1}) in half strength MS medium containing BAP 5 mg l^{-1} + KN 5 mg l^{-1} + CH 500 mg l^{-1} + CW 200 ml l^{-1} + AC 1 gl^{-1}. Out of this CH at 500 mg l^{-1} was found to be the best for callus initiation and subsequent development of plantlet. The callus obtained from the inoculation medium were grouped together and cultured on regeneration media with two different levels of CH, *viz*., CH at 250 mg l^{-1} and no CH. Presence of CH at 250 mg l^{-1} was found to have significant effect on shooting response.
Conclusions: The optimum medium combination for shoot initiation was found to be half strength MS medium with BAP 5 mg l^{-1}+ KN 5 mg l^{-1}+CH 250 mg l^{-1}+CW 200 ml l^{-1}+ AC 1 gl^{-1}. Plantlets were ready for plant out in six months. The refined medium was proved to be successful in mass multiplying the indigenous developed *Dendrobium* hybrids.
Keywords: *Dendrobium, in vitro* leaf, casein hydrolysate, *in vitro* medium, inoculation medium, tissue culture

01-44

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

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Background: The soil of Kuttanad is characterised by extreme acidity and accumulation of salts and the cultivation of paddy in this area faces problems due to water logging, acidity and metal toxicities of iron and aluminium. Iron toxicity can cause nutrient disorders and deficiencies of several elements primarily affects the production of lowland rice.This study was undertaken with the objectives to evaluate the effect of soil amelioration with rice husk ash in abating iron toxicity and supplementary foliar application of a customized nutrient formulation in increasing rice yield in the low lands of Kuttanad.
Method: A customized nutrient formulation was developed based on the available nutrient status of the region and crop requirement and was used for supplementary foliar nutrition @ 5 kg ha^{-1} as foliar application of 0.5% solution in two splits at maximum tillering and panicle initiation stage.The field experiment was conducted with nine treatments replicated thrice in RBD using rice variety Uma.
Results: Growth and yield of rice increased significantly due to soil amelioration and supplementary foliar nutrition. The treatments did not show a significant influence on number of tillers at maximum tillering and panicle initiation stages. The leaf iron content was also found to be low in treatments where soil amelioration and supplementary foliar nutrition was given.
Conclusion: From the investigation it can be concluded that, treatment where soil test based recommended dose of fertilizers + Rice husk ash @ lime (based on pH) + foliar spray of 0.5% solution of customized formulation at tillering and panicle initiation stage was given was the best treatment. Use of rice husk ash as soil ameliorant along with soil test based RDF and supplementary foliar nutrition improved rice yield in Kuttanad.
Keywords: Soil amelioration, Rice husk ash(RHA), Foliar nutrition, Customized formulation.

01-45

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

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Background: The genus*Annona*L. is an important source ofedible fruitsworldover and *A. muricata, A. squamosa, A. reticulata* and *A. glabra*are the major *Annona* species in Kerala. Though the fruit pulp is being utilised, the seeds of the *Annona* species are neglected and the present work aims a comparative prospecting of the seed oils of the *Annona* species.
Methods: The seeds of the *Annona* species(5 g each) were extracted using a Soxhlet extractor with n-hexane. The lipid components were studied through HPTLC and GC-MS FAME method. The phylogenitic relation based on the distribution of fatty acids among the four species has been evaluated through hierarchical cluster analysis (HCA) using SPSS.
Results: The oil yield of the seeds of *Annona* species varied from 15.9 %to 27.8 %. GC-MS FAME analysis revealed that oil of the four species had oleic acid (39.84-45.68) and linoleic acid (25.41-40.91) as the major fatty acids. The dendrogram based on the distribution of fatty acids showed*A. glabra*as a distinct species.
Conclusion: The *Annona* species seed oilswere found rich in the essential fatty acid linoleicacid, that has potential utility in functional foods. *Annonaglabra* was found to have a distinct lipid profile with higher concentration of linoleic acid.
Keywords: *Annona* species, Seed oil, HPTLC, GC-MS FAME, Linoleic acid.

01-46

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

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Background: In August 2018, the state of Kerala experienced severe flooding in 13 out of its 14 districts that resulted from an excessive rainfall. It was the worst flood Kerala ever experienced in this century. Apart from taking about 483 lives and damaging around 56,000 ha of cropped area, the deluge also impaired the socio-economic conditions of the state. This article studies various anthropogenic factors such as intensive cultivation without proper soil management, reclamation of wetlands and paddy fields, deforestation etc., which has triggered the pace of flood damage. And also, aims at studying the scope of unleashing the potential for agriculture to become a key to reduce the impact of flood damage rather than being part of the problem.
Method: The study is based on the secondary data collected from various research articles, scientific publications, study reports and annual reports of various government organisations.
Results: Water holding capacity of the soil is highly influenced by the top soil that contains the highly adsorbent organic materials. Unscientific land use and improper drainage practices especially in the high ranges, has promoted the erosion of top soil and consequently reduced the water holding capacity of the soil. On a different note, significant reduction in the area under wetlands and paddy fields of the state, due to ever-increasing population and consequent developmental activities can be attributed as one of the major cause ofthis disaster.On the other hand, it is possible to reduce the impact of flood damage by adopting various strategies that includes proper land and soil management measures, conservation of the wetlands and paddy fields, etc.
Conclusions: In an agronomic perspective, land and soil management has got a pivotal role to play in maintaining the inherent storage capacity of the soil as well as in controlling surface and sub-surface runoff. The findings reveal that, along with relying upon agronomic and engineering measures which has got its own limitations, conservation and use of the wetlands, flood plains, paddy fields etc., to intercept and hold the precipitation where it falls, can be a much better strategy towards the sustainable flood management.
Key words: Flood, Kerala, Agriculture, Wetlands, and Land management

01-47

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

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Background: Shedding of seeds at maturity is an important factor which leads to yield loss especially in case of field crops like rice. One of the main disadvantages of Jyothi, a popular rice variety of Kerala is seed shattering at maturity.
Method: Twenty-five rice genotypes were screened for yield andseed shattering using augmented design and IRI (Induced Random Impact) method, and analysed for the extend of variability. Seven genotypes- three susceptible (Pavizham (L1),Jyothi (L2) andAishwarya (L3)) and four resistant (Aathira (T1), Triveni (T2), Jaya (T3) and Manupriya (T4)) were selected and crossed in LxT mating design.
Result: There was significant variability among the genotypes for yield and seed shattering. Shattering was governed by high heritability and genetic gain, which indicates that selection for shattering will be highly promising. LxT analysis revealed a preponderance of non-additive and epistatic gene interaction for the same. The per se performance of the parents for yield contributing characters and shattering revealed that the genotypes L2, L3 and T2 were promising, whereas the general combining ability (*gca*) effect showed L2, T1, T2 and T3 as better combiner. When both *gca* effects and mean values were considered together L2, T1 and T2 found to be most promising parents. Studies on hybrids based on per se performance revealed that H1, H2, H3, H5, H6 and H11as better among the twelve hybrids. When these

hybrids were evaluated based on the specific combining ability (*sca*)effect,hybrids H3, H4, H5, H6, H8, H10 and H 11 were found to be better cross combination.Mean performance and *sca* effect for yield and shattering revealed that hybrids H1, H2, H3, H5, H6, and H11 were having high response and H8 with moderate response.
Conclusion: The top ranking hybrids involved parants with either high mean performance, high *gca*effects or combinations of both. Hence there is more chance of getting better recombinations in segregating generation through transgressive breeding.
Keywords: seed shattering, *gca* effect sand *sca* effects.

01-48

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

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Background: Environmental condition in Kerala is hot and humid for most part of the year, which is highly detrimental to seed longevity.Under this circumstance, storing of seeds under controlled environment is recommended to prolong viability. In addition to the high recurring cost to maintain the seed under ideal controlled conditions, such seeds also undergo thawing when taken out for distribution. Usually one to three months elapses before the distributed seeds are used for sowingSeveral techniques to enchance seed longevity under such environment are practiced. Seed invigoration is one such treatment methodology followed. However its applicability and utility in the storage environment prevailing in the state is to be analysed.
Method: The seed of ash gourd variety KAU Local collected immediately after extraction were invigorated with the respective priming agents in the ratio 1:2 on volume basis for the specified period. The invigorated and untreated seeds were shade dried at room temperature to ≤ 8 per cent moisture prior to packing. At monthly intervals up to 10 months of storage (MAS), three replicates of seed packed separately in polyethylene bags of 700 gauge and stored under refrigerated condition were taken out and the seeds allowed to thaw under ambient conditions for a period of five months and the effect of thawing on seed quality was assessed every month, up to five months from retrieval.
Results: It was observed that irrespective of the thawing period, when seeds were retrieved from refrigerated storage at monthly intervals (*i.e.,* 1 to 10 MAS), the germination in seeds invigorated with $CaCl_2$ 50mM 12h was retained above MSCS throughout, except at 2 MAS and 3 MAS.
Conclusions: Invigoration with $CaCl_2$ 50mM for 12h (I_1) is beneficial in instances when it is anticipated that seeds stored under refrigeration needs to be retrieved and stored under ambient storage before sowing.
Keywords: Ash gourd, Refrigeration, Thawing

02 - BIOTECHNOLOGY

02-01

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

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Background: Banana form a major agriculture commodity of Kerala and aggressive attack by *Odoiporus longicollis,*the banana pseudostem borer(BPB), is the major challenge.Farmers inject toxic insecticides in the pseudostem to control BPB.
Methods: Estimation of total phenol, flavonoidsand related enzymes such as Phenyl alanine ammonia lyase(PAL),Polyphenol Oxidase(PPO) and Peroxidase (POX) in susceptible(S) and resistant (R)cultivars.Toxicity of alarvicide of R cultivar onhemocytes, gut histology and gut enzymes. Extraction of RNA and Differential display reverse transcription

(DDRT) of mRNA and gene sequencing of PAL in R and S cultivars.
Results: *Kappa* (AAA) is a Scultivar and*Aadinkombu* (AA) is R. Phenols, flavonoids and related enzymes PAL, PPO and POX were very high in R cultivar.Stigmasterol-3-O-glucoside of R cultivar caused lysis ofhemocytes, histolysis of midgut and inhibition of gut protease and amylase. DDRT profile of mRNA and gene sequence of PAL showed sharp difference between S and R cultivars.
Conclusion: Stigmasterol-3-O-glucoside can be used as a natural systemic insecticide. Developing resistantcis genic *Musa* cultivars has prime importance.
Key words: Stigmasterol-3-O-glucoside, BPW, Histology, DDRT, PAL, PPO, POX

02-02

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

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Background: In industries, synthetic corrosion inhibitors displaying toxic effects produced an urge to search for ecologically acceptable materials which are easily available, inexpensive and inexhaustible.
Method: In this work, inhibitive response of the ethanolic extract of *Tamarindus indica* leaves on the corrosion of mild steel in 0.1 N HCl solution has been investigated as a potent source of green, environment friendly inhibitor. To determine the inhibition efficiency, the green inhibitors with concentrations of 10 g/L, 20 g/L and 30 g/L was studied using gravimetric weight loss method for 10 days (240 hours) under room temperature.
Results: The results obtained showed that the inhibition efficiency was up to 85.7% with 30 g/L concentration of the leaf extract. The protection efficiency increased with the increase in concentration of the inhibitor and decreased with time. With the aid of some binding agents, like PEG, iron oxide and poly (oxy ethylene), the surface of mild steel coupons were coated with the leaf extract. The usefulness of *T. indica* leaf extract with the increase in concentration was proved from the results of potentiodynamic polarization and Electrochemical Impedance Spectroscopy (EIS). For each coated samples, the EIS measurements was performed. The change in impedance parameters with the change in leaf extract concentration indicates the development of a defensive layer for corrosion on mild steel surface. Gas Chromatography Mass spectroscopy (GCMS) method was applied for the identification of about 58 components of the leaf extract.
Conclusions: The inhibitor activity may be posed by the active components present in the leaf extract. Experimental results reveal that *T. indica* leaf extract is a promising candidate to function as a corrosion inhibitor for mild steel in acidic environment.
Keywords: Corrosion, Mild Steel, HCl, *Tamarindus indica* Leaf Extract, Inhibitor, Gravimetric, Coating, EIS, GCMS

02-03

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

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

beneficial microbial flora of agricultural lands. To deal with such a condition, the most suitable way is via a "nature to nature approach". Here comes the relevance of endophytic bacteria which reside in plants by providing plant beneficial functions.
Methods: The current study involves the isolation and screening of promising plant growth promoting endophytic bacteria by phenomic and genomic approach.
Results: The isolate *Bacillus* Dcl 1 purified from the rhizome of medicinal plant *Curcuma longa* revealed it to be positive for IAA, ACC deaminase, nitrogen assimilation and phosphate solubilization. In addition, *in vivo* plant growth promotion in *Vigna unguiculata* seedlings showed its potential to promote plant growth under stressed and nonstressed conditions. Also, Dcl 1 was found to have the presence of antiphytopathogenic bioactive molecules such as surfactin, fengycin and plipstatin as revealed by LC-M/S and LC-MS/MS along with extracellular enzymes. Whole genome sequencing of further Dcl 1 revealed the presence of specific genes for direct plant growth promoting traits, bioactive secondary metabolites, proteins involved in colonization, abiotic stress tolerance such as drought, salinity, heat shock and cold shock along with heavy metal mobilization and hydrocarbon degradation.
Conclusion: The existence of all these plant growth promoting properties in *Bacillus* Dcl 1 make it to have promises as biofertilizer, biocontrol agent or bioremediator to save nature from hazardous chemicals and to protect plants from harsh environmental conditions and disease for better agricultural productivity.
Keywords: *Bacillus* sp., Drought, LC-MS/MS, Lipopeptides, Genome sequencing

02-04

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

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Background: The therapeutic properties of β-glucan make clear the application of β-glucan rich cereals such as barley and oats in animal feeds, which help to improve the health of cattle and other farm animals those maliciously suffering the health problems in flood-affected areas of Kerala. Along with β-glucan rich food, the exogenous enzyme β-glucanase, as a food additive is essential for the enhancing the digestibility of the molecule. For massive and cost effective production, an effort was taken for the over production of β-glucanase genes isolated form *Streptomyces* spp.
Method: The exo-β-1,4-glucanase and endo-β-1,3-glucanase producing *Streptomyces* strains were isolated fromWestern Ghats areas of Kerala. The enzyme producing genes were isolated and codon optimized for obtaining high level expression. The pET101 D-TOPO cloned genes were expressed in BL21 StarTM (DE3) *E.coli* strain. Biochemical and kinetic parameters ofnickel affinitypurifiedproteins were determined.
Results: The strains *Streptomyces althioticus* TBG-MR17 and TBG-AL13 as *Streptomyces showdoensis* TBG-AL13 were identified as efficient producers of exo-1,4- β- glucanase and endo-1,3- β- glucanase respectively.The codon optimized genes produced significantly elevated levels of expression than the native ones. The purified optexo14 showed 72.0 U.mg-1 of exo β-1,4-glucanase activity and optendo13 protein produced 65.63 U.mg-1 of endo β-1,3-glucanase activity. The expressed enzymes showed broad pH stability, good thermostability, and better affinity towards barley β-glucan substrate. The enzyme cocktail mix showed moreeffective degradation of barley β-glucan.
Conclusion: Our study implies the effectiveness of the reported enzymes as animal feed additive which helps to enhancing the nutritive value ofβ-glucanrich grains along with immune-enhancing effect.
Keywords: exo-β-1,4-glucanase, endo-β-1,3-glucanase, codon optimization, over-expression, cocktail mix.

02-05

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

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Background: The seminal unique position of gold nanoclusters (AuNCs) between the gold atom and gold nano particles (AuNPs) provides a surfeit of physiochemical features for many biomedical applications. Natural polysaccharides are gifted with biocompatibility and unique functionalities custom them as novel tools for harmless visible light imaging and targeted therapy in cancer. The complex polysaccharide (PSP001) isolated from the fruit rind of *Punica granatum* could be used for the effective preparation of AuNCs in a green chemistry approach. Since majority of the fluorescent compounds accounts for off-target distribution and systemic toxicity, design of a targeted biocompatible fluorescent counterpart could attract translational potential.
Methods: PSP001was conjugated to the cysteine (Y) by reductive amination. This conjugate (PSP-Y) was used for the biogenic synthesis of AuNCs (PSP-Y-AuNCs) in a facile manner which was later well characterized by ^{1}H NMR, FTIR, UV-visible and fluorescence spectroscopy, HRTEM, DLS and ICP-AES. Various *in vitro* studies such as hemolysis assay, cell viability assay, lymphocytes proliferation assay, cellular uptake studies by various modalities were also conducted. Toxicity and tumor targeting potential of PSP-Y-AuNCsin a fluorescent platform were evaluated in BALB/c mice.
Results: Apart from the promising quantum yield and other photo-physical features, the precise designed PSP-Y-AuNCs exhibited pH sensing fluorescence emission profile with excellent biocompatibility and non-toxicity with both *in vitro* and *in vivo* studies. The maximum fluorescence intensity was around the pH of 5.5 could be beneficial for real-time imaging of tumors because of the acidic microenvironment displayed by tumor region. This fact was well appreciated with the highest fluorescence intensity obtained at the tumor site within 4 hours of administration in solid tumor bearing mice models.
Conclusion: Novel pH sensing polysaccharide aided AuNCs could be effectively utilized for the real time optical imaging applications in oncology.
Keywords: Polysaccharides,gold nanoclusters, pH sensitive, *in vivo* imaging.

02-06

PRODUCTION OF POLYHYDROXYBUTYRATE BY *BACILLUS MEGATERIUM* TBGSP1

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Background: The synthetic plastic waste disposal is a major problem all over the world. The need of the hour is to find out suitable alternatives to synthetic plastics. Most of the bioplastics are biodegradable and biocompatible, which makes them very attractive from the biotechnological point of view. Polyhydroxyalkanoates (PHAs) are polymers produced by different types of microorganisms under nutrient limitation. PHAs are presently being used in many industrial purposes such as packaging materials, and medical applications, etc. Polyhydroxybutyrate (PHB) is one of the major groups among these polymers. They have almost similar physical properties with synthetic plastics. Since bioplastic production is expensive, selection of bacterial strains that are capable of producing PHB in large amount is also very important for industrial production. The present study aims at the isolation and characterization of bacteria able to produce PHB from different environments and media optimization for maximum PHB yield.
Method: Bacterial strains were screened for PHA accumulation based on Nile sulphate staining. The intra-cellular PHA was extracted with sodium hypochlorite and assayed. Out of the PHA positive isolates, one was selected based on its PHA production in the minimal medium. The biochemical and 16S rDNA based sequencing were done for characterization of the bacterium.

Results: The biochemical and 16S rDNA based sequencing analysis revealed that the isolate belonged to *Bacillus megaterium*. PHA accumulation was studied and found to produce >70% of PHB from its biomass within 48h of cultivation. Further analyses revealed the bioplastic produced was PHB.
Conclusions: Isolation and characterization of PHB producing bacteria from the environment was carried out and the maximum PHB production of isolated bacterial strain at different incubation period was also determined. Further studies are in progress for the commercial production of PHB using low cost substrates.
Key words: Biopolymer, Bacillus, PHA, Bioplastic.

02-07

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

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Background: Nano particle-based remedial frameworks for cancer treatment have increased now a day as it is very promising field and devoid of many drawbacks that the conventional drugs posses. Cancer is a worldwide danger and the main drawback associated with the treatment of cancer is the cost of drugs and the side effects of the therapeutic agents. Nanodrugs can decrease the effect of normal cell death and can increase the rate of tumour cell death. The nano drugs for cancer have another advantage that at the same time they act as antimicrobial agent to prevent the associated infections. Recent developments in cancer research suggest that the silver nano particle conjugates have enhanced antitumor activity against multi drug resistant tumour cells.
Methods: Biogenic silver nanoparticles were synthesized by an endophytic *Colletotrichum gloeosporioides* isolated from the medicinal plant *Withania somnifera* (L. The biogenic silver nanoparticles were conjugated with chitosan and screened well. MDA MB cells and Si Ha cells were obtained from National Centre for Cell Sciences (NCCS), Pune, India and were used for the studies. The effect of Bio-AgNP and Chitosan conjugate of Bio-AgNP on the tumour cell lines were studied by MTT assay. IC_{50} value was determined for both the cell lines and all the assay were preceded with the particular concentration. Acridine Orange/ethidium Bromide double staining method was used for the detection of apoptosis. *In vitro* RO production was studied using Dichloro dihydro fluorescien diacetate (DCFDA). Caspase - 7 and caspase- 9 for Si Ha cells and MDA MB cells were performed to ensure its role in apoptosis. The hallmark of apoptosis DNA fragmentation was studied. Cell cycle analysis was performed with flow cytometry (Becton Dickinson USA).Real Time PCR was used to study the gene expression analysis.
Results: IC_{50} value for Bio-AgNP and Ch Bio-AgNP for MDA MB cells are 4.346 ± 0.6381 µg/ml and 0.9851± 0.0065 µg/ml respectively. IC_{50} value for Bio-AgNP and Ch Bio-AgNP on Si Ha cells are 24.35 ±1.390 µg/ml and 2.086± 0.319 µg/ml respectively. It showed extensive pattern of cell death according to increasing concentration. Ch Bio-AgNP showed enhanced antitumour activity in comparison with BioAgNP. On double staining with AO/EtBr, MDA MB cells and Si Ha cells showed early and late apoptosis. *In vitro* RO assay using DCFDA showed significant green fluorescence on both cell lines due to RO production. MDA MB and SiHa showed increase in the caspase activity compared to the untreated cells. This clearly depicted the apoptosis of cells after treatment with Ch Bio-AgNP. DNA fragmentation was noticed after treatment with Ch Bio-AgNP on both cell lines. Flow cytometry revealed that SiHa cells exhibited cell cycle arrest at G_1/S phase. In Case of MDA MB cells the cell cycle arrest was at G_2/M phase. For MDA MB p38 and for SiHa p53 was selected for gene expression studies and both the genes showed increase in expression fold.
Conclusion: Cancer is a top cause of disease and a public health problem worldwide. The main drawback coupled with the cancer treatment is the expensive drugs and dangerous side effects of the drug. To balance with the current cancer treatment progressive research in the area is required. So far many reports are available on the use of nanoparticles for anticancer activity. Silver nanoparticles are extensively studied as an anticancer agent. The toxicity of silver nanoparticles was a hindering factor associated with the research but the Bio-AgNP, which resolved the issue of toxicity. In the present study, compared to the antitumour activity of Bio-AgNP, the conjugate with chitosan showed enhanced antitumor efficacy. The cytotoxicity on normal cell lines showed no toxicity and it makes the chitosan conjugate of Bio-AgNP as a promising alternative to the world of cancer medicine.
Keywords: *Chitosan-BioAgNP conjugate, Si Ha cells, MDA MB cells, Antitumour activity, Flowcytometry*

02-08

PHYTOCHEMICAL AND BIOLOGICAL EVALUATION OF TROPICAL GREEN SEAWEEDS

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Background: Seaweeds are macroscopic multicellular algae, which are either attached to the bottom in shallow waters or grow in deep sea areas. In recent days, spectral fingerprinting of the crude extracts from different phyto-resources has emerged as a potential tool to understand their potential bioactive properties and to additionally corroborate the results obtained by in vitro laboratory experiments in various disease models. In this study four tropical green seaweeds namely *Ulva fasciata, Halimeda macroloba, Chaetomorpha linum* and *Chaetomorpha antennina* were analyzed for its phytochemical indicators, antioxidant and antibacterial activities combined with proton spectral studies.
Method: The method includes collection, processing and extraction using EA-MeOH as the solvent system. The extracts were qualitatively and quantitatively analyzed for phytochemicals using standard methods. In addition to analytical methods such as DPPH and ABTS, antibacterial activities and spectral studies were also conducted to understand the nature of compound present in the extracts green seaweeds.
Results: Among the seaweeds *U. fasciata* showed the presence of phytochemicals which exhibited higher levels of total phenols 59.8 mg GAE/g, saponins 1.77 %, flavanoids 2.3 % contents as well as high DPPH scavenging activity (IC_{50} 0.86 mg/mL). *U. fasciata* and *C. antennina* were able to inhibit the gram negative bacterium *V. paraheamolyticus*. The NMR regions showed the proton integrals of *U. fasciata* were higher when compared to the rest of the seaweeds.
Conclusion: The phytochemical screening could be used as a baseline for isolating specific low molecular weight leads .The results suggested that *U. fasciata* has potent biological effects like antioxidant activity and antibacterial activities which can be used as a source of biomedical importance
Keywords: Green seaweeds, Phytochemical, antibacterial, spectral studies.

02-09

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

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Background: Polyhydroxyalkanoates (PHAs) are a group of biodegradable and biocompatible substitutes for conventional plastics.As the demand for bioplastics is rising, new PHA production approaches are being implemented for making the industrialprocesses more profitable.Employing recombinant*E. coli* for PHA production is an ideal strategy for PHA production.Poly (3-hydroxybutyrate) (PHB) is the first discovered and widely studied PHA. In the present study, we have developed a recombinant *E. coli* strain for the production of PHB.
Methods: PHB biosynthetic genes from a *Bacillus* sp. was amplified and cloned for the construction of a recombinant system in *E. coli*. The strain was tested for PHB production and visualised through Transmission Electron Microscopy. The polymer produced by the recombinant strain was physically characterized.
Results: The recombinant strain accumulated the bioplastic as granules with in the cytoplasm. The polymer yield was estimated as 1.163 g/L. The extracted polymer was confirmed as PHB by GC-MS and NMR analyses. The thermal characteristics of the polymer were also observed similar to that of the polymer standard.
Conclusion: The recombinant strain obtained in this study is accumulating biopolymer with the *phaARBC* gene cluster from the environmental isolate. The strain is a potential candidate for PHB production and hasto be evaluated for its capability to make use of cheap carbon feed stocks.
Keywords: Polyhydroxybutyrate, Bioplastic, *E. coli*, Gas Chromatography

02-10

ANTIMICROBIAL ACTIVITY OF A NEW ENTOMOPATHOGENIC BACTERIA *ACINETOBACTER*

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Background: The EPN are a nematode-bacterium complex. The symbiotic nematode-bacterial mutualism is highly specific. Novel EPN belonging to the family rhabditidae were reported for the first time from Central Tuber Crops Research Institute (Mohandas *et al*., 2002). These new EPN belonging to the *Rhabditis* sp. and their symbionts offer great scope for their exploitation of bio separation and identification of novel bioactive molecules. The present work is mainly focused on the antimicrobial activity of a new entomopathogenic bacteria *Acinetobacter*.
Method: The bacteria were isolated from infective third stage dauer juveniles of the nematode isolate collected from Vellayani, Thiruvananthapuram. Incubation time of the bacteria was standardized and cell free culture filtrate was prepared. The cell free culture filtrate was then separated into organic and aqueous fraction. Antibacterial and antifungal activity of the organic fraction was tested.
Results: Organic fraction of 72 hr have highest anti bacterial activity against *B.subtilis* with a zone diameter of 20 mm and lowest antibacterial activity with a zone diameter of 13 mm against *P.aeruginosa* and antifungal activity (29 mm zone diameter) in case of *A. flavus* and lower in case of *F. oxysporum* (18 mm zone diameter). Antimycotic and antibacterial activity was not observed in 24 hr organic fraction.
Conclusions: From the study it can be concluded that the organic fraction have significant antibacterial and antifungal activity. The present study also reveals that this entomopathogenic bacteria will be useful for the production of bioactive metabolites effective against bacterial and fungal diseases of plants and animals.
Keywords: Entomopathogenic nematodes (EPN), *Rhabditis*, *Acinetobacter*, *B. subtilis P. aeruginosa*, *A. flavus*, *F. oxysporum*, antibacterial, antifungal.

02-11

EVALUATION OF THE ROLE OF PAX6 IN RETINAL AXONAL GUIDANCE

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Background: Retinal ganglion cells (RGC's) are the sole output neurons which carry visual information from the eye to brain visual centres. Our findings have shown that RGCs generated from ES-NP's can be transplanted into the adult retina but they lack the cues to guide the axons to brain visual centres (Front.Cell.Neurosci.2017; 11:295). Therefore, it is very important to first understand how the axons of RGCs are guided to brain visual centres during development and the molecules involved in it. Here, we have analysed the role of Pax6 in regulating the intra-retinal axonalguidance.
Method: In order to understand the role of Pax6 in intra-retinal axonal guidance, we have generated Pax6 conditional knock-out animals, and the embryos were used for immunohistochemistry, RNA isolation, qRT-PCR and Transcriptomic analysis. Other methods involved in the study are cell culture, transfection, luciferase assay and ChIP-PCR.
Results: To understand the role of Pax6 in axonal guidance, we perturbed Pax6 expression in retinal explant cultures and also conditionally knock out (cKO) in the mice retina during the period of axon formation. Down regulation of Pax6 with siRNA in E16 retinal explants showed a significant reduction in RGC axonal growth and fasciculation.We further substantiated our results by knocking out Pax6 in E15.5 mice retina. Here, we have observed a decrease in the number of RGCs, amacrine cells, horizontal cells and photoreceptors which were confirmed by Brn3, Ap2-alpha, calbindin, and recoverin staining, respectively. Analysis of $Pax6^{+/+}$ (control) and $Pax6^{-/-}$ (knocked out at E15.5) retinal flatmounts showed a significant alteration in the axonal guidance and fasciculation in $Pax6^{-/-}$ retina compared to the control. To further understand axonal guidance molecules that Pax6 could be regulating, we performed ChIP-seq with Pax6 antibody and identified a number of axonal guidance genes that are regulated by Pax6. Out of which, the prominent ones were *EphB1* and *Sema5B*. The interaction and regulation of EphB1 and Sema5B by Pax6 was further confirmed with luciferase and qRT-PCR analyses. These findings highlight a novel role for Pax6 in the intra-retinal axonal guid-

ance by regulating key guidance molecules.
Conclusion: These findings showed an important role of Pax6 in regulating the intra-retinal axonal guidance in the mice retina
Keywords: Pax6, Axon

02-12

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

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Background: In the past decade, there has been an upsurge in the research initiatives aimed at the development of efficient and cost-effective waste water treatment technologies. Photo catalysis using visible light as perennial energy source is a sustainable solution to effectively tackle contaminants in industrial and domestic effluents. Among the diverse photocatalysts explored till date, semiconductor nanoparticles characterized by high photocatalytic activity and stability have gained considerable attention. The amenability of ZnS nanoparticles in initiating efficient photo-redox reactions enable their use as photocatalysts for environmental remediation.
Methods: Heavy metal tolerant fungi were isolated from water sample collected in proximity to effluent disposal sites. Biosynthesis of Zinc sulfide (ZnS) nanopaticles were carried out by the heavy metal tolerant fungus by a green process. Morphology and averagesize of the ZnS nanoparticles were analyzed using Transmission Electron Microscope, Scanning Electron Microscope, Fourier Transform Infrared Spectroscopy and X-ray powder diffractometer.The photocatalytic activity of biosynthesized ZnS nanoparticles was investigated by monitoring the efficiency of ZnS QDs in the photodegradation of Methylene Blue (MB) dye under sunlight.
Results: Zn tolerant *Penicillium*sp was isolated from industrial effluent samples for the successful green synthesis of ZnS nanoparticlesunder ambient conditions.The formation of ZnS QDs was confirmed by using spectroscopic and advanced microscopic analysis.The ZnS QDs were found to have an average diameter of 11.8 nm and were characterized with a zinc blend crystal structure. The optical and morphological characteristics were comparable to that of chemically synthesized counterparts. Further, photocatalytic degradation of Methylene Blue dye was carried out in the presence of sunlight and ZnS QDs. It was found that the green synthesized ZnS QDs exhibit good photocatalytic activity with a half-life of 4 hours. Further, the dye degradation efficiency was enhanced as the ZnSnanocatalyst/ dye ratio increased and reaches equilibrium within 6hrs.
Conclusion: This work establishes an inexpensive and scalable method to fabricate ZnS nano hybrids with practical applicability in the remediation of pollutants in textile, paper and dyeing industry.
Keywords: Biosynthesis, Methylene Blue, Photocatalysis, *Penicillium*, Quantum dots, ZnS nanoparticles

02-13

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

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mRNA processing at the 3′-untranslated region (3′-UTR) is an essential step in eukaryotic gene expression that involves two major steps: endonucleolytic cleavage followed by addition of a poly(A) tail (polyadenylation). Polyadenylation is carried out by enzymes called poly (A) polymerases (PAPs). Star-PAP is a non-canonical PAP that selects pre-mRNA targets for polyadenylation. A large set of Star-PAP target mRNAs encode factors plays a crucial role in heart diseases such as cardiac hypertrophy (CH), a major risk factor for heart failure (HF). We hypothesised that Star-PAP regulates CH/HF through unique associated factors.
Mass spectrometry sequencing identified RBM10 as a unique Star-PAP co-regulator. RBM10 is enriched in the heart and stimulates Star-PAP polyadenylation activity. RBM10 binds target mRNA and guides Star-PAP complex to specifi-

cally process cardiac mRNAs. Microarray analysis demonstrated that RBM10 and Star-PAP commonly regulates genes mostly down regulated during CH/HF suggesting RBM10 as a master regulator of CH. Further HITS-CLIP sequencing and qRIP analysis confirmed requirement of RBM10 for the assembly of Star-PAP complex on the overlapped targets. We extended our study to physiological relevant models of CH, cellular (rat cardiomyoblast, H9c2), and animal (Wistar rat) models for CH. We observed downregulation of both RBM10 and Star-PAP resulting in reduced expression of target anti-hypertrophic genes. In H9c2 cell line, RBM10 depletion resulted in the generation of molecular events of hypertrophic response, and ectopic re-expression of RBM10 rescued the induced-hypertrophy. Similarly, there was reduced expression of both RBM10 and Star-PAP after the compensatory hypertrophy transitioned into HF in our hypertrophic heart model.
Our results establish a novel anti-hypertrophy gene program mediated through Star-PAP-controlled selective 3'-end processing of cardiac mRNAs. We identified a splicing factor, RBM10 as unique Star-PAP co-regulator that determines Star-PAP specificity for mRNAs encoding key anti-hypertrophy regulators in heart.
Keywords: mRNA processing, 3'-UTR, RBM10, Star-PAP, Cardiac hypertrophy

02-14

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

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Background: Breast cancer is the most frequent female cancer worldwide representing nearly a quarter of all cancers with an estimated 1.67 million new cancer cases diagnosed in 2012. The burden of the disease is riotously increasing and is accounting for the largest crude incidence rate and prevalence of any cancer type. The dysregulation of Hippo pathway is found to play a critical role in tumorigenesisand cancer survival in a vast range of cancers; nevertheless, our understanding of how core components of this particular pathway regulate breast cancer survival remains incomplete.
Method: We have aimed at exploring the role of Hippo pathway effector YAP in progression and survival of breast cancer cells *in vitro.* The effect of YAP gene silencing by siRNA transfection in breast cancer cell proliferation, migration, apoptosis and cell cycle arrest was studied.
Results: siRNA silencing of YAP was confirmed in breast cancer cell lineat both transcriptional and translational level. Weobserved increase in apoptosis in YAP silenced cells compared to the control cells. The cell cycle analysis revealed that, silencing of YAP caused a significant accumulation of cells in the sub G0 phase of cell cycle. Absence of YAP delayed wound healing process as observed in scratch assay.
Conclusions: Our work elucidates role of Hippo pathway effector-YAP on breast cancer cell proliferation and survival. The present study shows that YAP act as a proapoptotic gene and its transient silencing promoted apoptosis and inhibited proliferation and metastasis. Further validations in both upstream and downstream components of Hippo pathway are to be done for substantiation and characterization of YAP as a clinical marker and therapeutic target for breast cancer treatment.
Key words: Breast cancer, Hippo pathway, YAP, apoptosis, cell proliferation.

02-15

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

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

acetoacetyl-CoA reductase (PhbB) to R-(–)-3-hydroxybutyryl-CoA. The final step is the polymerization of 3-hydroxybutyryl-CoA to PHB with concomitant release of CoA which is catalyzed by the PHB synthase(phbC) .
Methodology: Acid hydrolysis and enzymatic hydrolysis of coir waste followed by the preparation of nitrogen deficient coir hydrolysate medium with the inoculation of *Bacillus subtilis* was carried out and the optimum pH, temperature and incubation period for the maximum yield of PHB was determined.
Result: The extracted PHB polymer was assayed and confirmed by Law and Slepecky's method using con.H_2SO_4. Production of PHB was maximum at pH 7, temperature 37 C and incubation period of 2 days.
Conclusion: This study provided valuable information about the coir industrial waste utilization and as an inexpensive potential substrate for the production of eco-friendly plastic.

02-16

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

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Background: Antimicrobial peptides (AMPs), also called host defense peptides are part of the innate immune response found among all classes of life. They are small molecular weight proteins with broad spectrum antimicrobial properties against pathogenic organisms. They are evolutionarily conserved molecules, which are usually positively charged. They have the potential to act as novel therapeutic agents. The present study is focused on isolation of AMP from Black fin sea cat fish, *Arius jella*
Methods: The crude peptide was extracted by modified acetic acid-acetone precipitation method and its activity was tested against bacterial pathogens by disc diffusion assay. The peptide extracts were reconstituted in sterile milli Q and subjected to solid phase extraction using Sep-pak^R c-18 cartridges (Waters, USA). 5%, 40% and 80% Sep-pak^R fractions eluted was subjected for further purification by cation exchange chromatography employing UNO^{TM} QI (Q1 BioRad) column using Fast Protein Liquid Chromatography (FPLC). FPLC active fractions were tested for antimicrobial activity by the liquid growth inhibition assay against gram positive bacteria like *Bacillus cereus, Staphylococcus aureus* and gram negative bacteria *Vibrio alginolyticus.*
Results: The crude peptide sample from *Arius jella* displayed potential activity against the tested micro organisms. FPLC of 5% Sep-pak fraction yielded 6 fractions (Aj5-1, Aj5-2, Aj5-3, Aj5-4, Aj5-5 and Aj5-6), FPLC of 40% Sep-pak fraction yielded 5 fractions (Aj40-1, Aj40-2, Aj40-3, Aj40-4 and Aj40-5), FPLC of 80% Sep-pak fraction yielded 3 fractions(Aj80-1, Aj80-2 and Aj80-3). In the liquid growth inhibition assay Aj5-3, Aj5-5, Aj5-6, Aj40-1, Aj40-2, Aj40-4, Aj40-5 and Aj80-2 showed maximum inhibition(~90%) against the tested bacterial strains(*B.cereus, S.aureus* and *V.alginolyticus*)
Conclusion: The study suggests that the Black fin Sea cat fish is a source of potent antimicrobial peptides. The array of AMPs produced by this cat fish can be utilized by pharmaceutics to develop novel therapeutic agents.
Keywords: AMP, FPLC,Host Defense Peptides

02-17

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

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

Method: Sediment sample (2 Kg) was collected from the most inner zone of Kongsfjorden, Arctic as a part of Indian Arctic Expedition 2015-16 conducted by NCAOR, Goa. Viral population was enumerated using epifluorescence microscopy. Separation of virus from the samples was done through a series of steps such as washing, centrifugation, filtration, flocculation and resuspenison. The sediment suspended in the wash buffer was subjected to low speed centrifugationfollowed by high speed centrifugation. Then the supernatant was subjected to multi-step filtration through a series of filter membranes followed by $FeCl_3$-based virus flocculation and resuspenison. Viral nucleic acid isolation was done using QIAamp MinElute Virus Spin Kit (QIAGEN) from the Fe-virus flocculate.

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

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

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

02-18

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

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

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

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

Conclusion: The isolation and characterization of DEHP degrading *G. hongkongenesis*offers a new insight to plastic degrading bacteria from natural sources.
Key word: DEHP, Bacteria, biodegradation, *Gordoniahongkongenesis*

02-19

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

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Background: Bioactive peptides which are present in all classes of life as part of their innate immune system. In the present study two antimicrobial peptides ALF and Crustin have been identified and characterized from the Speckled shrimp, *Metapenaeus monoceros*.
Method: RNA was extracted from hemocytes and cDNA was synthesized. The PCR amplification of cDNA done with crustacean primers ALF and crustin at an annealing temperature of 60°C. PCR product was cloned into pGEMT Easy Vector and transformed into DH5 alpha *E.coli* competent cells. The plasmid was isolated and sequenced.
Results: Mature peptide region of ALF consisting of 100 amino acids exhibited 96% similarity to ALF from *Macrobrachium rosenbergii.* The ORF of crustin consisted of 115 amino acid residues showing maximum similarity to crustin from *Fenneropenaeus indicus* (99%).
Conclusion: The present study reports two antimicrobial peptides ALF and Crustin from *Metapenaeus monoceros*. Further studies on expression profile of the AMPs might open a new avenue for the development of new drugs to fight microbial infections.
Keywords: Antimicrobial peptides, Antilipopolysacchaide Factor, Crustin.

02-20

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

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Mucuna pruriens. L is a leguminous plant of Fabaceae family and is a natural source for L-Dopa (3,4-dihydroxyphenylalanine). L-Dopa is a precursor for neurotransmitter which is used against Parkinson's disease. In the present study, callus cultures of *Mucuna pruriens* were developed in modified Murashige-Skoog (MS) medium with hormonal supplementation. The study focused on NMR based metabolic profiling in catecholamine biosynthetic pathway and the effect of elicitation on L-Dopa production.
Callus cultures were established in MS medium supplemented with benzyl amino purine (BAP 1mg/mL).Abiotic elicitor namely, methyl jasmonate (MeJA) was supplemented to the callus cultures at different concentrations (0.1-2mg/L) and its effect on L-Dopa production was studied. Elicited callus was extracted and harvested using acidified aqueous extract and quantified using high performance liquid chromatography (HPLC). Quantification was also correlated with high performance- thin layer chromatography (HPTLC) using standardized solvent system n-butanol: acetic acid: water.
Callogenic response of the cultures was recorded in regular intervals and was possible to obtain full-fledged callus cultures in 20-25 days using hormone supplementation. Compared to the untreated control sample, 3-4 times increase in L-Dopa production was seen in 1mg/L concentration of MeJA. NMR based analyses of catecholamine metabolites in *Mucuna* were performed using 50% aqueous methanolic callus extracts (untreated with elicitor) using standard protocol. The callus cultures induced from nodal explants showed signals of catecholamines and the highest signal was of tyrosine followed by L-Dopa using NMR spectroscopy. These are precursors for major catecholamine and neurotransmitter dopamine, which has therapeutic potential. In this study, the metabolite content of callus cultures of *Mucuna* was estimated and studied using the powerful tool for compound identification. This work establishes the enhancement

of L-Dopa using elicitor treatment in callus culture, which can be optimized and exploited for large-scale production.
Keywords: *Mucuna pruriens*, MS medium, MeJA, HPLC, HPTLC, NMR

02-21

ANTICANCER AND ANTIBIOTIC EXTRACTS FROM INTERTIDAL MACROALGAE ASSOCIATED HETEROTROPHS

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Background: Since the discovery of the first antibiotic with anticancer activities, numerous researches have been focused on isolation, modification, partial or total synthesis, over and above uncovering the mechanism of action, increasing the efficacy, and in the meantime reducing the toxicity of potential metabolites. The marine environment is a habitat for many unique microorganisms, for instance, marine surface associated microorganisms especially, macroalgae associated microbes have proven to be a rich source for novel bioactives because of the necessity to evolve allelochemicals capable of protecting the producer from the brutal competition that exists between microorganisms on the surfaces of marine hosts. As is the case for bioactive discovery in general, progress in the detection and characterization of marine microbial bioactives has been limited by a number of obstacles, such as unsuitable culture conditions, laborious purification processes, and a lack of de-replication.
Method: The work ascertain the production of antibacterial compounds from selected intertidal macroalgae associated heterotrophs collected from the Southern coast of India, in a culture-dependent method, identified as *Shewanella algae* (KX272635) and *Bacillus amyloliquefaciens* (KX272634) and their ability to inhibit infectious diseases and prevent cell proliferation in human cancerous cell lines such as Liver carcinoma cell lines (HepG2) and Breast cancer cell lines (MCF 7) without affecting the normal cells, ie, fibroblast cells (L929) by means of micro dilution method and MTT (3-(4, 5-dimethylthiazol-2-yl)-2,5- diphenyltetrazolium bromide) screening assay, respectively.
Results: Significant antibacterial activity of organic extracts was observed against broad spectrum pathogens including Multi Drug Resistant pathogens MRSA and VRE (minimum inhibitory concentration 6.25-12.5 µg/mL). The extracts were also exhibited anticancer activity against human carcinoma cell lines, HepG2 with the best half maximal inhibitory concentration IC_{50} 77.64 - 82.68 µg/mL and MCF^{V} with IC_{50} 44.96 - 47.97 µg/mL in MTT screening assay without showing any cytotoxic effects (IC_{50} on L929 cell lines above 100 µg/mL).
Conclusion: This study evaluated the antibacterial activities and cytotoxicity of the secondary metabolites of intertidal macroalgae associated heterotrophic bacteria. The secondary metabolites from the bacteria shown antibacterial activity against clinically significant pathogens and anticancer activity against human cancer cell lines without exhibiting cytotoxicity against normal cell lines.
Keywords: antibiotic, anticancer, heterotrophic bacteria, surface associated microorganisms, human cancerous cell lines

02-22

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

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

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

02-23

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

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Background: *Aerva lanata* Juss. (Amaranthaceae) is a vital medicinal plant used in traditional medicine for the treatment of diabetes mellitus, urinary calculi, hematesis, bronchitis, nasal bleeding, cough, scorpion stings, fractures, spermatorrhea etc. The increasing demand together with lack of cultivation of the plant necessitates efforts for its conservation. This study aims to develop a micropropagation based stratergy for the conservation of *Aerva lanata* Juss.
Method: The present work suggests protocols for the large scale multiplication through shoot tip/nodal segment culture and indirect organogenesis. The explants were cultured on MS (Murashige and Skoog) medium fortified with different concentrations of benzyl adenine (BA) or Kinetin(KIN). Combinations of BA/ KIN along with indole 3- acetic acid (IAA) was also used to initiate cultures. Encapsulation of explants in the form of synthetic seeds and general cytochemical analysis of the callus were also done as part of the study.
Results: A maximum of 3 shoots were induced from nodal segments cultured on MS medium amended with 1 mg/ l BA. 3 shoots have emerged from shoot tip explants in presence of 2 mg /l BA. 3 shoots were developed from nodal segments in presence of 1 mg/l KIN. Callus was induced from stem explants cultured on MS medium supplemented with 2.5 mg/l BA alone and also in cultures containing 1 mg/l KIN and 1 mg/l BA.
Conclusion: Tissue culture protocols were standardized for the micropropagation of *Aerva lanata* Juss. Rapid clonal multiplication was achieved via nodal segment culture, shoot tip culture and indirect organogenesis.
Keywords: Micropropagation, *Aerva lanata* Juss., Murashige and Skoog medium, Encapsulation, Indirect organogenesis, Indole 3- acetic acid, Benzyl adenine, Kinetin

02-24

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

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

Method: The preliminary dataset for the work was obtained from transcriptome sequencing and profiling of mosaic infected *A.paenifolius*. About 25152 sequences were used for study**.** MISA and SSRIT tools were used for the identification of SSR.Micro Satellite Identification tool allows identification and localization of perfect microsatellites as well as compound microsatellites which are interrupted by certain number of bases. General syntax for running MISA is Misa.pl <FASTAfile>.The tool SSRIT (Simple Sequence Repeat Identification) uses Perl regular expressions to find perfect SSR repeats within a sequence. Insilico validation was performed using FastPCR. Primers were designed with the aid of Primer3plus tool.Primer pairs are designed to amplify each discovered SSR site. Based on the hit percentage of contigs containing SSR, Sequences are selected.
Results: From 7000 contigs created, about 10,307 SSRs were identified using MISA. Around 1713 SSRs were identified using SSRIT. In MISA, Di type of SSR was found to possess higher percentage than other types of SSR. In SSRIT, Mono type of SSR was found high. By performing comparative evaluation it was found that MISA showed more promising SSR than SSRIT. Insilico validation was performed using FastPCR.SSR with hit percentage between 80% -100% was chosen. Primers were designed with the aid of Primer3plus tool.
Conclusion: Novel markers developed with the aid of these prediction tools which will aid in developing varieties resistance to dasheen mosaic disease in *Amorphophallus*. The availability of large EST sequence data makes it an economical choice to develop SSR markers. DNA polymorphism discovery using computational tools will help in the identification of SSRs in sequence data as well as designing primers for these markers. These will help plant breeders, new to molecular breeding and marker assisted selection to opt for SSR markers to solve crop disease related problems. Therefore it is more economical and efficient to use computational tools to identify SSR loci.
Keywords: Simple sequence repeats, Primers, Expressed Sequence tags, Markers

02-25

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

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Background: The *Pseudomonas aeruginosa* strains were isolated from sea water samples. Some of the strains produced pigments and it showed antimicrobial activity against pathogenic microorganisms. The antimicrobial activity was screened and the antimicrobial pigment were extracted and purified and subjected to UV-VIS absorption spectra analysis at a range of 200-700nm.
Methods: *Pseudomonas aeruginosa* strains were isolated from sea water samples in Zobell Marine agar plates and identified by Vitek 2 system analysis. Antimicrobial activity was screened by Cross streak method and Scrap method. The extraction of antimicrobial pigment was done. Purification of the pigment was done by column chromatography. Purified pigment was subjected to UV-VIS absorption spectra analysis at a range of 200-700nm (SHIMADZU UV-3600).
Results: The antimicrobial activity of the isolated *Pseudomonas aeruginosa* strains against test organisms such as *Escherichia coli, Salmonella typhi, Staphylococcus aureus* and *Bacillus cereus* were done. In Cross streak method, after incubation, the *Pseudomonas aeruginosa* strain that does not produce any pigments does not inhibit the growth of the test organisms. The *Pseudomonas aeruginosa* strain that produced blue green pigment, pyocyanin inhibited the growth of all the test organisms. The strain showing antimicrobial activity was subjected to scrap method. After incubation, it was observed that the growth of all the test microorganisms were inhibited. The UV-VIS absorption spectra analysis of purified pyocyanin in 0.1N HCl showed peaks at 206 nm, 258.20 nm and 310.80 nm and that in methanol showed peaks at 218.80 nm, 230.20 nm and 308.80 nm.
Conclusion: This work concludes that the *Pseudomonas aeruginosa* strain that produced blue green pigment, pyocyanin showed antimicrobial activity against all the test organisms.
Keywords: Pyocyanin, *Pseudomonas aeruginosa*, Antimicrobial activity.

02-26

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

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Background: Antimicrobial peptides, which form the effector molecules of innate immune system of every class of life, continue to garner attention as alternatives to conventional antibiotics. Pioneering studies have led to the discovery of various types of these 'host defense peptides' with remarkably different structures and bioactivity profiles. Among the various cationic peptides, reported so far histones and histone-derived fragments with antimicrobial activities have been found in some specific cells of a diverse range of organisms from microbes tomammals.
Method: Isolation and molecular characterization of a putative Histone-derived antimicrobial peptide from the Malabar trevally, *Carangoides malabaricus* has been done.Total RNA was isolated from gills using TRI ® reagent (Sigma) following manufacturer's protocol. First-strand cDNA was generated. PCR amplification of the cDNA was done using Hipposin primer. PCR products were cloned into pGEMT Easy Vector, and transformed into DH5 alpha *E.coli* competent cells. Positive recombinant clones were selected for plasmid isolation. Recombinant plasmids were sequenced and *insilico* analysis done.
Results: *Carangoides malabaricus*Histone H2A (CMH2A)nucleotide sequenceconsisted of 243 bp, encoding 81 amino acid sequences, which showed 90% similarity to H2A identified from *Serioladorsalis*.
Conclusions: Histones are conserved eukaryotic cationic proteins present in the cells and are involved in the antimicrobial activities. Hence, characterization of CM H2A showed that they can be a potential candidate for development of therapeutic drugs.
Keywords: Antimicrobial peptide, Histone, *Carangoides malabaricus*

02-27

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

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Background: Drug resistance is a major problem associated with cancer chemotherapy which limits the effectiveness of drug treatment. Cancer cells evade drug treatment by entering a reversible drug tolerant state which is non-cycling in nature. The survival signalling mechanism can be targeted to limit the drug escape of these tolerant cells.
Method: Cancer cell lines of different origin were engineered to express genetically encoded probes for apoptosis, autophagy and cell cycle. These cells are treated with different classes of anticancer agents at very high concentrations to generate drug tolerant cells and these cells were analysed for various survival signaling pathways by immunoblotting and live cell imaging.
Results: Adaptive autophagy with the induction of stress proteins like Hsp90 and Nrf2 stabilize the drug tolerant cells in their non-cycling state and protect the cells. These novel pathways can be targeted by small molecule inhibitors to prevent drug escape and tumor recurrence.
Conclusions: Autophagy and stress signalling by Nrf2 and Hsp90 plays a key role in the generation of drug tolerant cells during cancer chemotherapy
Keywords: Drug resistance, Tumor recurrence, Autophagy, Live cell imaging

02-28

PRECLINICAL EVALUATION OF THE CHEMOTHERAPEUTIC EFFECT OF KAEMPFERIDE AGAINST CERVICAL CANCER

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

Methods:

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

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

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

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

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

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

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

03 - CHEMICAL SCIENCES

03-01

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

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A novel Suzuki type cross-coupling reaction of organoboron reagents with alkynyl bromides have been developed in the presence of catalytic Et_2Zn/DMEDA system. The reaction afforded a variety of internal alkynes in moderate to excellent yields under mild reaction conditions without the formation of any homocoupling products. The resulting internal alkynes have valuable applications in pharmaceutical as well as in industrial areas. The use of relatively non-toxic zinc and chelating amine ligand, low reaction temperature make this protocol a better alternative for the synthesis of internal alkynes. The scope and limitations of this protocol were investigated.

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

03-02

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

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

complex have been developed and identified as suitable catalyst for coupling reactions.
In our study, we have successfully developed a novel reusable copper and palladium supported polymer catalysts by metal complexation on chemically modified polymer. As heterogeneous catalysts, they exhibit both high activities and excellent recyclability in classical coupling reactions. The results of this investigation involving optimization and generality studies using a series of substrates with various electron demands are described.
Keywords: Polyacrylonitrile; Supported Catalysis; Coupling reaction; Copper; Palladium

03-03

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

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Background: Metal organic frameworks have aroused a flurry of interest in recent years owing to their fascinating architectures and potential applications. To date large number of coordination polymers have been synthesized on the basis of carboxylate, phosphonate, sulfonate and nitrogen heterocyclic ligands. Herein, we employed a new polytopic compartmental ligand, 2,3-butanedione bisisonicotinichydrazone (BDIH) with three remote binding sites for the construction of a novel Cd-MOF.
Method: The ZMOF was synthesized by simple refluxing rather than hydrothermal methods. The single crystals were isolated by recrystallization. The complex was characterized by X-ray diffraction, thermal analysis, UV-Vis and FTIR spectroscopy, SEM and rheology.
Results: Cd(II) in MOF is heptacoordinated and adopts a pentagonal bipyramidal geometry. The framework contains hexagonal channels along crystallographic 'c' direction and resembles SOD topology. The complex exhibit reversible thermochromic behavior over a working temperature ranging from room temperature to about 80 °C. The thermochromism is investigated by variable temperature UVDRS, FTIR and PXRD studies. Coordination driven gelation of Cd-MOF is also demonstrated. It shows a super smart and fully reversible thixotropic property and anion selectivity.
Conclusions: A novel Cd-MOF derived from a polytopic compartmental ligand have been constructed. The unusual thermochromism and gelation property of this MOF opens up new insights into the construction of novel smart MOF materials.
Keywords: *sod*-ZMOF, Thermochromism, Coordination polymer gel, Rheology

03-04

PHOTOLUMINESCENCE PROPERTIES OF PARA-AMINOBENZOIC ACID COMPLEXES OF EU^{3+} AND TB^{3+} ENCAPSULATED IN ZEOLITE Y

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Background: Lanthanide organic complexes show advanced luminescence properties and high colorimetric purity of the emitted light but their applications are limited due to low mechanical and thermal stability. In order to overcome this limitation lanthanide based hybrid materials which combine the advantages of inorganic part (high thermal and mechanical stability) with the benefits of organic part (synthetic versatility, luminescence property etc) are synthesized. This study reports stable inorganic organic hybrid material; para amino benzoic acid lanthanide(Eu^{3+} or Tb^{3+}) complex encapsulated in zeolite Y.
Methods: Lanthanide exchanged zeolite Y was synthesized by ultrasonication of the lanthanide solution with activated zelite Y followed by annealing. Para-amino benzoic acid was introduced to the lanthanide exchanged zeolite Y via ultrasonication to form zeolite Y encapsulated Eu^{3+}/Tb^{3+} complex.
Results: The synthesized Tb^{3+} based hybrid material showed good luminescence property and increased thermal staility

Conclusion: High luminescence property together with the high thermal stability would enable the use of synthesizedTb^{3+} based hybrid material in applications like luminescent probes, sensors, etc.
Key words: inorganic-organic hybrid material, zeolite Y, luminescence

03-05

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

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Background: Photoacoustic (PA) imaging is an emerging modality that brings significant promise to enhance the depth of penetration as well as spatial resolution, while maintaining the high contrast of optical imaging. However, the utility PA imaging has not been fully established owing to a lack of analyte-specific photoacoustic probes. In this work, we will present the development and evaluation of novel PA contrast agent based on squaraine (SQ) dye, which has an intense absorption at NIR-II region, poses much better photostability and higher PA efficiency compared to commercial ICG (Indocyanine green)dye.
Methods: SQ dyes were synthesized by the condensation reaction of benzindolium salts (1) and squaraine derivatives in 1:1 butanol/benzene mixture at 100^{0}C gave the corresponding SQ dyes in 10% yields. The structure was characterized *via* ^{1}H &^{13}C NMR, and mass spectrometry. The spectral features of dyes were measured using UV-Vis-NIR spectrophotometer (Evolution 220). To evaluate the PA efficiency, solutions of SQ1, SQ2 and ICG in dimethylsulphoxide (DMSO) at optical density (OD) of 1.0 were prepared and their photoacoustic spectrum was measured using Vevo 2100/LAZR system operating with a 40 MHz linear array transducer (FUJIFILM VisualSonics, Inc., Toronto, ON, Canada). **Results and Discussion:** SQ dyes absorbs in the NIR-II window, more specifically, has a strong absorption within 850 to 1000 nm. Furthermore, SQ dyes has high molar extinction coefficients in the range (2-4x10^5 M^{-1} cm^{-1}) and exhibit higher photostability. The PA signal strengths recorded for the SQ1 dyes are 4.8 -fold stronger than the signal for the benchmark compound ICG. The signal strength recorded for SQ2 is still nearly 3.6-fold stronger shows the relative advantages of the SQ dyes overICG.
Conclusions: We have demonstrate the synthesis of small organic SQ dyes, absorbing in the NIR-II region by appropriate turning the donor and acceptor moiety. SQ dyes exhibits better photo-stability and higher photoacoustic activity compared to the commercially available ICG, makes it a promising PA contrast agent. Ongoing studies will examine scattering and penetration effect on both tissue mimic phantom and biological hard tissues. Future work will focus on the application of SQ dye as contrast agent for *in vivo* PA imaging.
Keywords: Near Infrared, Contrast agent, Photoacoustic Imaging,

03-06

GRAPHENE QUANTUM DOT- PORPHYRIN NANOCONJUGATES FOR PHOTODYNAMIC THERAPY

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

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

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

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

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

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

03-07

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

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

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

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

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

obtained in moderate to excellent yields. The reaction is more effective in room temperature than at elevated temperature.
Conclusions: We have developed a simple, rapid, efficient and green method for the synthesis of perimidines from 1,8-diamino naphthalene and benzaldehyde in the absence of any catalyst on water at room temperature in 30 min time.
Keywords: Perimidine, 1,8-diamino naphthalene, aldehyde, water, heterocycle

03-08

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

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Background: With the evolution and progress of nanofillers, rubber technology has been undergoing a sea change. The present work has been undertaken in this context to develop nanofillers from biobased and renewable sources through simple and eco-friendly methods to upgrade natural rubber (NR). This work is particularly relevant to the state of Kerala which produces 92 % of the country's natural rubber. The research has been focused on developing new fillers/methods that can be utilized for the sustainable development of the society. By the proper channelization of the agricultural waste materials into value-added products, problems like waste disposal, pollution etc. can be minimized.
Method: Chitin nanowhiskers (CHNW) were synthesized from chitin powder by acid hydrolysis method. The synthesized nanowhiskers were characterized using different analytical techniques like FTIR, XRD, SEM, TEM, TGA etc. NR-CHNW composites were prepared by using a masterbatch of CHNW in NR latex followed by dry rubber compounding in a two roll mill. The cure behavior, mechanical, thermal, dynamic mechanical, transport and fractographic properties of the composites were analyzed using ASTM standards.
Results: Chitin nanowhisker (10-30 nm) with high crystallinity index was synthesized in the alpha form. Cure enhancement was shown by natural rubber composite with 10 phr CHNW addition (NR-CHNW10). The tensile strength and tear strength of NR-CHNW10 composite showed an improvement of 10 % and 14 % respectively compared to neat NR. The swelling index of NR-CHNW10 composite was found to be less than that of NR gum. The fractographic studies of NR-CHNW composites revealed that effective stress transfer has taken place in the composite. The NR-CHNW10 composite showed an ample improvement in the onset degradation temperature (T_{on}), the temperature at which 50 % degradation occurs (T_{s0}) and the temperature at which maximum degradation occurs (T_{max}). The DMA studies revealed that there is no notable change in the glass transition temperature of NR-CHNW10 composite in comparison with neat NR. The loss tangent (tan δ) at 60 °C of NR-CHNW composite was found to be less than that of NR gum, indicate low rolling resistance. Thus they can be recommended for green tire applications.
Conclusions: Mechanical, thermal, dynamic mechanical and transport properties of NR can be improved by the addition of chitin nanowhiskers.
Keywords: Chitin nanowhiskers, Crystallinity, Composite, Green tire.

03-09

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

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

Method: After the preliminary treatments the obtained α-cellulose was used for the isolation of CNW. In a typical procedure 1 g of α-cellulose was hydrolysed by refluxing with 10 mL of 68% con H_2SO_4 at 40 □C for 1 h with vigorous stirring, followed by the addition of distilled water to quench the reaction. The suspension was centrifuged to remove excess acid. The resultant residue was rinsed, centrifuged and dialyzed against distilled water until constant pH was achieved. The resultant suspension was freeze dried. Different weight percentage of isolated CNW was dispersed in water containing PVA via ultrasonic treatment for 1 h at 30% amplitude. The PVA-CNW composite developed through solution casting technology.
Results: The isolated CNW was systematically characterised using different spectral and analytical studies. The FT-IR spectra confirm the delignification process and structure of CNW. The SEM images of α-cellulose and CNW indicates the self-assembled and highly agglomerated structures like stacked flakes. Strong hydrolysis also influence the lenth of the fibers. The TEM images of CNW suggest that cellulose fibre aggregate to form network of sub fibrils and are crystallized to nano fibrils. XRD results suggest that harsh hydrolysis affect both crystalline and amorphous domain. With respect to the pure PVA the tensile strength of composite was enhanced. The increase in mechanical strength of PVA composite revealed the presence of strong interfacial interaction and uniform dispersion of CNW on PVA matrix. However, a decrease in tensile strength of PVA composite is observed by changing the quantity of CNW from 2 wt % to 3wt %. This decrease in tensile strength can be explained on the basis of flocculation of CNW where CNWs are highly stabilized in water medium
Conclusions: During the isolation of CNW different components are isolated from Country almond shell and the isolated components are successfully characterised using different spectral and analytical studies. The potential capability of CNW was confirmed from mechanical studies on PVA-CNW biocomposite.
Keywords: Country almond shell, cellulose nano whiskers (CNW), Poly (vinyl alcohol), Solution casting.

03-10

MOLECULARLY IMPRINTED CONDUCTING POLYMER FOR ELECTROCHEMICAL SENSING OF CHLORPYRIFOS

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Background: Chlorpyrifos (CPF) is one of the most widely used organophosphorus pesticides in agriculture to control broad-spectrum of insect pests. Many reports have demonstrated that CPF could produce toxic effects by inhibiting acetylcholinesterase (AChE) and also induce oxidative stress and DNA damage. Molecular imprinting technique, produce selective and specific binding sites coupled with voltammetry offers fast response and sensitive CPF quantification.
Method: The present work involves the synthesis of multiwalled carbon nanotube (MWCNT) based molecularly imprinted conducting polymer (MICP) based electrochemical sensor for the trace determination of CPF in real samples. MICP was synthesized on thiophene linked MWCNT by in-situ oxidative polymerization mechanism using 3, 4-ethylenedioxythiophene (EDOT) as cross linker. Organized material was characterized by FTIR, SEM, and TEM analysis. The sensor electrode was fabricated simply by drop-casting MICP into glassy carbon electrode.
Results: The cyclic voltammetric curves demonstrated that MICP had a higher electrochemical response for $[Fe(CN)_6]^{-3/-4}$ compared with the other modified electrodes. The maximum peak response of the sensor was observed at pH 7.0 and was selected as optimized value for the electrochemical oxidation of CPF.
Conclusions: An efficient molecularly imprinted conducting polymer composite based electrochemical sensor for the sensitive and selective determination of CPF was successfully constructed using surface immobilizing of the template. A lower detection limit and a dynamic linear range obtained during DPV analysis can concluded to the applicability of the sensor in the analysis of CPF from real samples.
Keywords: Chlorpyrifos; Multiwalled carbon nanotube; Molecularly imprinted conducting Polymer; Electrochemical Sensing

03-11

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

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We have successfully achieved a promising protocol for the zinc-catalyzed S-arylation of aryl l thiols with differently substituted aryl iodides. The *in situ* generated Et_2Zn-BINOL in DME in the presence of K_2CO_3 at 80 °C showed moderate catalytic activity in C-S cross-coupling reactions.

R^1 = 4-CN, 4-$COCH_3$, 4-OCH_3

03-12

RECOGNITION OF Al^{3+} ION *VIA* TRANSMETALATION OF Ni (II) BASED BICOMPARTMENTAL SALEN SCHIFF BASE COMPOUNDS

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

Method: In order to investigate the sensing performance, 0.1 mmol of the synthesized compound (probe) was taken in R.B. flask and was heated under reflux condition at a temperature of 50 °C. To this solution, 0.2 eq of $AlCl_3$ in aqueous media was added and refluxed for 10 minutes. From the reaction mixture, 2000 µL was withdrawn and absorption and emission measurements were done to monitor the spectral changes and thereby the sensing performance. Job's plot and Life time measurements were done in order to study the mechanistic aspects. The selectivity of the analyte was also tested.

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

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

Keywords: Transmetalation, Salen Schiff base, Al^{3+} ion, Detection limit

03-13

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

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Background: Investigation of coordination complexes with halogen/pseudo halogen bridging ligands is of enduring interest to coordination chemists for their rich structural aspects and potential applications in various fields.However, up to now, 1D chain like compounds with chlorine as bridging ligand are rarely reported .Copper complexes of Schiff bases have aroused considerable attention to find new chemotherapeutic drugs because of their diverse biological activity and oxidative nature.
Method: An NNO donor tridentate Schiff base ligand, 4-bromo-2-(((3-(methylamino)propyl)imino)methyl)phenoland its one dimensional polymeric copper(II) complex were synthesized and physicochemically characterized by means of elemental analysis, molar conductivity measurements, FT-IR, UV-Vis, fluorescent and NMR spectral studies.Molecular structure of the copper complex was confirmed by X-ray crystallography. Hirshfeld surface analysis of the complex has been carried out. Moreover, the cytotoxicity of the complex has been screened *in vitro* against lymphoma ascites cell lines.
Results: From X-ray crystallography, copper complex is found to be a 1D coordination polymer in which chlorine acts as a bridging ligand. Value of Addison parameter for this complex is found to be 0.1813. Presence of different types of non-classical intermolecular interactions, which strengthen the polymeric chain of the complex, were further supported by Hirshfeld surface analysis and associated fingerprint plots. The emission profile of the copper complex reveals its quenching behaviour. Furthermore the copper complex exhibited a concentration dependent cytotoxicity against lymphoma ascites cell lines.
Conclusions: A one dimensional copper(II) coordination polymer of a Schiff base ligand has been synthesized and physicochemically characterized. From the value of Addison parameter, geometry of the complex is confirmed to be square pyramidal. Through the coordination to the metal centre, fluorescence of the Schiff base ligand has been quenched. As the concentration of the copper complex increases, its cytotoxic activity against lymphoma ascites cell lines increases. Complex produced a maximum of 78% cytotoxicity at 200 µg/mL.
Keywords: 1D coordination polymer, Schiff base, Hirshfeld surface analysis, Cytotoxicity

03-14

CONDUCTIVITY STUDIES OF POLYBUTYLMETHACRYLATE (PBMA) BASED NANOCOMPOSITES USING CEO_2 NANOPARTICLES

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The present work emphasizes on the effect of Ceria (CeO_2) nanoparticles on the conductivity properties of polybutylmethacrylate [PBMA] polymer. The PBMA nanocomposites with different loadings of CeO_2 nanoparticles were synthesized via in situ polymerization method. The incorporation of CeO_2 nanoparticles in the PBMA matrix were examined by FTIR, XRD and optical micrograph studies. The FTIR and XRD results confirmed the effective incorporation of CeO_2 nanoparticles in the PBMA matrix. The optical micrographs of the samples revealed the homogenous dispersion of nanoparticles in the PBMA matrix. The conductivity properties such as dielectric constant, dielectric loss and AC conductivity of the PBMA- CeO_2 nanocomposites were measured in various frequencies and are compared with bare PBMA. It was observed that the composites have better conductivity properties than bare PBMA.

03-15

SOLVENT FREE SYNTHESIS OF SPIROPYRROLIDINONES

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Background: Spiranes have received great attention nowadays because of their valuable properties. Spiropyrrolidinones, for example, are major structural motifs in many biologically active compounds. As the synthesis of spirohetereocyclics requires specific synthetic strategies the synthesis of these compounds are challenging for synthetic organic chemists. Furthermore, due to steric strain, the spiro compounds easily rearrange to different cyclic compounds. 1,3-Dipolar cycloaddition reactions represent a powerful tool for the synthesis of many pharamacologically important N-hetereocyclic compounds.Here we adopted a solvent free reaction of fluorenylnitrones with 1,1-disubstituted allene to afford spiropyrrolidinones. Our synthetic protocol is operationally simple and green.
Method: *N*-Fluorenylidene-*N*-phenyl nitrone (**1**, 0.27 g, 1 mmol) and allene (**2**, 0.2 g, 1 mmol) were heated at 110 °C in a sealed tube for 15 min.

Scheme 1

Results: We have examined the reaction between *N*-fluorenylidene-*N*-phenyl nitrone (**1**) with allene**2** under solvent free conditions. Here the spot of spiropyrrolidinone**4** was seen in tlc (thin layer chromatography) after 15 min. The product was isolated by routine column chromatography. Prolonged heating led to the decomposition of reaction mixture. IR spectrum of **4** indicated additional carbonyl group which was confirmed as keto carbonyl at 204 ppm in ^{13}CNMR spectrum. This structural feature ruled out the normal [3+2] adduct**3**as the final product. Moreover in ^{1}H NMR peaks corresponding to exocyclic double bond in **3** are absent; instead signals corresponding to diasterotopic methylene protons were observed at d 4.53 and 4.67 ppm, which further confirmed the possible rearrangement of isoxazolidine**3**to **4**.
Conclusion: We have developed a simple solvent free green approach for the synthesis of spiropyrrolidinones. Our method is operationally simple and requires short reaction time. Spiropyrrolidinones are important structural motifs with wide range of pharmaceutical applications as antibacterial, antifungal, antimalarial, anticancer agents.
Keywords: Nitrones, Allenes, Spiropyrrolidinones

03-16

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

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Background: Growing demand of nanotechnology based materials has attracted researchers to produce nanofibers and nanocomposites with attractive morphology and properties.
Method: Electrospinning is a simple and cost-effective method which can produce fibrous materials with broad range of diameter. This work explains the process of nanofiber formation and fabrication of ultrafine beadless polycarbonate (PC) fibers from very small quantity of polymer using less toxic solvents. Highly dispersive surface protected semiconductor cadmium sulphide (CdS) nanoparticles with attractive band gap, thermal stability, and prominent photolumi-

nescence properties were prepared by a low temperature and less toxic method. The PC nanocomposites prepared by dispersing the surface protected semiconductor nanoparticles were also characterized by various methods.
Results: Uniform fibers with average diameter 90 nm without any beads were formed at a PC solution concentration of 14 w/v%. TEM images of PC fibers incorporated with CdS shows dispersed nanoparticles throughout the fiber. This is confirmed by XRD analysis. The uv-visible spectrum of the PC fiber composite shows a red shift in absorption. The composite shows a characteristics optical property by the photoluminescent spectra.
Conclusions: The large specific surface area and small pore size of nanofibers obtained by this method making them excellent candidates for filtration and membrane applications. The polymer nanocomposites prepared by electrospinning after dispersing various nano sized materials also have wide variety of applications.
Keywords: Polymer nanocomposite, Electrospinning, Photoluminescence, nanofibers, Bead, Nanoparticles.

03-17

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

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Background: The strategies of waste management nowadays aim at making wealth from waste. Chicken feathers from poultry waste are an excellent prospect, because they are inexpensive and abundant. The present study aims on the use of waste chicken feather as filler in acrylonitrile butadiene rubber (NBR), which is a synthetic rubber that possesses good heat and oil resistance.
Method: Composites with three series of chicken feather fibres were studied i.e., raw (RCF), sterilized (SCF) and alkali treated (ACF). Composites were prepared using a conventional laboratory two roll rubber mixing mill. Surface modification of the fibre was done by alkaline treatment to improve the interfacial adhesion and it characterised by FTIR. The swelling behaviour of the composites in N, N-dimethylformamide, acetonitrile, dimethyl sulfoxide and water were analyzed for the swelling coefficient values. The biodegradable characteristics of CF reinforced NBR composites were studied by soil burial test. Effect of soil burial on the rubber was primarily followed by quantitatively observing the change in their mechanical properties.
Results and Discussion: Tensile strength, moduli at 10 and 20 % elongation and hardness of the composites decreased after ageing under soil due to the degradability of fibre. ACF- NBR composite shows highest drop in tensile strength and modulus. This is due to the degradation of fibres which easily takes place in the ACF composites by the direct involvement of micro-organisms. As the loading of fibre increases, the swelling coefficient value decreases in all solvents except in water. This is due to the increased hindrance exerted by the fibre at higher loading. It can be seen that the composites with ACF shows higher values of swelling coefficient than the gum sample.
Conclusions: The investigation shows that the addition of chicken feather to NBR improves its biodegradability as indicated by the decrement in values of mechanical properties. The solvent resistance of the composites also increaes upon the incorporation of fibres.

03-18

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

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

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

Method: This work focuses on developing a sensing platformfor the ultrasensitive detection of a few common pesticides. As part, sulphur-doped graphene quantum dot (S-GQD) as fluorescent probe was synthesized using graphene oxide as starting material, $KMnO_4$ as oxidising agent and H_2SO_4 as precursor for sulphur by sonochemical method with intermittent microwave heating at 400 W keeping the reaction temperature constant at 90 °C in 5 minutes. In order to make a solid state fluorescent material as a sensing device, polymer composite film based on poly (vinyl) alcohol (PVA), as matrix polymer and S-GQDs, were prepared by casting from aqueous solutions.

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

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

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

03-19

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

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

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

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

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

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

03-20

DEVELOPMENT OF COBALT NICKEL BASED METAL ORGANIC FRAMEWORK FOR PHOTOCATALYTIC HYDROGEN EVOLUTION

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

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

Keywords: MOF, water splitting, hydrogen

03-21

POLY (P-AMINO HYDROXYL NAPHTHALENE SULPHONIC ACID) MODIFIED ELECTROCHEMICAL SENSOR FOR THE SIMULTANEOUS DETERMINATION OF XANTHENE AND HYPOXANTHENE

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

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

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

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

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

03-22

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

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Background: The design and synthesis of halide/pseudohalide bridged dinuclear copper(II) complexes of aroylhydrazones have been an attractive area of research. Structural and magnetic properties of asymmetric double end-on ($\mu_{2\text{-}1,1}$-N_3) azido-bridged dimeric complexes are relevant in the current situation. Among the various transition metals, dinuclear copper(II) complexes are gaining more importance because of their relevance in biological fields.
Methods: Molar conductivity measurements,infrared, electronic, EPR and single crystal XRD measurements were used for the characterization of synthesised compounds.
Results: Crystallographic measurement reveal that the two copper(II) complexes were bromide/azide bridged box dimers having distorted square pyramidal geometry with monoclinic space group symmetry $P2_1/n$. Antibacterial and cytotoxic studies gave good results.
Conclusions: This work gave an idea about the syntheses, crystal structures, various stabilising interactions present inbox dimer copper(II) complexes of aroylhydrazone. Also the antibacterial and cytotoxicity studies of complexes were explored.
Keywords: Halogen bridged box dimer; Copper(II) complexes; Square pyramidal; Antibacterial

03-23

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

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

ple, efficient and economical approach for SET-LRP in which tiresome deoxygenation procedures were eliminated by the use of triphenylphosphine and this report constitutes the first description of SET-LRP using triphenylphosphine under ambient conditions. **Result:**
We showed that anthracene-bismaleimide DA adduct structural motif undergo *retro* DA reaction under the influence of mechanical stress to generate free anthracene and bismaleimide terminated chains, which can thus function as a stress sensor (**Scheme 1**) observed by concomitant development of UV−Vis absorption (**Figure 1**) and emission of anthracene chromophore. Interestingly both anthracnose emission and absorption of sonicated polymer faded over time (**Figure 2**) indicating self-healing.
Conclusion: We have developed an efficient SET-LRP method for the synthesis of high molecular weight materials under ambient conditions. The newly synthesized polymer combines stress-sensing with self-healing. Judicious selection of monomers and initiators can even lead to polymers that can potentially achieve self-strengthening of polymers under stress.

Scheme 1 **Figure 1** **Figure 2**

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

03-24

METAL FREE MODIFICATION ON Ag_3VO_4 PHOTOCATALYST FOR AUGMENTED SUNLIGHT INDUCED DEGRADATION OF ORGANIC POLLUTANTS IN WATER

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Background: Clean water is a necessity to life, while access to itbecame knotty than ever owing to recent floods. Recently, photocatalysts have been assessed to address this worsening concern. Herein, we demonstrate a sonochemical method for obtaining sulphur doped graphene oxide modified silver vanadate (sGO-Ag_3VO_4) nanocompositesas photocatalysts whereAg_3VO_4nanoparticles are dispersed on the sulfonated graphene oxide nanosheets. Modification by sGO is much desirable since it provides metal free, stable, eco-friendly and economic method to improve photocatalytic action of Ag_3VO_4.
Methods: The structural and optical properties of obtained nanocomposites were characterized by XRD, FTIR, UV-vis. DRS, PL,SEM and TEM analysis.
Results: Analysis revealed that the composite is star shaped and dispersed on sGO sheets promoting charge mobility and vanadate is present in α-Ag_3VO_4 form. Strong absorption span from 200-500 nm without much change in band gap (2.15 eV for composite) and a huge collapse in emission intensity was observed for composite relative to pure Ag_3VO_4indicating enhanced charge mobilization effect of sulphur doping, thus reducing charge recombination and photo corrosion rather than band gap. The photocatalytic degradation performance of the compositetowards organic pollutants was explored by using methylene blue (MB) as a model compound. The results showed that 1% sGO-Ag_3VO_4 nanocomposites could degrade ~99% of the dye within 30 min, under sunlight. Sulphur doping render sGO-Ag_3VO_4 with superior activity than sGO, Ag_3VO_4 and GO-Ag_3VO_4. With holes as the predominant active species in the system, the catalyst could bring about 99% degradation of textile dyes rhodamine B (RhB) while 50% for methyl orange (MO) and reactive red (RR) in 30 minutes.

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

Keywords: Sunlight, Photocatalysis, sGO, Ag_3VO_4, Pollutant, Degradation

03-25

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

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

Scheme: First iron catalyzed Ortoleva-King-type reaction towards the synthesis of imidazo[1,2-a]pyridines

Efforts to achieve quantitative yield of the product and to explore the scope of the reaction are going on in our laboratories.

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

03-26

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

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

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

Methods: Into an oven dried sealed tube containing magnetic stirring pellet was added aryl iodide (0.5 mmol), $MnCl_4.4H_2O$ (5 mol%), Cs_2CO_3 (1 mmol), phenol (0.75 mmol) and acetonitrile (3 mL). The tube is then evacuated, back-filled with nitrogen and stirred in a preheated oil bath kept at 110-145°C for 24-48 h. On the completion of time period the reaction mixture is quenched using water and extracted with ethyl acetate, dried and concentrated. The crude mixture obtained thus was purified with silica gel column chromatography using hexane/ethyl acetate.

Results:

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

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

03-27

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

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

Methods: A 10 ml glass vial was charged with 1-bromo 2-substituted acetylene (0.5 mmol, 1 equiv.), organoboron compound (0.6 mmol, 1.2 equiv.), CuI (0.05 mmol) and K_3PO_4 (2 equiv.) in ethanol (3 ml). The mixture was stirred at 130 °C for 15 min in a microwave reactor. The reaction wasquenched 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: At first the initial reaction was conducted by choosing phenylbromoacetylene**1a** and 4-phenylboronic acid **2a** as model substrates in ethanol expecting the formation of 1,2-diphenylacetylene as the product **3a**. Firstly we started our reaction by screening different Cu salts and found that CuI showed good catalytic activity compared to other Cu salts. $Cu(acac)_2$ also gave comparatively good yield. Cu salts like CuBr and$CuBr_2$ showed some catalytic activity but

less than that of CuI. Then we focused our investigation on the effect of different bases on the microwave assisted copper-catalyzed coupling reaction. Among the screened bases, inorganic bases gave considerably good yield compared to organic bases and K_3PO_4 was found to be the most effective one giving the coupled product in 83% yield.
When the reaction was carried out using higher catalyst loading of 15 mol%, the yield of the desired product **3a** remained the same as 83%. In order to optimize the temperature, the reaction was conducted at higher and lower temperatures than the 130 ^oC used in the above reaction, which afforded only decreased yield in both the cases. Increasing the reaction time from 15 min to 20 min showed no change in the yield of the reaction. Thus, under the optimized condition of 10 mol% CuI and 2 equiv. of K_3PO_4 in 3 mL ethanol under microwave irradiation at 130 ˚C for 15 min we could successfully prepare the differently substituted diphenyl acetylenes in good to excellent yield.
Conclusion: In short, we have developed a copper-catalyzed protocol for the synthesis of 1,2-disubstituted acetylenes in good to excellent yields from organoboron derivatives and alkynyl bromides using microwave irradiation under ligand-free conditions. The best condition that we have observed was a catalytic system consisting of copper (I) iodide (10 mol%) in the presence of K_3PO_4 (2 equiv.) as base in ethanol (3 ml) at 130°C for 15 min under a MW reactor. Internal alkynes are important synthons present in many complex molecules and thus it is worthwhile to develop an eco-friendly and cheap catalytic method with minimum consumption of time.
Keywords: Cu-catalysis, C-C bond formation, Suzuki coupling, internal alkynes, alkynyl bromides, boronic acids.

03-28

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

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Background: At present the world is in great need of technologies providing renewable energy. The challenge is how to meet the increasing global energy consumption without sacrificing our future environment. More solar energy strikes the earth in one hour than all the energy consumed on the earth in a year. Solar energy provides clean abundant energy and is therefore an excellent candidate for a future environmentally friendly energy source. Solar cells are the devices that convert light energy into electrical energy. Looking at photovoltaics, dye sensitized solar cell is considered to be a promising candidate, they having long shelf life and are low cost renewable energy sources.
Carbazole based derivatives have attracted much attention because of their interesting photochemical properties. Recent interest in the carbazole derivatives have been caused by its good charge transport function, which can be exploited in the molecular design of new types of HTMS in DSCs. Another fascinating advantage is the versatility of the carbazole reactive sites that can be substituted with a wide variety of functional groups, allowing fine tuning of its optical and electrical properties. The carbazole derivatives generally possess good thermal stability and hole transport properties. The combination of carbazole derivatives and triphenyl amine derivatives is expected to offer the improved thermal and morphological stabilities as well as their good hole transport properties.
Molecules contain a π-rich heterocyclic or aromatic ring system functionalized with one or more electron donating substituents exhibits good hole transporting properties. The most commonly encountered substituents are amino and alkoxy groups, which contain single bonded heteroatoms possessing sharable lone pairs. The most widely used hole transport molecule are aromatic amines. Carbazole based derivatives have attracted much attention because of their interesting photochemical properties, good chemical and environmental stability provided by the fully aromatic unit, easy substitution of the nitrogen atom with a wide range of functional groups permitting a better solubility and a fine tuning of the electronic and optical properties.
The present work focuses on the synthesis of a hole transporting material based on carbazole by Ullmann coupling. By using the synthesized compound and a natural dye, organic dye sensitized solid cell was fabricated and the performance analysed .
Materials: The reagents Carbazole, Dimethyl formamide , NBS, Potassium carbonate , Copper powder,Copper(I) chloride,Ethanol(Commercial- distilled), 1,2-Dichlorobenzene,Sodium,Sodium nitrite, Aniline,Glacial acetic acid, Chloroform, Ethylacetate, 18-crown-6 were purchased from Merck. The solvents were distilled before use according to availing procedures in literature. Spectroscopic grade solvents (Merck) were used for UV-Visible spectroscopic measurements.
Infrared (IR) spectra were recorded on a Shimadzu FT-IR 8400 S spectrometer as Potassium bromide (KBr) disc.

UV-Visible spectra were recorded on a UV-Vis Shimadzu 1700 using 1.0 cm length quartz tube.^{1}HNMR spectra were recorded on a NMR-JEOL GSX-400 spectrometer with tetramethylsilane as the internal reference using $CDCl_3$ as solvent.

Synthesis of 3, 6 – dibromocarbazole (A)

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

The completion of the reaction was monitored by TLC.

Scheme 1

Synthesis of 3, 6 – diethoxycarbazole (B)

3, 6-diethoxycarbazole (B) was prepared from 3,6-dibromocarbazole on treatment with sodium ethoxide and copper (I) chloride. Yield: 60%, Appearance: Pale brown solid, Melting point: 185^0C

Scheme 2

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

1,3,5-Tribromobenzene(C) was prepared from 1,3,5-Tribromoaniline according to available procedure of Vogel. Appearance: white solid, Melting point: 122^0C

Scheme 3

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

3,6-Diethoxycarbazole 1.25g (0.0075 mol), Tribromobenzene 0.8g (0.0025 mol), 2.65g K_2CO_3, 1.8g Copper powder and 200mg of 18-crown-6 were heated together in 50ml of orthodichlorobenzene under nitrogen atmosphere and the resulting mixture was refluxed for 24hrs at 170^0C. The inorganic compounds were removed by filtration and the filtrate was diluted with water. The combined organic layers washed with brine, drying by passing through sodium

sulphate and concentrating in vacuum. Appearance: pale brown solid, Melting point: 160^{0}C

Scheme 4

Dye extraction

Red sandalwood was commonly known as 'rakta chandan' (botanical name: *'Pterocarpus santalinius'*, $C_{14}H_{14}O_7$). Perkin and Everest have identified that there are at least two or more maroonish red colouring components in the red sandalwood, viz. santalin A, santalin B and deoxysantalin of which santalin A is considered as the main component. Red sandal was extracted according to the literature (Samanta *et al* 2006)

Results

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

Characterization of 3, 6 – dibromocarbazole

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

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

FT- IR Spectra (KBr, cm^{-1}): 3406, 3068, 1471, 1284, 570

FT-IR gave characteristic peaks 3406cm^{-1} indicated NH stretching frequency, 3068cm^{-1} indicated the Ar C-H stretching, 1471 cm^{-1} indicated the Ar C=C stretching, 1284 cm^{-1} indicated the C-N stretching and 570 cm^{-1} indicated the C-Br stretching.

Characterization of 3, 6 – diethoxycarbazole

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

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

Characterization of 1, 3, 5 – Tribromobenzene

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

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

FT- IR Spectra (KBr, cm^{-1}): 3409, 1326, 1053

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

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

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

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

FT- IR Spectra (KBr, cm^{-1}): 3070, 1326.

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

^{1}H NMR Spectra ($CDCl_3$, ppm): 7.1-7.9 (m, 21 H), 3.48 (s, 12H), 1.58 (s, 18 H)

The NMR spectrum confirms the presence of aromatic ring at7.1-7.9δ, $–OCH_2$ group at3.48δ and $–CH_3$ group at 1.5δ. The structure of the synthesized compound 9-(3,5-bis(3,6-diethoxy-9-H-carbazol-9yl)phenyl)-3,6-diethoxy-9H-carbazole is confirmed from the spectral data.

Device Fabrication

DSSC device comprised of a transparent conducting oxide (TCO) glass electrode coated with porous nano crystalline titania (TiO_2), dye molecule attached to the surface of the nano crystalline titania, hole transporting material and a counter electrode. Fluorinated tin oxide (FTO) coated transparent glass strips (25mm x 25mm) with resistance of 30μohms were used for the device fabrication. The structuring of the TCO is done using a chemical etching method. Zinc granulates are spread out on the glass (٢٠ mg/cm^2). Scotch tape is used to mask the TCO area needed for the back contact. The fast reaction between HCl and Zinc powder leads to the removal of the SnO_2 .After two treatments of 3 minute reaction time, the SnO_2 is completely removed. The structured glass is then cleaned by ultra sonication in various solvents such as acetone, ethanol and water, for 10 min in each solvent. Compact TiO_2 (30 nm) were deposited on FTO glass by spin coating that acts as a blocking layer. The FTO is placed in a chamber for 1 min and accelerated at a speed of 1000 rpm. 150 μl of TiO_2 solution is applied onto the substrate. The substrate is spun up to a speed of 1000 rpm for 30 second with an acceleration of 200 rpm/s. The samples were dried for 30 min. After deposition, the prepared TCO/ TiO_2 was annealed at 200°C for 1 hour in air with a hot plate to achieve complete pyrolysis of organic species. Then nanoporous TiO_2 (~2.5μm) was coated by doctor blading. The layers were sintered for 30 min at 350 °C to consume the organic additives and to obtain mechanically stable samples. Then the sample is cooled down slowly to 80 °C and placed into alcoholic solution of red sandal dye overnight. After the dip coating, HTM in THF deposited on the cell by spin coating method. The cells were kept overnight to allow maximum penetration of HTM in TiO_2. The metal electrode silver (200 nm) is coated on HTM of DSSC by thermal evaporation. The current-Voltage (I-V) characteristics is monitored and measured by using a Keithley 276 source measurement unit.

Photocurrent-Voltage (I-V) characteristics of DSSC based on D as HTM is measured using I-V characteristic curve plotted in figure 1.The result for photocurrent density (Isc), open-current voltage (Voc), fill factor(FF) and corresponding photo-energy conversion efficiency (η) are summarized in table ١.The low conversion efficiency may be due to the following reasons: (i) instead of the ruthenium dye, which is commonly used for DSSC s, we used a natural dye, the red pigment of red sandal and (ii) instead of gold as back electrode we applied silver.

Compound	Voc	Isc	Jsc	FF	η
D	1.7476	0.006487	0.2162	2.223	0.84

Table 1

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

Conclusion

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

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

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

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

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03-29

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

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

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

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

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

Keywords: Drug Delivery System; Curcumin, Layerd double hydroxide

03-30

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

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

hydrogen peroxide serves as the best terminal oxidant next to dioxygen. Among the various transition metals used as catalysts, molybdenum(VI) compounds containing the *cis*- $[MoO_2]^{2+}$ core have been successfully studied in recent years due to their application in biological and industrial oxidation processes and oxo- transfer reactions.Among the various co-ligands used, O, S based systems *viz*,thiosemicarbazones have been received considerable attention owing to the essential role played by these atoms in the coordination sphere of molybdenum containing enzymes.

Method: This work deals with the synthesis of a new dioxidomolybdenum complex, *viz*, $[MoO_2L(MeOH)]$ (where H_2L= 3 Ethoxy-salicylaldehyde-N(4)- (3-methoxyphenyl) thiosemicarbazone) as catalyst which can be used along with $NaHCO_3$ as co-catalyst to function as an efficient peroxidicepoxidation catalyst.

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

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

03-31

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

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

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

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

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

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

03-32

PLANARITY CONTROLS THE ULTRAFAST INTRAMOLECULAR SINGLET FISSION DYNAMICS IN PENTACENE DIMERS

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Background: One of the sustainable techniques to meet world power consumption, with reduced manufacturing costs and adequate power conversion efficiency is the design of efficientphotovoltaic devices. The third generation solar cell, aimed to improve power conversion efficiency, can be accomplished by singlet fission (SF) process, since it converts high energy photons into two triplet excitons and exceeds the Shockley-Queisser limit. The understanding of the SF mechanism is challenging,influenced by the various factors including, molecular orientation, conformation and energy levels of the chromophores.
Method: The influence of planarity of the bridge on intramolecular singlet fission (iSF) dynamics in series of 2,2'-linked bipentacence derivatives has been investigated using femtosecond time resolved spectroscopy and nanosecond laser flash photolysis. Hence we synthesized three dimers having different bridges such as (i) fluorine,planar with rigid, (ii) 2,2',6,6' tetramethyl 1,1'biphenyl,twisted and (iii) diphenylacetylene,planar with longer conjugation.
Results: Transient absorption spectra of these dimers revealed the occurrence of the iSF dynamics by changing the excitation energy and concentration. A large difference of formation oftriplet excitons was observed between planar (200 ps) and twisted dimers (12 ns). The ultrafast photoexcitation of planar dimers yields ~200% triplet compared to twistedyielding 20%.
Conclusions: Ultrafast investigation of these bridged pentacene dimers revealed that theplanarity of bridge controlsiSF dynamics and provides new guidelines to design efficient iSF chromophores.
Keywords: Intramolecular singlet fission, Pentacene dimers, Femtosecond pump-probe spectroscopy, Nanosecond laser flash photolysis.

03-33

IRON-LOADED BIOCHAR AS A SUPER CAPACITORS

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Background: In this work, we demonstrate a facile fabrication method for the synthesis of Fe loaded biochar/PANI composite by using low-cost banana stem waste. The produced polymer composite shows an enhanced specific capacitance 613 F/g.
Method: Characterization study of Fe loaded biochar/PANI composite done by FTIR and the electrical conductivity as well as the electrochemical performance were analyzed using cyclic voltammetry.
Result: Functional groups are well characterized by FTIR. Data obtained from electrical conductivity and CV helps to calculate the Cs value of polymer composite (613 F/g).
Conclusion: Fe loaded biochar/PANI composite exhibits a good potential for future supercapacitor applications.
Keywords: Fe loaded biochar/PANI composite, specific capacitance, supercapacitors

03-34

BIOSYNTHESIS OF CALCIUM OXIDE NANOPARTICLE AND ITS ANTIBACTERIAL ACTIVITY

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

ity for pharmaceutical and other biomedical applications as they do not use toxic chemicals for the synthesis. Calcium oxide nanoparticles have several applications in catalysis, adsorption, water purification and also as antibacterial agents.
Method: This work made use of Piper betel leaf extract for the synthesis of nano calcium oxide from calcium nitrate [Ca $(NO_3)_2.4H_2O$]. The polyols present in the leaf extract acted as capping as well as reducing agents for the synthesis. The precipitate formed in the reaction between calcium nitrate and leaf extract was collected, dried and calcined at 600°C for 3 hours. It was then tested for antibacterial activity towards Staphylococcus aureus and Pseudomonas aeruginosa using agar well diffusion method.
Results: The crystalline nature and particle size of calcium oxide nanoparticle was obtained using XRD technique. The average crystallite size was found to be 24.9 nm. SEM image showed that the prepared nanoparticles were spherical in shape. Absorption spectrum of CaO nanoparticle was recorded and λ_{max} was found to be 262 nm. The band gap energy calculated using Planck's equation was found to be 4.73 eV. It was observed that CaO nanoparticles showed good antibacterial activity at a concentration of 1000µg/ml towards Staphylococcus aureus (13mm) and Pseudomonas aeruginosa (13mm).
Conclusion: The present work demonstrates a good method for developing a simple, safe, cost effective and ecofriendly preparation of CaO nanoparticles using an aqueous extract of piper betel. Piper betel leaf extract act as reducing as well as capping agent and proves to be an excellent source for synthesizing nano CaO. XRD and SEM studies confirmed the formation of nano CaO of spherical shape. FTIR analysis reveals that biomolecules with carbonyl, hydroxyl and amine functional groups have the potential for metal ion reduction and for capping the newly formed nanoparticles. Anti bacterial activities were assayed and exhibited good activity against the tested bacterial pathogens. CaO nanoparticles exhibit unique structural and optical properties, so they can be exploited for a variety of biomedical applications such as photodynamic therapy (PDT), photo-thermal therapy (PTT) and synaphic delivery of chemotherapeutic agents.
Keywords: Green synthesis, piper betel, calcium oxide nanoparticle, antibacterial activity.

03-35

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

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Background: The controlled drug delivery is better than free conventional dosage to reduce the cell toxicity and side effect due to overdosage.Among different kinds of drug delivery systems, the pH stimuli responsive controlled drug delivery system has a special attention because human body exhibit variation in pH along gastro-intestinal tract from the stomach to colon. In this study, the biocompatible natural clay bentonite was modified to attained better pH responsive property for the controlled release of anti-cancerous drug 5-Flurouracil.
Method: Drug delivery system was synthesised by modifying bentoniteusing 3-aminopropyltriethoxysilane. The encapsulation and *invitro* release study was optimised under wide range of pH from 1.0 to 9.0. The drug delivery system was characterised by FT-IR, XRD, TG/DTA and FE-SEM analysis.
Results: Maximum encapsulation of drug was occur at pH 8.0 (90.5%).And the maximum release was found to be at pH 1.2 (70.5%). Release profile follows Korsemeyer-Peppas kinetic model with n = 0.5866, follows non-Fickian diffusion, means the release of drug controlled by both swelling and diffusion.
Conclusion: Modified bentonite can be used as a promising drug delivery system to deliver 5-Flurouracil for the treatment of gastric cancer, without leakage of drug in other biological pH conditions.
Keywords: Bentonite, Controlled drug delivery, 5-Flurouracil, *In-vitro* release.

03-36

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

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

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

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

03-37

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

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

Method: Microporous hypercrosslinked networks **PFBC, PTCPC and PTCPB** were synthesised by Friedel Crafts reaction using $FeCl_3$ as the catalyst**.**The post modified materials such as **PFBCA, PTCPCA and PTCPBA** were synthesised by the amination of the above three by using trimethylenediamine.

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

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

Keywords: MicroporousOrganic polymers, post-synthetic modification, carbon dioxide capture

03-38

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

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

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

Results: LBL method resulted in uniform coating of nanoparticles on to the hybrid filter. The synthesized hybrid coating possessed excellent antimicrobial activity against gram-positive and gram-negative bacteria. Sample $(T\text{-}Ag)_5$@ PET showed an antibacterial activity of twenty times compared to that of neat PET sample. Furthermore, the fabricated hybrid filter exhibited ~97% leukocyte removal efficiency.

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

promising candidate as both leukocyte and microbial filter in blood transfusion.
Keywords: Non-woven Electrospunfibre, LBL, TiO_2, Silver nanoparticles, Antimicrobial, Leukocyte removal

03-39

DNA CONDENSATION THROUGH ORDERED ASSEMBLY OF FULLERENE AMPHIPHILE

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Background: The long DNA strands can be folded to make tiny, compact structures using various cationic species such as histone protein, metal ions, polyamines etc.Different DNAnanostructures with unique morphologies can be achieved through this process and is termed as DNA condensation. Incorporation of self-assembling, functional materials to the DNA condensatesopen up new avenues in DNA architectonics.Here, the ordered assembly of amphiphilic fullerene is achieved through the non-covalent interaction of DNA andan amphiphilic, pyridinium appended fullerene derivative (**FPy**$^+$).
Method: This work exploits the condensation of plasmid and lambda DNA with anamphiphilic pyridinium appended fullerene derivative (**FPy**$^+$) in 10% DMSO-phosphate buffer solution. Preliminary DNA condensation studies werecarried out with UV-visible absorption spectroscopy andfurther morphological studies were conducted through AFM and TEM analysis.
Results: UV-visible absorption studies of **FPy**$^+$ with increasingconcentration of DNA showshypochromism at 260 nm, which is a clear evidence for the DNA condensation in presence of **FPy**$^+$. The formation of micrometer sized nanosheets were observed by AFM analysis and is further confirmed through TEM analysis.SAED pattern obtained fromTEM analysis providesfurther information about the crystallinity of the nanosheet and is attributed to the ordered assembly of fullerene in the resultant nanostructure.
Conclusions: This work explores the utilization ofDNA in the ordered assembly of amphiphilic fullerene derivative with consequent DNA condensation.
Keywords: DNA condensation, Fullerene Amphiphiles, Self-assembly, AFM, TEM

03-40

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

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

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

03-41

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

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Graphene a single layer of carbon atoms arranged in a hexagonal honeycombed network is the fundamental building block of all graphitic materials. The novel properties associated with graphene offer many advantages for electrochemical applications. The present work aims at preparing graphene copper chitosan composite for the voltametric determination of the most prominent catechol amine dopamine. Graphite oxide (GO) was prepared by modified Hummers method. GO and $CuSO_4.5H_2O$ were brought into an aqueous solution, to this chitosan was added which was refluxed and subsequently reduced to obtain the required graphene –copper composite. The composite was characterized structurally and morphologically by XRD, SEM and it was used for modifying a glassy carbon electrode. The modified electrode was used for sensing dopamine by CV and DPV. The influence of scan rate and pH on the performance of glassy carbon electrode was evaluated. The fabricated electrode was also evaluated for the simultaneous determination of dopamine in presence of uric acid. This electrochemical sensor was found to be most sensitive and reliable at the physiological pH 7.
Keywords: Graphene-Copper composite, electrochemical sensor, Dopamine

03-42

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

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Background: Structural studies and investigation of supramolecular chemistry of f-block complexes continue to be an active area of research. Research interest on 5,5'-dimethyl 2,2'-bipyridine containing complexes has been increased within a few years. It is mainly because of the presence of extended π-systems and bidentate chelating ability which have been used in designing complexes to mimic the non-covalent interactions in biological processes. Many of the bipyridine based complexes also show luminescence property. 5,5'-dimethyl 2,2'-bipyridine molecule and its protonated species constitute an important aspect in the understanding of the properties of this ligand in coordination chemistry.
Method: Slow evaloration method has been adopted for the synthesis of single crystals of the complexes. Nitrate salts of corresponding metals (of Sm $(NO_3)_3.6H_20$ for complex **1** and $Ce(NO_3)_3.6H_20$ for complex **2**), 5,5'-dimethyl 2,2'-bipyridine and methanol are used. Intensity data sets for complex **1** and **2** were collected on a Bruker Smart X2S benchtop diffractometer. Structure was solved by SHELXS97 and refined by SHELXL14.
Results: The asymmetric unit of complexes, $[Sm(NO_3)_3]_{0.5}$ $(2H\text{-}DPY)_{0.5}$ (1H-DPY) (complex **1**) and $[Ce(NO_3)_3]_{0.5}$ $(2H\text{-}DPY)_{0.5}$ (1H-DPY) (Complex **2**) contains one half of metal hexanitrate unit, a half of diprotonated 5,5'-dimethyl 2,2'-bipyridine (2H-DPY) and a molecule of monoprotonated 5,5'-dimethyl 2,2-bipyridine (1H-DPY). From the values of bondlength and bond angle protonation of nitrogen atom in the lignads are confirmed if any. These two complexes show similar non covalent interactions like N-H...O, N-H...N and C-H...O hydrogen bond and π...π interactions forming three dimensional supramolecular architectures.
Conclusions: Isomophous complexes of two lanthanide complexes were synthesised. Crystal structure and supramolecular interactions of complexes **1** and **2** are studied. From the studies, it is clear that, the conformations of DPY and its protonated species constitute some important aspects in the understanding of the properties of this ligand in coordination chemistry.
Keywords: Supramolecular interactions, asymmetric unit, isomorphous

03-43

SILVER BASED NANOHYBRID AS AN EFFICIENT ELECTROCHEMICAL SENSOR AND PHOTOCATALYST

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Background: Different nanohybrids are reported either as a good electrochemical sensor or as an efficient photocatalyst. Very few nanohybrids are only reported as having both electrochemical and photocatalytic activity. So here we develop a simple silver based ternarynanohybrid as a good electrochemical sensor and an efficient photocatalyst.
Method: The developed ternary nanohybrid can be used as a wonderful electrochemical sensor for determining the minute concentrations of different toxic organic pollutants, especially the phenolic isomers such as hydroquinone, catechol and quinone. Also it is an efficient photocatalyst for the degradation studies of different toxic organic dyes.
Results: By using the voltammetric analysis, very minute concentrations of the toxic phenolic isomers can be effectively detected with this ternary nanohybrid. The simultaneous detection of these phenolic isomers can be easily analyzed using this sensor. The better degradation of different organic dyes such as methylene blue and pesticides such as methyl viologen can be easily done with this ternary sensor.
Conclusions: The development of this silver based nanohybrid is via a simple heating method and the presence of Fe_3O_4nano rods provides magnetic separation of the hybrid. A high limit of detection is obtained for the phenolic isomers with this electrochemical sensor. Better photodegradation occurs for dyes such as methylene blue and pesticides such as methyl viologen.
Keywords: Nanohybrid, Voltammetric sensor, Pesticides, Electrochemical sensor, Photocatalyst

03-44

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

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Background: Sustainable landscaping includes maintenance of the flora in such a way that a proper balance between the various species is assured. In this context, plant growth regulators or "plant hormones" form an important class of molecules responsible for the growth and development of a plant. Apart from natural molecules such as auxins, gibberellins, cytokinins and abscisic acid, several synthetic plant growth regulators have also been developed in order to maintain healthy ecosystems. These synthetic molecules include benzopyrans such as isocoumarins, isochromans, flavanoids, chromones etc. For instance sclerin and sclerotinin are known to promote seed germination and shoot elongation of moong bean, rice and other plants.
Method: In the present study we have synthesized a series of novel isochroman derivatives by a one-pot reaction of ninhydrin, secondary amines and nitrones. The scheme below shows a representative reaction (compounds confirmed by NMR, IR and Mass spectroscopy)

(i) Pyrrolidine, anhydrous THF, reflux, 8h, N_2, 85%

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

the reaction.
Conclusions: The generality of the reaction has been proved using various secondary amines. The details of this novel chemistry and the photophysical properties of the isochromans will be presented.
Keywords: Plant hormones, isocoumarins, isochromans, ninhydrin, secondary amines and nitrones

03-45

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

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Background: The genus *Annona*are a potential group of plants explored for their edible fruits and also used in different herbal preparations.*Annona*species are rich source of structurally diverse acetogenins which possess several biological properties. Among the *Annona* species grown in south India, *A. muricata* is reported to show promising anticancer activities.The present study reports the distribution and quantification of annonacin, a neurotoxic acetogenin, from *A. muricata* seeds, by HPTLC method. Also, the antioxidant properties of the plant parts are discussed.
Methods: The marker compound annonacin was isolated by column chromatography of *n*-hexane extract of seedsof *A. muricata*. The structure of the isolated compound was confirmed by ^{1}H, ^{13}C NMR, mass spectral analysis and comparison with literature. Different parts of *A. muricata*were extracted by Soxhlet extraction and the content of annonacin were estimated by HPTLC (Camag HPTLC, Switzerland). Antioxidant properties of the extracts were evaluated by DPPH assay.
Results: HPTLC quantification revealed that *A. muricata* seeds contain maximum amount of annonacin (54.35 µg/g) while, annonacin content was least in bark (40.11 µg/g). Antioxidant analysis revealed lower ability to scavenge DPPH radicals (IC_{50} value 88.01µg to 24.55µg) and the result is in corroboration with low range of phenolic content (< 48.5 mg/g GAE).
Conclusions: The study revealed *A. muricata* as rich source of a mono-THF acetogenin annonacin and it was confirmed that the seeds contain high amount of annonacin. The plant possesseslow phenolic content and also low antioxidant activity. This is the first report of the comparative phytochemical profiling of different parts of *A. muricata*.
Keywords: *Annona muricata*, annonacin, HPTLC, antioxidant properties

03-46

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

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Background: The extensive use of pesticides may cause the environment pollution and thereby adversely affect the human life. So the development of detection protocols for pesticides is a challenging issue. In this context we are utilising natural resources derived platform for the detection purpose. We developedmangostin based analytical system for the detection of pesticides
Methods: α-mangostin was isolated from the pericarp of the mangosteen fruit and purified by column chromatography and characterised by different techniques . Graphene Quantum Dots (GQDs) are synthesised from honey via emulsion template method.
Results: The fluorescence intensity of GQDs is quenched by α-mangostin which was regained by the addition of the pesticide carbofuran. This off-on system was exploited for the construction of molecular logic gate.
Conclusion: An analytical platform based on α-mangostin – GQDs system (both derived from natural resources) was developed for the detection of the pesticide carbofuran. Based on this system we have designed a molecular logic gate.

Keywords: α-mangostin, Graphene Quantum Dots, FluorescenceQuenching,Carbofuran, Logic Gate

03-47

ENHANCED FLUORESCENCE USING HOST-GUEST FORMATION ON SOLID SURFACES

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Background: Fluorescence (FL) based detection techniques are increasingly captivating the attention with its well-known advantages such as simplicity, high sensitivity, selectivity, cost-effectiveness and is one of the most widely used techniques for environmental monitoring, disease diagnosis and genomic/proteomic research. Currently, many efforts focus to improve its performance by amplifying the fluorescent signal for obtaining higher sensitivity and lower limit of detection. Herein, Fluorescence (FL) enhancement has been achieved by the synergistic effect of colloidal photonic crystal (PC) and a macrocyclic container molecule, cucurbituril (CB).
Method: Polstyrene (PS) colloidal PCs were made by colloidal self assembly method. FL intensity of rhodamine B (RhB) was amplified by making an inclusion complex with cucurbit[7]uril (CB7) and was infiltrated into three dimensional colloidal PC for further FL enhancement.
Results: PS colloidal PCs were fabricated by evaporation induced vertical deposition method onto a hydrophilic glass substrate. FL enhancement of RhB were examined by infiltrating the dye solution into the voids of the colloidal PCs. FL enhancement factor (EF) is found to be 21.9±1.7, 23.2±6.5 and 32.6±7 for violet, green and orange PCs respectively. FL of RhB was amplified by making host-guest complexes with CB7. Further FL enhancement of CB7-RhB host guest complex was studied on violet, green and orange colloidal PCs. We obtained a highest FL EF value of 190±0.3 on orange PC, which is due to the enhanced light-matter interactions by the localized density of states (LDOS) in the solid phase.
Conclusion: We successfully demonstrated that FL intensity can be amplified significantly by the synergistic effect of PC and CB7. This novel approach can be extended into highly sensitive fluorescence based detections such as chemical/biochemical sensing.
Keywords: Photonic crystal, Cucurbituril, Fluorescence enhancement

03-48

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

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Background: Over the years, the development of thermoelectric materials as a means of harvesting electricity from waste heat is continuously progressing. The power conversion efficiency of any thermoelectric (TE) material is related to its figure of merit, $ZT = \alpha^2\sigma T/\kappa$, where α, σ, T and κ are Seebeck coefficient, electrical conductivity, absolute temperature and thermal conductivity respectively. Hence, a small κ in organic materials is therefore an advantage to obtain high *ZT*. The advantages of organic semiconducting materials over the inorganic ones apart from the lower thermal conductivity includes abundance of resources, ease of production, flexibility and the potential in large area production. In addition to conducting and semiconducting polymers, organic small molecules are of keen interest over the recent years.
Method: In this work, we have synthesized two acceptor-donor-acceptor (A-D-A) type thiophene oligomers which are flanked by dioctyl terthiophenes on either side and an acceptor *N*-ethyl dicyanorhodanine (**OT1**) or *N*-octyl rhodanine (**OT2**). We have extensively explored the thermoelectric properties of the oligothiophene derivatives.
Results: Giant Seebeck effect was observed in both the small molecule based organic semiconductors. The magnitude ofα intensely varied from 1-22 mV/K by doping with transition metal salts like ferric chloride.

Conclusions: This work establishes the effect of transition metal saltdopants on the oligothiophene derivatives and its upshot on the thermoelectric performance.
Keywords: Thermoelectric material, Giant Seebeck effect, thiophene oligomers

03-49

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

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Background: Stimuli responsive organic solid-state fluorescent materials attract increasing interest in both fundamental and technological applications. Reversible switching of solid-sate fluorescence with high contrast and reproducibility is a challenging task but important for several optoelectronic applications. One promising approach towards this end is to control the mode of solid-state packing of luminescent organic chromophores with an external stimulus. The attachment of flexible alkyl chain to a functional chromophore has a significant impact on the solid-state fluorescence.
Method: In this work, we have designed and synthesized a series of benzoxazole derivatives with different length of alkyl chains (R= **DMBO**: CH_3, **DHBO**: C_6H_{13}, **DBBO**: $C_{12}H_{25}$, **DOdBO**: $C_{18}H_{37}$) and their fluorescence properties were extensively investigated.
Results: Thermally induced high contrast switching of solid state luminescence were observed for all of them except in the case of **DMBO**. Interestingly, the spectral shift towards heat stimuli and the measured colour transition temperatures of the four oligomers are different and have dependence on the alkyl chain length. DSC and XRD analyses further confirmed that heating of these oligomers results in a phase transformation between two states having different molecular packing modes.
Conclusions: These findings reveal the structure-property relationship of thermochromic materials that would benefit the development of luminescent thermochromic solids.
Keywords: Solid-state fluorescence, Thermochromic materials, Benzoxazole

03-50

YELLOW PHASE Δ-$FAPBI_3$ NANORODS – AN INSIGNIFICANT MATERIAL RENOVATES INTO VALUABLE RESISTIVE SWITCHING MEMORY DEVICE

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Background: Resistive random access memory (ReRAM) emerge as a promising candidate for the next-generation optoelectronic devices due to its smaller size, simple device architecture, minimum power consumption, low switching voltage, scalability, high operation speed (ns), long data retention, endurance and low-cost fabrication. Recently, organic-inorganic perovskite materials are found to be potential candidates for resistive random access memory devices due to their low switching voltage and high On-Off ratio.
Method: The phase pure hexagonal δ-$FAPbI_3$ nanorods (NRs) were prepared via self-assembling of individual nanocrystals for memory device applications.The dielectric δ-$FAPbI_3$ NRs dispersed in toluene was probe sonicated for 30 minutes and spin coated on the FTO glass plate to get uniform and smooth film with the thickness of around 200 nm. After drying the film under ambient condition, 200 nm thick aluminium was thermally evaporated on the NRs layer using a shadow mask, to form FTO/NRs/Al devices.
Results: The devices showed better switching voltage, endurance and retention properties with greater ON/OFF ratio of 10^5. These 1D hexagonal nanorods are more stable compared to other PNCs due to their face sharing octahedras and hence the devices showed long-term stability.
Conclusions: The performance of the δ-$FAPbI_3$ NRs based devices were found to be better compared to other PNCs based memory devices in many ways. The electronic properties of the current devices could be further improved by modifying the device structure.
Keywords: Hybrid perovskites, Nanocrystals, Nonvolatile memory, Resistive switchin

04 - EARTH & PLANETARY SCIENCES

04-01

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

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Background: The Western Ghats (WG) is one of the great escarpments that extends ~1500 km parallel to the west coast of India in the NNW-SSE direction, with an average elevation of ~1.2 km. It is a mosaic of disparate geological formations of diverse structural and physical characteristics. Generally, geological processes like upliftment, erosion, sedimentation, have an expression within the Earth's interiorfrom the shallow subsurface to the deeper parts. In this context; we decipher the crustal structure along and across the WG to shed light on its evolution processes.
Method: In the present study, three component teleseismic waveform data recorded at 27 broadband seismological stations are analysedto investigate the crustal structure in terms of crustal thickness and Poisson's ratio along and across the Western Ghats through application of slant stacking (H-K) and common conversion point (CCP) imaging to the converted phases (Ps) isolated by receiver functions.
Results and Conclusion: The receiver functions computed at 27 broadband seismological stations spread along and across the WG yield important results on the crustal structure beneath each station. The variation in the arrival times of the first positive conversions from ~4.5 s to 5.5 s indicate undulations in the Moho. Further, the variation in crustal thickness along and across the WG from 33 km to 46.8 km is ascertained by H-K analysis and CCP images. The images of the crust along two profiles parallel to the WG reveal a central high (~12°N to 16°N) with a crustal thickness of ~ 42 km, that decreases to ~36 km towards both the southern and northern parts. These results are in conformity with the geological units covering the WG. Further, a clear step-like variation is observed across the WG, with a sudden jump in the Moho depth from ~39 km to ~44 km. We could clearly discriminate the Archean-Proterozoic Granulites and the Archean-Proterozoic Peninsular Gneiss. The obtained results do not favour a thick crust beneath the WG, lithospheric/crustal thinning and/or magmatic underplating models. The results from the present study support the rifting model proposed for the west coast of India. A strong negative phase just after the Moho is observed in the RF images, which could be due to the existence of a low velocity layer (LVL) below the Moho. The LVL(s) at such depths could be attributed to the different rifting episodes experienced by the west coast of India and gain support from the strong and consistent negative isostatic anomalies over the WG.
Keywords: Western Ghats, Receiver Functions, Moho, LVL and Rifting.

04-02

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

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Background: Munroe Island – an estuarine island within the Ashtamudi Lake in the southwest coast of India has long been under menace of submergence due to flooding. Multitudes of notions have been attributed to this phenomenon, like loss of sediment input from the Kallad River, tidal flooding and self-weight consolidation of the buildings, etc. Speculation *in vogue* also advocates displacements due to neo-tectonic activity. Foremost perception of flooding with minimal/scattered field observations attribute the events to tidal inundation, though the residents always lived under the fear that the island is sinking (subsiding) mainly because of the settlements and structures put up on the land with subsurface sediments rich in carbonaceous clayey substratum. A review into the word of mouth hypotheses on the subsidence of island do lack credibility due to paucity of scientific information to substantiate. In this context, the recent advancements in microwave DInSAR time series analysis technique - Persistent Scatterers Interferometry (PSI) - is applied with the sole objective to identify surface displacement in the island.
Method: The DInSAR time series technique takes advantage of the variation in "phase" of the Radar pulse backscattered from the scattering target over time. The satellite radar measures the phase of the microwave signal backscattered

from the target during consequent acquisitions and any change in phase is attributed to the displacement of the target after the removal of the phase variation induced by the change in earth topography. In this study, the line of sight displacement of the permanent scatterers in the estuarine island were estimated using the Sentinel 1A SLC datasets acquired during February 2015 upto September 2018. The persistent scatterer Interferometry (PS InSAR) technique is used to process the time series stack of 83 datasets by constructing differential interferograms assuming a single master. The selection of the persistent scatterers depends on the coherence threshold (0.6) and the amplitude stability index (0.6) during Atmospheric Phase screening which accounts for the variation in the amplitude of the pixel due to atmospheric influence. The Line of sight displacement with respect to the satellite for the resultant persistent scatterer points is quantified to assess the magnitude of surface deformation over the island region.

Results: Line of Sight displacement at selected locations within and around the island shows deviation between the points selected as stable and unstable. The points categorized under stable do display certain minor deformation trends between +5 mm to -5 mm per year which invariably is due to the compaction properties of the subsurface sediment built-up of Quarternary to Recent formation forming the island. The unstable points indicate accelerated displacement of the order of 20 mm/year. This classical categorization of the scattering points negates the claim of the island's subsidence whereas the buildings/hard structures constructed on the unconsolidated sedimentary surface obviously undergo deformation, the process termed as self – weight consolidation.

Conclusion: Satellite remote sensing provided an unblemished picture on the present situation of the island. The outcomes have clearly distinguished the possibilities for perceptible sinking of the buildings in addition to answering the question of subsidence. This has augmented the scope for further research to revisit the issue of submergence. Further research is mooted to quantify for the variable displacement by 3D settlement modelling collocated with tide induced flood modelling for the island.

Keywords: Microwave Remote Sensing, Synthetic Aperture Radar, Single Look Complex, Persistent Scatterers, Submergence

04-03

INTENSIFICATION OF SOUTHWEST MONSOON OVER KERALA IN 2018: QUANTIFICATION AND MECHANISMS

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Background: Heavy rainfall over a small area in a short span of time can lead to flood. Studies related to extreme precipitation events are essential for the prediction as well as mitigation purpose. Recently, Kerala visualized a high amount of rainfall in south-west monsoon which results in the filling of dams from its extreme capacity. A heavy rainfall from 14 August 2018 to 17 August 2018 made a drastic situation to drain all dams. In this study, we investigated the possible mechanism that drove to heavy precipitation and quantified the amount of rainfall distributed over the entire state. Rainfall over an area can be influenced by many factors but we are focusing some of the possible situations which might have helped the intensification of rain in the month of August 2018.

Method: INSAT 3D L3B Hydro estimator data with a temporal resolution of one day and spatial resolution of 4 km at nadir is used for analysis (https://www.mosdac.gov.in/). Cumulative precipitation for four days is estimated. For U-wind and V-wind NCEP/NCAR Reanalysis 1 Pressure data with a special resolution of 2.5□× 2.5□ is used for analysis (https://www.esrl.noaa.gov/psd/). NINO 3.4 Index is used to analyse the presence of ENSO. Indian Ocean Dipole Index based on INCOSIS-GODAS SST analysis and monthly climatology OISST constructed using 1981-2010 data is used to study the Indian Ocean Dipole (IOD). NOAA Interpolated Outgoing Longwave Radiation (OLR) is used to analyse convections over the Indian Ocean region (https://www.esrl.noaa.gov/psd/).

Results: Thrissur, Ernakulam, Idukki, and Pathanamthitta districts showed high intensity in rain from 14th -17th August 2018. Isolated places of Malappuram, Wayanad and Trivandrum also showed heavy showers. In 2018, the monsoon months showed a positive dipole in which the onset season had an exceptional value. But all other months showed high positive dipole which is favourable for the Indian Summer Monsoon Rainfall. The intense convection over the Bay of Bengal acts as a heat source that leads to an increase in westerly winds in the Arabian Sea, with a lag of about 3 days.

Conclusions: The study concluded that Thrissur, Ernakulam, Idukki, and Pathanamthitta districts of Kerala received heavy rainfall during 14th to 17th of August 2018 with isolated places of heavy rainfall in Wayanad and Trivandrum. ENSO and IOD during the study period showed a favourable condition for normal monsoon rainfall. It was found that the magnitude of wind over the Kerala region was too high and this higher westerly winds increased the advection of moist air into the Indian landmass, which caused heavy rainfall over Kerala. Depression which formed over the Odisha

coast also contributed to the intensification of wind speed in west coast resulting in excess rainfall.
Keywords: Precipitation, ENSO, Indian Ocean Dipole, Convection, Low-Pressure System.

04-04

GROUNDWATER-SEAWATER INTERACTION ALONG THIRUVANANTHAPURAM COAST, KERALA

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Background: In a steady state condition, freshwater-saltwater interface (transition zone) in the coastal aquifer is stationary which indicates a dynamic equilibrium between the fluids due to their density difference. Due to increased sea level rise, tidal fluctuation, over exploitation of groundwater and modification of hydrological cycle, the shape, size and position of the transition zone will migrates towards inland. The present study investigates two main processes such as submarine groundwater discharge (SGD) and seawater intrusion (SWI) that control the coastal groundwater dynamics.
Method: Based on the literature and archival data available with CGWB and State groundwater department, well locations were selected for regular monitoring. Groundwater investigations were carried out in the coastal aquifers of Thiruvananthapuram District in Kerala through hydrogeological surveys. The depth to water table was measured in wells, after taking GPS locations.90 samples were collected and analyzed in the laboratory to check water quality. Radon (Rn-222) values were obtained from the pore-water/well water samples of locations.
Results: Majority of the wells in the area have less supply of fresh water in the summer season and good supply in the post monsoon season. Most of the groundwater samples in the study area shows acidic trend in nature. The wells trapped in the coastal alluvium aquifer show salinity problem due to the encroachment of seawater in the pre-monsoon period. Majority of the groundwater samples are CaCl type. From the different radon-salinity observations, radon concentrations high in the inland wells and lower in the porewater samples.
Conclusions: The current work provides strong evidences to select the significant locations foradvance studies in SGD and SWI. It was evident that decrease in freshwater discharge in the pre-monsoon was the most sensitive parameter causing saltwater intrusion. The SGD and SWI zones were mapped based on the dynamism prevailed in 2017-2018.
Keywords: Coastal Aquifer, Freshwater-Saltwater Interface, Submarine Groundwater Discharge, Seawater Intrusion

04-05

ROLE OF CHANGING DYNAMIC PARAMETERS IN CONTROLLING THE EXTREME EVENTS OVER PENINSULAR INDIA IN THE RECENT DECADES

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Background: As part of the global climate change, extreme events are increasing in weather pattern over the tropical region also. The signals of climate change have already visible in the synoptic events like Indian summer monsoon itself. Scientists have already reported the changes happened to the Findlater Jet in the recent decades over the Indian subcontinent. Recent events like Chennai rainfall 2016 and Kerala rainfall during 2018 are some of the examples to show that how divergence fields at the lower and upper levels of the atmosphere will become a potential danger to lead extreme spells.
Method: During the advent of an abnormal event, the divergence field at the surface levels and the upper levels are in a favourable condition to support large scale convection vertically. Increasing air temperature gives enormous opportunity for the atmosphere to hold and dissipate large amount of water in a small time scale itself. Thus atmosphere is supporting extreme spells which may reach upto 30 to 40 cm in a day itself and causes severe consequences.
Results: The standard Pet test reveals that a change in the rainfall pattern over Kerala during the southwest monsoon has happened from 1960 onwards. These changes are having a direct link to the changes occurred in the global oceans during these periods. As part of the global green house impact, the atmospheric temperature has increased about 0.9 ^{o}C over the study region in the last six decades itself and which allows the atmosphere to hold more water vapour in the recent decades. An effective mechanism of lifting all these moisture to the upper levels especially during a monsoon depression will give extreme rainfall pattern over the region. Even though generally a decrease in strength of Findlater Jet eventually reduced monsoon rainfall activity over the peninsular India in the recent decades, invariably it helped

another way to trigger more localised convective activity over the region in the presence of some meso-scale phenomena like monsoon depression and offshore vortex etc. There by atmosphere will work as a moisture siphon during these events and initiate the available water vapour to precipitate over the region within a period of 24 hours itself. This has resulted to create extreme precipitation anomaly over the study region in the recent years.
Conclusions: The global climate changes are showing its signals not only in the lower levels but also in the upper levels of the atmosphere in the recent years. The divergence field associated with wind systems over the upper and lower levels as well as an increased storage of moisture at various levels of atmosphere is invariably becoming a potential threat to create extreme precipitation anomaly over the study region.
Keywords: Findlater jet, Divergence field, Pet test, Moisture siphon

04-06

MAJOR ION CONCENTRATION IN THE GROUNDWATER SOURCES OF BHAVANI RIVER BASIN (KERALA) - ITS IMPLICATIONS ON SILICATE WEATHERING

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Background: Groundwater is one of the most exploited fresh water resources that sustains life on earth. The quality of groundwater deteriorating year after year and is a major concern all over the world, and India is not an exception. This is mainlyattributed to limited recharge processes and effluent discharges in the critical zone due to human intervention and climate change. For an effective management of groundwater resource it is important to identify the drivers of changesin the quality of groundwater system. In the present study we examine the hydro-chemical attributes of one of the important east flowing riversof Kerala - the Bhavani river, which is not hither to been well studied.
Method: Thirty-seven well water samples were collected and analysed for various physicochemical parameters. The parameters like pH, EC, TDS and DO were estimated*in situ*using a portable water quality analyser and other physico-chemical parameters were analysed in lab following standard methods.The chemical parameters are compared with that in the rain and river water samples in order to address their level variabilities in the groundwater. Correlation existing among the major ions was determined using the Xlstat and other statistical procedures.
Results: The geochemical analysis shows that groundwater is slightly alkaline. About 76%of water samples show fresh water character while the remaining are brackish due to high solute contents. Water samples in the study area are moderately hard to very hard.The samples exhibit low sodium hazard properties.The paramaters are compared with the WHO standard and most of the samples are good for the domestic uses.The concentration of ions in the water samples are of order ofCa>Na>Mg >K for cationsand HCO_3>Cl>$SO_4$for anions.Hill-piper diagram was prepared to understand the geochemical relationship existing among the groundwater samples and it is inferred that majority of the water samples are Ca-HCO_3 type.The ionic concentrations are low in the upper catchments of Bhavani river basin than the lower counterparts. Scatter diagrams of Ca+Mg *vs* HCO_3, Ca+Mg*vs* HCO_3+SO_4, Na+K*vs* total cations, Na*vs C*l, and Na-Cl vs Ca + Mg-HCO_3-$SO_4$and also thechloro alkaline indices were attempted to unravel the role of silicate weathering in solute dynamics in the groundwater regime.It is inferred that the silicate weathering and reverse ion exchange are major processes responsible for the observed ionic propositions in the groundwater sources of theBhavani basin.
Conclusions: Rock water interaction during percolation and movement of water through the critical zone is responsible for the observed solute loading in the groundwater sources of the study area. The groundwater in the Bhavani river basin isgenerally goodfor both irrigation and domestic uses. Silicate weathering and reverse ion exchange are major processes that attribute the observed ionic concentrations in the groundwater resource of the Bhavani river basin in Kerala.
Keywords: Groundwater, Bhavani river basin, Hydrochemical Characteristics, Silicate weathering.

04-07

HYDROBIOLOGICAL CHARACTERISTICS AND COMMUNITY STRUCTURE OF MICROPHYTOPLANKTON ALONG THE SOUTH EASTERN ARABIAN SEA DURING EARLY SUMMER MONSOON

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Background: The South Eastern Arabian Sea (SEAS) is one of the most productive regions of the world ocean, is influenced by coastal upwelling mainly during the summer monsoon period. The summer monsoon upwelling positively influences the phytoplankton production which can directly or indirectly influence the trophic structure and biological productivity of SEAS.
Method: The data presented in this study has been obtained from field observations made onboard research vessel FORV Sagar Sampada during the summer monsoon season along the coastal and open ocean regions of South Eastern Arabian sea (SEAS). Samplings were carried out from Thiruvananthapuram in the south (8°N) to Goa (15°N) which is the northern limit of SEAS.
Results: Based on the analysis of various physico-chemical parameters along the study area, upwelling was well evident along the southern region which decreased further north. The coastal waters of Thiruvananthapuram had high chlorophyll *a* concentration (10.8 mg m^{-3}). Although along Mangalore and Goa upwelling was confined to narrow coastal zone, also showed high chlorophyll *a* concentration. Microphytoplankton community of upwelled waters showed 60% similarly with diatoms as dominant species, where as dinoflagellates dominated the non-upwelled waters. Highest phytoplankton cell density was observed along off Thiruvananthapuram, with maximum cell density along coastal waters ($3.2x10^4$ cells L^{-1}). The abundance of phytoplankton decreased towards offshore as well as northward of the SEAS.
Conclusions: The present study provides an account on the phytoplankton community structure along with the physico-chemical characteristics of SEAS during early summer monsoon. There appears significantly higher production in the upwelled waters with the dominance of diatoms.
Keywords: South Eastern Arabian Sea (SEAS), Summer Monsoon, Upwelling, Phytoplankton

04-08

SOLUTE TRANSPORT THROUGH THE RIVERS DRAINING SILENT VALLEY AND ADJOINING REGIONS OF SOUTHERN WESTERN GHATS, INDIA

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Background: The river water chemistry and solute transport are controlled by many natural and anthropogenic factors. The hydro chemical characteristics of water can be used as a tool to investigate the biogeochemical processes operating in the catchments because hydrochemistry of rivers is being regulated by complex interactions among various physical, chemical and biological subsystems of the catchments. With this mind, an attempt has been made in this paper to address thespatio-temporal variability and the role of natural and anthropogenic effects in the Bhavani-Kunthipuzha twin rivers draining respectively the eastern and western flanks of the pristine natural system, the Silent Valley in the southern Western Ghats, India.
Method: Hydrochemistry data of the both Bhavani and Kunthipuzha were obtained from field work, sampling and in-situ and laboratory analysis. In order to understand the spatio-temporal changes in the river water chemistry and causal mechanisms behind the changes in the long-term discharge characteristics, data from 4 gauging stations (Nellithurai, Thengumarahada and Savandpurfor Bhavani river, Pulamanthole for Kunthipuzha) have been obtained from the Central Water Commission (CWC) via the surface water module of the India - WRIS (Water Resources Information System).
Results: The cations and anions in the river waters of bothBhavaniand Kunthipuzhaexhibit marked spatial and seasonal variations.The annual particulate sediment transports for the Bhavani and Kunthi river are 0.026 and 0.088 million tonnes, respectively.The annual chemical load that being carried by the main channel in the Savandpur gauging station is estimated to be 0.15 million tonnes while that of Kunthi river is just 0.067 million tonnes.The Particulate load/Dis-

solved load (PL/DL) ratio of the Bhavani river is 0.17 and for Kunthi river the PL/DL ratio came to be 1.31.
Conclusions: The eastern part of the Bhavani basin experiences semi-arid/ arid climate with rainfall essentially predominated by North east monsoon, but the western most part of the river basin experiences humid climate with Southwest(SW) monsoon dominance. This contrasting character of the river basin is reflected in the solute transport as well the discharge of the Bhavani river. But the Kunthipuzha river basin experiences humid climate with SW monsoon dominance. The low PL/DL ratio of the Bhavani river indicates the dominance of chemical weathering over physical weathering. On the other hand, physical weathering dominates in the Kunthipuzha which is well reflected in the higher PL/DL ratio.Bivariate plots of Gibbs model indicate the role of rock-water interaction and subsequent baseflow contribution in the Bhavani river basin and dominance of rainfall contribution in the Kunthipuzha for controlling the elemental chemistry of the river water. The mixing diagram indicates that silicate weathering plays a pivotal role in contributing solute concentrations in these two river waters.
Keywords: Kunthipuzha, Bhavani river, Silent Valley, Solute transport, Western Ghats.

04-09

SPATIAL VARIATION OF RAINFALL $\delta^{18}O$ OVER PENINSULAR INDIA REFLECTING THE MOISTURE TRANSPORT MECHANISM DURING NORTHEAST MONSOON RAINFALL

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Background: The stable isotopes aided ($\delta^{18}O$ and $\delta^{2}H$) moisture circulation dynamics related to the tropical rain activities are of current research interest. Numbers of studies have tried to explain the $\delta^{18}O$ variations associated with southwest monsoon (SWM) circulation, yet the $\delta^{18}O$ swings in north-east monsoon (NEM) rainfall remains poorly addressed. The available information reveals that $\delta^{18}O$ depletion is more predominant during NEM and the spatial variation of the amount effect is significant over regions where NEM rainfall exceeds SWM.
Method: Here we collated the $\delta^{18}O$ data from Global Network of Isotopes in Precipitation (GNIP) stations (monthly accumulated samples) spread over southern peninsula and analyzed the controls on $\delta^{18}O$ variations using moisture budget perspective and back trajectory modeling. The enrichment/depletion in $\delta^{18}O$ and $\delta^{2}H$ are explained on the basis of moisture budget term (moisture flux convergence-MFC), column integrated moisture transport, outgoing Longwave radiation (OLR) and the presence/absence of cyclone (evaporation and recycling of moisture).
Result: Regression analysis doesn't show any significant correlation in rainfall $\delta^{18}O$ variations with that of the average moisture convergence over Bay of Bengal (BoB). The spatial variation in MFC over the moisture source along with the presence/absence of cyclonic activity over BoB well interpreted the spatial variation of $\delta^{18}O$ in monthly accumulated precipitation.
Conclusions: The $\delta^{18}O$ depleted months corresponded to back trajectories dominantly derived from BoB while the enriched months showed assorted manner. Particularly in Kozhikode station, many times, dominant moisture influx from BoB (trajectory frequency >80%) results in enriched records. However, the spatial spread in MFC along with vertically integrated moisture transport performs as the better surrogate explaining the $\delta^{18}O$ variation. Thus, rainfall proxies capable of providing seasonal variation (teak cellulose) may be interpretable in terms of moisture flux convergence over the oceanic source.
Key words: *Moisture budget, Moisture Flux Convergence, stable isotopes, Outgoing Longwave Radiation*

04-10

IMPACT OF PENETRATING ELECTRIC FIELDS TO THE EQUATORIAL THERMOSPHERE - IONOSPHERE SYSTEM

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Keywords: Equatorial F region, F region dynamo, O^1D 630.0 nm emission, interplanetary electric field, PPEF, Thermosphere Ionosphere system
Abstract: This study reports the response of Equatorial Thermosphere Ionosphere System (ETIS) system over a dip

equatorial station, Trivandrum (8.5° N, 77° E, 0.5° dip lat.) to two distinct prompt penetration electric field (PPEF) events occurred on 25 March 2014 and 14 March 2016. The nights demonstrate the distinctive nature of PPEF on ESF. The investigation carried out using the data from a Portable Nighttime Photometer, Digital Ionosonde, and Fluxgate Magnetometer revealed that the thermosphere responds promptly to the PPEF events. It has been observed that, during the westward PPEF event, the thermospheric nightglow intensity enhances whereas during the eastward PPEF event the intensity decreases. In the first event (25 March 2014) the ESF got suppressed subsequent to the onset of PPEF, by suppressing the dynamo electric fields; while in the second event (14 March 2016) PPEF didn't affect the ongoing ESF, could be due to the fast multiple polarity reversals of the PPEF generated electric fields. Though the PPEF is considered as the transient phenomenon, the two distinct events considered underline the role of lasting effects of PPEF to the ETIS. This study discusses these aspects in detail.

04-11

IN SITU AND MODELING INVESTIGATION OF LIGHT ABSORBING AEROSOLS OVER THE HIMALAYAS

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Background: The Himalayas and Tibetan Plateau, known as the "third pole", is extremely critical and sensitive to global climate system, which is reported to have increased anthropogenic influence in the recent years. The build up of light absorbing aerosols (LAA) in the free-tropospheric atmosphere over highly reflecting surfaces of Himalayas associated with long-range and their deposition over snow surfaces has become a serious climatic concern.
Method: The present study includes the in-situ observations of Black Carbon (BC), made continuously using multi-wavelength Aethalometers over six stations during the period from 2009-2018, in addition to campaign mode observations at a few selected sites, to address the broad features of LAA across the Himalayas extending from Lahaul and Spiti valley in the west to Lachung in the east. Further, SNow, Ice Aerosol Radiation (SNICAR) model used to understand the implications of LAA on snow.
Results: The study reveals that BC loading over the Himalayas peaks mainly during the spring season, unlike the winter time peaks at the lower attitude urban or continental sites. This is attributed to the combined effect of varying anthropogenic influence associated with synoptic meteorological and dynamic processes. The influence of anthropogenic activities leading to higher BC loading is more over the eastern part of the Himalayas. For example, BC mass concentration (M_{BC}) at an eastern Himalayan site Tawang (~ 3 km a.s.l.) is nearly double (~ 1788 ± 1008 ng m^{-3}) than the values (~ 991 ± 741 ng m^{-3}) at a central Himalayan site Nainital (~ 2 km a.s.l.).
Conclusions: The quantitative information of LAA, when combined with the scattering properties of aerosols, will improve the scientific understanding on both direct and snow albedo effect of aerosols over the vast Himalayan regions.
Keywords: The Himalayas, Aerosols, Black Carbon, Snow-Albedo

04-12

RESPONSE OF EQUATORIAL AND LOW LATITUDE IONOSPHERE OVER INDIAN REGION TO A LONG DURATION MIDNIGHT M1.4 CLASS SOLAR FLARE

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Background: Solar flare is the intense brightening and sudden release of electromagnetic energy from solar corona when the accumulated magneticenargy is released by sun's atmosphere. During solar flare events, enhancements in X-ray and EUV rays result in enhancemnt in the ionization which in turn has several impacts on the ionosphere. Equatorial electrojet(EEJ), which is confined to a narrow band of latitude near the magnetic equator, exhibits variation in its strength during solar flare.In the present study, the effects of a long duration midnight M1.4 solar flare from sunspot region 0808 on 7th September 2005 over the eqautorial and low latitude Indian region is being discussed.
Method: Equatorial electrojet strength (EEJ), maximum height of F2 layer (hmF2) and Total electron content over equatorial (Trivandrum), low latitude (Hyderabad) and Equatorial Ionization Anomaly zone (Bhopal) are compared with non flare day. EIA proxy has been calculated to confirm the flare induced EIA inhibition during the event day.

In order to address the reason for the suppression of EEJ electric field, the observations are compared with quasi two dimensional first principle ionospheric model calculations. The electron density profile are calculated at non flare and flare conditions. The integrated Hall to Pederson conductivity ratios are calculated from these electron density profiles under two conditions.
Discussion: Using quasi two dimensional model, the electron density profiles for the flare and nonflare day is simulated.The integrated Hall to Pederson conductivity ratio is calculated by using modeled electron density profiles. The conductivity ratio during flare is less than the non flare day and it is deviated maximum after 10:00 IST,when EEJ started to decrease
Results: The M1.4 X-ray flare on 7 September 2005, which was started in the midnight, was a long duration flare lasted for more than 5 hours. Eventhough the flare lasted till 06:15 IST, the EEJ was not normal and it was reduced for a considerable part of the day. In response to the reduction in electrojet strength, hmF2, EIA were also shown reduction.
Keywords: Solar flare, equatorial electrojet, conductivity

04-13

REGIONAL VARIABILITY OF SUMMER MONSOON RAINFALL OVER INDIA AND ITS ASSOCIATION WITH LOWER TROPOSPHERIC STABILITY

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The monsoon that mainly affects India and its surrounding regions during June to September is the Indian summer monsoon. It exhibits large variability on temporal scale as well as spatial scales. These variabilities are influenced by many factors from topography to oceanic and atmospheric factors. So studying the variability of summer monsoon rainfall especially in regional scale is very important and useful to the Indian society and thus to the economy. This paper mainly aims to explore the regional variability of Indian summer monsoon rainfall especially over west coast, northeast and central India for the period 1948-2016, by identifying its relationship with the lower tropospheric stability (LTS). LTS is calculated using potential temperature at different atmospheric levels form NCEP/NCAR reanalysis data set during the period 1948 to 2016. The variations in LTS have a major impact on cloud fraction and thus the summer monsoon rainfall. We used CRU rainfall data for the same period to evaluate the variability during the summer monsoon season. It was found that the summer monsoon rainfall exhibits high spatial variability over the different regions considered. As LTS increases, it reduces the moisture transport between the surface and lower troposphere and thus reduces the rainfall. Thus we arrived at the conclusion that the relation between LTS with monsoon rainfall during the period of study is different over different regions with different influencing mechanisms
Keywords: Indian summer monsoon; cloud fraction; spatial variability

04-14

VOLUME ESTIMATION OF TILE/BRICK CLAY FROM IDENTIFIED SUITABLE SITES FOR MINING IN THRISSUR DISTRICT USING GEOSPATIAL TECHNIQUES

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Background: Thrissur district of Kerala, a well renowned for tile/brick clay mining and manufacturing region is home to 283 clay based enterprises. At present clay mining from the paddy field is restricted after the implementation of "The Kerala Conservation of Paddy Land and Wetland Act" during 2008. So the tile industry is in crisis and procuring clay (major raw material) from neighbouring states to meet their demands. Industries & Commerce Department entrusted KSREC to identify the sites converted before 2008 and not included in Paddy and Wetland Act. KSREC carried out the study using the available data of the 15 identified suitable sites in the Clay mining project (2007). The study aims to identify suitable location from the converted lands before 2008, depth and quantity for sustainable clay mining.
Method: The suitable sites are visually interpreted in Google Earth images and IRS LISS-IV data during 2007-2008 period and converted area in each suitable site were delineated in 15 locations in ARCGIS(10). The cadastral boundary

overlaid and survey plot level status of suitable area (converted) were generated for the 10 locations. For the remaining 5 suitable locations, cadastral information is not available and the plot wise assessment could not be done.Themes like settlements, roads, assets, village boundary occurs within a buffer of 50m from suitable sites werealso incorporated in the map from Google earth imagery. The maps (vector as well as bing overlaid)were provided to Mining & Geology Department (Collaborating agency) for depth estimation of identified suitable sites. They conducted depth estimation of22 survey plots in 10 identified suitable sites and provided the same.
Results: Total of 71 survey plots were recommended by the Mining & geology Department for clay mining. Depth information is provided for 10 identified suitable sites (22 survey plots). Depth of clay observed in the suitable area ranges between 0.5-1.5 m. By using the parameters area and depth of clay, volume and weight is calculated. The total volume of clay present in 22 survey plots is 1, 10,609.88 m^3 and possess 2,14,701.91MT of clay.
Conclusions: The study using geospatial technology facilitated to derive plot wise status of suitable sites for clay mining from the criteria fixed. The total area and volume of the 22 recommended sites are 13,634.93 m^2 and 1,10.609.88 m^3 respectively. The quantity of mineable clay in the proposed sites is 2,14,701.91 MT.
Keywords: Tile/brick clay mining, converted area, suitable sites,cadastry,depth of clay, volume estimation

04-15

COMPUTATION OF SUBMARINE GROUNDWATER DISCHARGE USING RADON MASS BALANCE MODEL

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Background: To distinguish as well as detect the presence of terrestrial and re-circulated marine submarine groundwater discharge (SGD) the tracers that can be used are radon and salinity. Due to its conservative nature, short half-life, high abundance in groundwater compared to surface water, radon (^{222}Rn) acts as a good indicator for total submarine groundwater discharge in coastal water. Salinity differentiates sea water and fresh groundwater, with values <2 PSU reflecting the presence of fresh groundwater and values of around 35 PSU reflecting seawater.
Methods: Combining radon with salinity measurements in coastal water provides clear distinction of seawater with terrestrial groundwater. We measured radon in groundwater to distinguish the source of groundwater in thirty five coastal wells along the coastline of Kozhikkode, NW Kerala (India). Further, continuous monitoring of radon concentration with tide was carried out to quantify the Submarine Groundwater Discharge flux.
Results: In the Northern segment of study area, the wells are fed from both shallow sandy layers and deep lateritic and weathered/fractured rock whereas wells in Southern part are fed from shallow sandy layers. Also time series measurement of radon in coastal water was carried out at three locations (Site A-Gotheeswaram, Site B-Puthyappa and Site C- Kappad) to quantify the rate of submarine groundwater discharge. These sandy and other aquifersystems show definite signatures ofterrestrial SGD, which was confirmed based on hydrochemical evaluation and resistivity surveys.
Conclusions: The groundwater discharge in Kozhikkode coast varies in the ranges of 0.91-56.3 cm/day, 3.2-43cm/day and 2.5-208cm/day at Site A-Gotheeswaram, Site B-Puthyappa and Site C- Kappad respectively.
Keywords: Radon, Submarine Groundwater Discharge, seawater intrusion, coastal aquifer, South West Coast of India, Kozhikkode, Kerala

04-16

SPATIAL DISTRIBUTION OF MESOZOOPLANKTON ALONG THE SOUTH EASTERN ARABIAN SEA DURING EARLY SUMMER MONSOON

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Background: Summer monsoon season and associated coastal upwelling profoundly influence the production dynamics of South Eastern Arabian Sea (SEAS). Mesozooplankton community and its variations in SEAS significantly contribute towards the patterns of productivity in the region and is modulated along with the physical process of coastal

upwelling. The present study attempts to delineate the community structure of mesozooplankton along SEAS during early phase of summer monsoon upwelling along with the variations in the physicochemical characteristics due to the process

Method: Present study was carried out during the summer cruise of *FORV Sagar Sampada*. The study surveyed pattern of coastal upwelling and its relation to mesozooplankton distribution between 8°-15°N latitudes. Physico-chemical and biological parameters were collected using standard protocols. Surface mesozooplankton was sampled with Bongo net having a mesh size of 200µm and were sorted, enumerated and identified using standard keys.

Results: Upwelling was strong and extensive at southern most transect off Thiruvananthapuram (8°N) and diminished towards Off Goa (15°N). Surface biomass of mesozooplankton varied from 0.03-1.66 ml m^{-3}, while its numerical abundance ranged from 473-48,563 ind. $10m^{-3}$. Biomass and abundance were observed as higher towards near shore waters of southern transects characterized by significant upwelling and nutrient enrichment. Mesozooplankton community along coastal and shelf waters showed more dominance but less diversity. The study observed significant positive correlation between zooplankton biomass (ZBM) and chlorophyll *a*, since both these are concentrated towards neritic waters of shelf and coast Spatial distribution of mesozooplankton observed maximal biomass and count at the shelf station of Thiruvananthapuram. A total of 22 groups of mesozooplankton were identified. In general, Copepods (49-97%) was the dominant taxon observed throughout the study. Other major mesozooplankton groups included cladocerans, chaetognaths, gelatinous zooplankton, decapods larvae, tunicates etc.

Conclusions: Community composition and relative abundance of MZP in the South Eastern Arabian Sea (SEAS) alters significantly with the onset of summer monsoon (SM). The influx of nutrient rich waters enhances the phytoplankton abundance and rate of autotrophic production in the upper water column. The study emphasizes the influence of spatial variations in physico-chemical factors (SST, salinity, DO, inorganic nutrients) and the effect of upwelling event on spatial distribution of MZP in southeastern Arabian Sea (SEAS). Zooplankton being the secondary producers efficiently links primary producers with secondary consumers, thereby channeling biogenic carbon through food web.

Keywords: Mesozooplankton (MZP), South Eastern Arabian Sea (SEAS), Summer Monsoon (SM), Upwelling, Phytoplankton

04-17

GEOSPATIAL AND ANALYTICAL NETWORK PROCESS TOOL MIX FOR LANDSLIDE VULNERABILITY MAPPING IN KUTTIYADI RIVER BASIN, NORTHERN KERALA

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Landslide vulnerability zonation in highlands and midlands of Kuttiyadi river basin in Kozhikode district, Kerala, India has been carried out using geospatial techniques. From past and recent landslide evidences, being a landslide prone area a hazard zonation is attempted using terrain vulnerability concept. This work explore the usage of Analytical network process based decision making approach for landslide conditioning factors to determine the relationship between each factors effectively. The normalized weight of each factors will obtain after a 1-9 scale comparison increased the accuracy of result. Factor maps of various landslide triggering parameters such as slope, soil, landuse, drainage density, stage of landform, lineament density, geology and geomorphology were prepared and integrated through geospatial analyses in GIS platform, the study area (478km^2) is categorized into four classes of Very low vulnerability (186 km^2), low vulnerability (70km^2), Medium vulnerability (84km^2), High vulnerability (67km^2) and Very high vulnerability (74km^2). The last two categories together form 30% of the area which is the most hazardous regions and it require implication of immediate mitigation measures to prevent future slope failures. The result of this work concluded that application of ANP is an effective tool to weight the factors causing landslides and to generate landslide vulnerability zonation map with maximum accuracy using Geo-spatial technology, the validation of output data with landslide inventory data satisfying it.

Keywords: Geospatial, ANP, landside vulnerability and Kuttiyadi river basin

04-18

A STUDY OF THE URBAN HEAT ISLAND IN A COASTAL CITY INTERLACED BY WETLANDS

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Background: Urbanisation leads to significant changes in the local climate of the location. The rapid urbanisation and industrialization bring about microclimatic changes particularly with regard to thermal structure of the cities. The most pronounced effect of urbanisation on the microclimate of a region is the development of the Urban Heat Island (UHI). An urban heat island is the name given to describe the characteristic warmth of both the atmosphere and surfaces in urban areas compared to their non-urbanized surroundings. This study has investigated the development of the Urban Heat Island in Kochi, a tropical coastal city based on the Local Climate Zone classification (LCZ).
Method: Mobile surveys were conducted in the city of Kochi in Southern India, during winter season, covering pre-dawn and early evening periods in 2018. In situ measurements were carried out to record urban parameters which best match with each Local Climate Zones. Local Climate Zone map was prepared on the basis of standard zone properties defined in the LCZ classification system.
Results: The Urban Heat Island in Kochi, a fast growing urban region in coastal South India, interlaced by a network of canals and wetlands was moderate to high during winter and is seen to relate well with the urbanization. Highest observed urban heat island intensity in Kochi is 4.0^{o}C during winter morning. Highest observed UHI during winter evening is 2.5^{o}C. Maximum intensity was seen in Compact Midrise zones which cover the central part of the city. **Conclusions:** The Urban Heat Island intensity and spatial temperature distribution during winter season exhibits a good correlation with the Local Climate Zone Classification. Maximum average intensity was seen in Compact midrise zones which cover the central part of the city and minimum intensity found at sparsely built area. Wetlands in the study area play an important role in maintaining the thermal balance. Even though the development demands that determine the choice of the paths upset the natural harmony, conservation of wetlands and paddy fields is the easiest and appropriate method to reduce the heat island effect at the study area.
Keywords: Urban Heat Island, Local Climate Zone, Urban Climate

04-19

MAPPING FLOOD AFFECTED AREAS ON GROUND IN ERNAKULAM, THRISSUR AND PALAKKAD DISTRICTS IN KERALA, INDIA

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Background: In the month of August 2018 Kerala witnessed the devastating fury of extreme climatic events, resulted in an unexpected flood which engulfed the entire state. Soon after the flood when the water started receding, KFRI was set off to conduct a pilot study to understand the dynamics of the deluge. Later, the Government of Kerala commissioned KFRI to undertake the flood mapping of Palakkad, Ernakulam and Thrissur districts which includes major rivers of the state Bharathapuzha, Periyar, Chalakudy, Karuvannur and Muvattupuzha. Through this study, detailed mapping of flood intensity of these regions using ground data was done to identify the total area affected.
Method: The area inundated was surveyed on foot, and the water levels were marked and recorded in all three districts. A minimum sampling density of four points per square kilometre was ensured as per the directions of the Disaster Management Authority. In order to avoid omissions in the inundated areas, the satellite derived flood maps obtained from the National Remote Sensing Centre and crowd sourced water levels under the Rebuild Kerala initiative of the Government of Kerala were used. The water levels collected from the field were spatially interpolated using Inverse Distance Weighted (IDW) geostatistical technique. The interpolated surface was overlaid on ASTER DigitalElevation Model, and zero water levels were used to mark the boundary of the inundated areas.
Results: A total of 2591 samples were collected from the flood-affected areas in Thrissur, Ernakulam and Palakkad districts. An area of about 509 km^2 was flooded in Palakkad district, and the maximum height of water level observed

was 2.5m. The large size of Bharathapuzha has reduced the intensity of flood in the area.In Thrissur district, an area of about 747 km^2 is found to be flooded. A water spreadof 2.3 -5.5 m found over 9km^2 of the study area.Ernakulam district which encompasses Periyar and Muvattupuzha a total of 904 km^2 area was flood affected. Isolated places like ManjaliThuruth, Kozhithuruth and Thuruth showed a maximum water height of 6m.
Conclusion: The study concluded that one fifth of the three districts was flooded in the mass flood event in August 2018. This comes to 2160 km^2 of the total 10582 km^2 area. Reclamation of wetlands and unplanned constructions in the area has triggered the rate of destruction in Thrissur, Palakkad and Ernakulam districts. Deposition of alluvial soil is a major sedimentation occurred after the flood.
Key words: flood, water levels, mapping, DEM, interpolation.

04-20

AN OPERATIONAL FRAMEWORK FOR MONITORING WEATHER AND CLIMATE FOR KERALA: DATA SOURCES, PROCESSING AND OUTCOME SHARING

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Background: Weather forecasting is the submission of science and technology to envisage the state of the atmosphere at a future time and given location. Since the procedural activities of forecasting is subtle, sometimes the agential errors encompasses which lead to wrong sharing of information with the public and it causes to take precautions erroneously.
Method: Analyse the available data sets of atmospheric variables like Sea Surface Temperature, Precipitation, Wind vector and Relative Humidity using various data processing software such as GrADS, ArcGIS, MATLAB and Python and so on.Attempts to study the meteorological aspects of the causes of Kerala flood 2018,Evaluate the possibility to have an operational monitoring system that provides vital weather and climate information to the common public.
Results: The wind vector intensity from the Arabian Sea at the time was very high, along with that a low pressure depression was formed in the Bay of Bengal and it moved towards the Arabian Sea. There was an involvement of Madden-Julian Oscillation also that is characterized by an eastward propagation of large regions of both enhanced and suppressed tropical rainfall. As the Sea surface temperature is increased along with the tremendous increase in the normal Indian Summer Monsoon activity, the rate of precipitation upraised. In addition the high relative humidity in the region amplified the precipitation.
Conclusions: The analysed variables are involved in making the climate terrific. Proper and slip free analysis of future data sets will lead to exact prediction of weather. For the ease of sharing the deduced information with the people, some public friendly interfaces are necessary.
Keywords: Sea Surface Temperature (SST), Madden-Julian Oscillation, Indian Summer Monsoon.

04-21

MONITORING FLOOD AREAS USING MICROWAVE SATELLITE DATA - A CASE STUDY OF ALUVA TALUK, KERALA

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Background: Beginning of the second week of August 2018, Kerala was affected with severe flood. . Over 483 people died, and 15 were missing. At least a million people were evacuated Flood Hazard Mapping is a vital component for appropriate land use Planning in flood-prone areas. The study is regards with the extraction of flood area from the microwave data. Flood maps help to analyse the areas affected, intensity etc. Remote sensing and GIS is used as a vital technique for the analysis
Method: For this study, two microwave satellite data were used. SENTINEL-1A and ALOS PALSAR were downloaded from the European Space Agency- Sentinels Scientific Data Hub and Vertex ALASKA SATELLITE FACILITY respectively. Water bodies were extracted by SNAP-developed by European space agency, ASTER DEM was downloaded from the USGS earth explorer to analyse the elevation with flood intensity.
Results: from also palsar the total flooded area was found to be 27.40 km2. This includes rivers, streams, wetlands and other water bodies in the area that were responsible for causing the flood. the Sentinel data flood extend dated 21 August 2018. ALOS PALSAR data

usedforthestudywascapturedbeforetheflood,whereasSENTINELdatawascapturedafterthe flood.OnAug21,waterfromalmost all areas receded. It can be seen in the the above image that the south eastern parts of the Taluk are completely flooded. A total of 25.53 km^2 of land area is under water.

Conclusion: There is 1.86 km2difference between two images. Except some regions in north east the elevation of all other areas of Aluva Taluk is below 100 metre. The areas where maximum flood inundation occurred are found to be in and around the banks of Periyar River. In both the data obtained before and after the flood, the regions where flood inundation occurred are the same and that these regions are found to be low laying lands.

Keywords: flood zone extraction ,GIS,Microwave Remote sensing

04-22

SUBSURFACE DIURNAL TEMPERATURE FLUCTUATIONS AND THERMAL CONDUCTIVITY AT A TROPICAL STATION

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Background: Knowledge of thermal characteristics of soil is important to study the surface energy and radiation budgets, to quantify the heat storage required in agriculture for seed germination rate etc. Soil temperature plays an important role in land surface processes, and it is critical in energy balance applications such as land surface modeling, numerical weather forecasting and climate prediction.

Method: The data was recorded at Astronomical Observatory (76° 59' E longitude and 8° 30' N latitude), University of Kerala, adjacent to India Meteorological Department, Thiruvananthapuram in South Keralausing Automatic Hydro-meteorological data acquisition system during an observation period , 19– 25th February (Winter) and 25-31st October 2007 (North-East).

Results: On the normal undisturbed dry conditions (winter), the soil temperature in the top layers (0-0.20 m) shows high diurnal variation depicting the peaks in the afternoon hours. At the depths greater than 0.30 m, the soil temperature does not change diurnally or the diurnal temperature variation is damped out. In the north-east monsoon season, the diurnal soil temperature range is small as compared that of the clear day. On both the cases, the amplitude of the diurnal soil thermal wave decreases exponentially with depth.The values of thermal conductivity are nearly equal for the two seasons, but slightly greater in the N-E monsoon than in winter.

Conclusions: The amplitude of this wave decreases with depth and at 50cm depth from the surface, the amplitude is practically zero. The most fluctuation in soil temperature with respect to time was observed at the soil surface. Soil temperature at the deeper layers (>0.30 m) stayed almost constant during a day. The amplitude of the thermal wave is found to be high on winter season.The thermal conductivity of the soil during north-east monsoon period is greater than that of winter period.

Keywords: Diurnal thermal wave, Thermal wave amplitude, Thermal conductivity

04-23

DIURNAL AND SEASONAL VARIABILITY OF SUBSURFACE HEAT FLUX AT A TROPICAL STATION

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Background: Soil heat flux is an important input component of surface energy balance.Many field studies in topics such as microclimatology and hydrology require reliable measurements of the soil surface flux. The study of the vectorial heat of the soil stratum is important to understand the magnitude of heat exchange across the earth's surface leading to the influence of local climate during various seasons. The objective of this study is to estimate soil heat flux using soil temperature collected at various depths and to study the diurnal variation in various seasons.

Method: The data was recorded at Astronomical Observatory (76° 59' E longitude and 8° 30' N latitude), Univer-

sity of Kerala, adjacent to India Meteorological Department, Thiruvananthapuram in South Keralausing Automatic Hydro-meteorological data acquisition system during an observation period,Pre-monsoon (11-17 May 2008), Winter (19-25 February 2008) South-west (SW) monsoon (08-14 July 2008) and North-east (NE) monsoon (25-31 October 2007). Soil heat flux was estimated from soil temperature profile measurements.

Results: The diurnal curves of soil heat flux in the Winter and Pre-monsoon seasons exhibit a clearly defined maximum around local noon and have regular and symmetrical shape. Soil heat flux on NE monsoon season could reach a value of only 15.26 Wm^{-2} for the layer 0.05-0.10 m in the noon hour. Soil heat flux in SW monsoon season could reach a value of only 10.59 Wm^{-2} for the layer 0.05-0.10 m in the noon hour. The 24-hour sum for the day is -3.3 Wm^{-2} which means the overall flow of heat is from the soil to the atmosphere. The top layer accounts an increased heat balance during day and fluctuation in heat balance decreases exponentially with depth.

Conclusions: The diurnal variation is characterized by a cross-over from negative to positive values in the early morning occurrence of maximum around noon and return to negative values in the late evening. The amplitude of the diurnal heat flux is found to be high during winter and pre-monsoon seasons as compared to monsoon seasons. During NE monsoon, the daily total heat flux is found to be negative.

Keywords: Soil heat flux, Thermal Conductivity, Diurnal variation.

05 - ENGINEERING & TECHNOLOGY

05-01

GROWTH AND CHARACTERIZATION OF MOLYBDENUM OXIDE NANORODS BY PULSED LASER ABLATION: ANNEALING INDUCED PHASE TRANSITION

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Background: In recent years, transition metal oxides have attracted much attention due to their scientific and technological applications in various fields. Among the transition metal oxides, molybdenum oxide (MoO_3) possesses interesting properties such as good chemical stability and high electrical conductivity. Molybdenum oxide has shown a variety of technological applications in various fields such as photodetectors, light emitting diodes, photovoltaics, optical and electronic devices, gas sensors,batteries and multi-chromic coatings etc. Molybdenum oxide is a wide band-gap n-type semiconductorand type III electrochromic material which also have thermochromic and photochromic applications because of its various oxidation states, coordination number and stoichiometry.It can be used as a potential electro-active material for high energy density secondary lithium ion batteries due to the existence of different allotropes and sub-oxide phases of molybdenum oxide depending on the chemical composition and the formaloxidation state of molybdenum.

Method: In this work, we report the fabrication of thin films of molybdenum oxide (MoO_3)via pulsed laser deposition technique (frequency tripled 355 nm laser radiation from Q-switched Nd-YAG laser)using laser energy 70 mJon quartz substrates. The deposited films arethen annealed at different annealing temperatures (300, 400, 500 and 600^{0}C) and the effect of annealing on the structural, morphological and opticalproperties of the films are also studied.

Results: It is found that the annealing temperature has an important impact on the predominant phase formation and crystallinity of the MoO_3 films. Structural studies by X-ray diffraction (XRD) and Micro-Raman spectra confirms the predominance of orthorhombic phase at an annealing temperature of 600 ^{0}C. Chemical analysis revealed that the film annealed at 600 ^{0}C showed only Mo^{6+} oxidation state indicates the growth of α-MoO_3. Morphological analysis shows that the film annealed at 600 ^{0}C shows a rod-like morphology.

Conclusion: It is found that the annealing temperature has profound effect on the predominant phase formation and crystallinity of the MoO_3 films. Among the various annealing temperatures, 600 ^{0}C is found to be optimal for the orthorhombic phase and enhanced photoluminescence emissions.

Keywords: Pulsed laser deposition,X-ray diffraction, Field emission scanning electron microscope, X-ray photoelectron spectroscopy, Atomic Force Microscopy.

05-02

COBALT PHTHALOCYANINE - BASED ORGANIC FIELD EFFECT TRANSISTORS FOR ULTRAVIOLET SENSOR APPLICATIONS

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Background: Nowadays skin cancer has become an increasing human health issue. Suntan and sunburn are familiar effects of over-exposure of skin to Ultraviolet (UV) radiation, leading to skin cancer. Organic electronics is an emerging technology for low temperature and portable applications. Organic semiconductors (OSCs) exhibit interesting properties which can be exploited for the fabrication of organic field effect transistors (OFETs). The chemical variety in OSCs allows us to apply them in active layers of OFET based sensors with high sensitivity. Phthalocyanines are considered as the most important organic material for sensing applications. The aim of this paper is to report the performance of cobalt pthalocyanine (CoPc)-based organic field effect transistors for high sensitivity flexible UV-sensor applications.
Method: In this work, bottom gate top contact OFETs were fabricated on a silicon (Si) wafer with CoPc as the OSC. Before starting the deposition, the substrates were cleaned in an ultrasonic bath. N-type Si wafer acted as substrate and gate electrode with a 50 nm thick thermally grown oxidized silicon dioxide (SiO_2) on top, which functioned as the gate insulator. The optimized thickness of 50 nm CoPc film was thermally deposited on the gate insulator. Finally, 100 nm silver electrodes were deposited onto the CoPc film through a shadow mask by thermal evaporation. The OFETs were fabricated with a constant channel width of 1000 µm and a channel length of 135 µm. Finally, the electrical characterizations of the OFETs were done in air using a probe-station connected to an Agilent B2900A semiconductor parameter analyzer.
Results: The morphology of the CoPc thin films reveals that the surface has a smooth structure. The absorbance spectrum of CoPc films shows maximum absorption in UV region and makes them more attractive for UV-sensor applications.Also we investigated a time-resolved photoresponse of the device underradiation on and off. Theoutput characteristic of the fabricated devices with and without irradiation was also studied and shows excellent output characteristics with clear saturation and gate dependence.The OFET revealed an effective mobility of 0.45±0.09cm^2/Vs with -4.12±0.05V threshold voltage, subthreshold swing of the transistors appears to be 715.50±72.37mV/decade under UV irradiation at drain-source voltage of -2 V.
Conclusion: In conclusion, the effects of UV radiation on the electrical properties of CoPc-based OFETs were investigated. The properties of CoPc films were studied through morphological and optical characterizations. The optical studies demonstrated that the material shows maximum absorption in UV region and makes it attractive for flexible UV-sensors. The electrical properties of the fabricated devices with and without irradiation were also studied. These operating parameters show that CoPc-based OFETs can be promising for scalable, low-power flexible UV-sensor applications.
Keywords: Organic field effect transistor, Cobaltphthalocyanine,UV-sensor, Mobility, Sub threshold swing.

05-03

ULTRA FAST HEAT DISSIPATING AEROGELS DERIVED FROM POLYANILINE ANCHORED CELLULOSE NANO FIBERS AS EFFICIENT MICROWAVE ABSORBERS IN THE X BAND

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Background: We report a facile and environmentally benign strategy to synthesize ultra-light and highly conductive aerogels derived from cellulose nanofibers (CNF) anchored with polyaniline (PANI) via a simple in-situ polymerization and subsequent freeze drying process. The PANI/CNF aerogels were fabricated solely with a rationale to screen undesired EM radiations emitted out from electronic devices functioning in microwave frequencies and to suppress further electromagnetic pollution. These conductive aerogels were comprehensively characterized using Fourier Transform Infrared Spectroscopy, X Ray Diffraction, Scanning Electron Microscopy, Transmission Electron Microscopy and results were correlated with Vector Network Analyzer to access its EM shielding properties. The obtained conductive aerogels

exhibited density as low as 0.01925 g/cc with a maximum EMI shielding effectiveness (EMI SE) value of -31 dB (> 99.9% shielding) in X band (8.2-12.4 GHz) region at 5.0 mm thickness. It is also noteworthy that the fabricated aerogels demonstrated a strong microwave absorption behavior (ca. 95%) with minimal reflection (ca. 5%) of the incoming EM radiations which is very much crucial to stifle electromagnetic pollution. Nevertheless, PANI/CNF aerogels can also be exploited for a plethora of sensing applications such as gas sensors, strain sensors and biosensors.

Method: In this study, oxidative polymerization of aniline monomer onto the surface of cellulose nanofibers was performed via an *in-situ* strategy as reported by *Gopakumar et al* Initially, calculated quantities of aniline was mixed with 1M HCl solution and cooled down below 5°C in an ice bath under constant stirring. This solution was then slowly added to CNF suspension (0.03g/ml) and homogenized at 3000 RPM using a homogenizer to ensure uniform dispersion of aniline in CNF suspension. The oxidant solution was then prepared by dissolving 0.2 molar APS in 1 molar HCl. This was followed by slow drop wise addition of oxidant solution to the aniline coated CNF suspension kept below 5°C in an ice bath with continuous stirring to initiate the polymerization. In all the reaction scheme, APS:aniline ratio was 1:1 and kept constant. After 6 hrs, dark green colored PANI/CNF suspension was obtained which was washed with deionised water, acetone and 0.1 M HCl to remove untreated aniline monomer. The washed PANI/CNF suspension was then cooled at -80°C for 8 hrs and subsequently lyophilized at -85°C at 0.05 mbar for 48 hrs to form robust PANI/CNF aerogels.

Results: The conductive aerogels exhibited density as low as 0.01925 g/cc with a maximum EMI shielding effectiveness (EMI SE) value of -31 dB (> 99.9% shielding) in X band (8.2-12.4 GHz) region at 5.0 mm thickness. It is also noteworthy that the fabricated aerogels demonstrated a strong microwave absorption behavior (ca. 95%) with minimal reflection (ca. 5%) of the incoming EM radiations which is very much crucial to stifle electromagnetic pollution. The thermal heat dissipation studies reveal that the these aerogels are capable to cool down from 102°C to 27°C in just 45 seconds when subjected to microwave radiation at 2.54 GHz for 6 seconds. These unique properties make PANI/CNF aerogels as sustainable microwave absorbers for the future.

Conclusions: We conclude that PANI/CNF aerogels were fabricated and tested for their microwave absorption and heat dissipation characteristics. The aerogels with ultra low density (0.01925 g/cc) were fabricated via freeze drying process. An effective shielding effectiveness (EMI SE) value of -31 dB (> 99.9% shielding) was achieved in X band. The thermal imaging studies reveal that the fabricated aerogels have demonstrated ultra fast heat dissipation ability when subject to high energy microwave radiations.

Keywords: Cellulose Nanofibers, Aerogels, PANI, EMI Shielding, Microwave Absorption, Heat Dissipation.

05-04

AUTOMATION OF BANDWIDTH REDESIGN AND ITS APPLICATIONS IN AMPLIFIER TUNED OSCILLATORS BASED ON NULLORS

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Background: In an amplifier circuit, it is principally the reactive elements (usually capacitors) that establish the higher and lower cut-off frequencies. Capacitors lies along the signal path, which is in series with the flow of signals, can affect the lower cut-off frequency. Coupling and bypass capacitors are belongs to this category. On the other side, capacitors parallel to signal flow can affect higher cut-off frequencies, which include internal capacitors of active devices. The frequency- bandwidth based studies are useful as they find applications in video/audio amplifiers, hearing equipment etc. and it will be more interesting if we go for automation of bandwidth design.

Method: The Fixator Norator pair (FNP) is the tool of this methodology. Our strategy in this technique is to define additional sub-circuits containing one or more passive devices (mainly reactive elements) using the FNP so that the addition of the sub-circuit into the original amplifier circuit will revise its frequency response and the amplifier possesses a narrow band-pass behaviour. At this moment, the amplifier can be treated as an active narrow band-pass filter. By giving proper positive feedback, the circuit can be turned into an oscillator. The frequency of oscillation will be same as the designed central frequency.

Results: In the proposed approach, the main task is to convert the norator Bode plot into reliable two-terminal sub-circuit. For a systematic designer, this is not so hard, as one can use a pre-defined library for this purpose. Above all, this study connects among amplifier, filter and oscillator circuits and hence it receives pedagogical importance. The benefit of FNP procedure is that the designing can be performed in a linear-like way. The design parameters are immobilized at some pre-determined values and thus the complications incorporated with the non-linear elements get diminished.

Conclusions: A method has been propounded for the design automation of narrow band-pass amplifier and hence am-

plifier turned oscillators. Fixator-norator pair together with reference circuit is used for the design of sub-circuits; which is added to the original circuit for getting the desired frequency response. Such a circuit possesses a narrow pass-band similar to that of a narrow band-pass filter. The usages of reference circuit and nullor elements are temporary in the circuit. They can be removed once the sub-circuit is designed. The scope of this approach is wide and it can be extended to other areas of analog design including linear equivalent circuit modelling.

Keywords: Analog Circuits, Feedback, Amplifiers, Active Filters, Oscillators, Fixator Norator Pair, Nullor.

05-05

PVA/ POLYPHOSPHORIC ACID MODIFIED MMT COMPOSITE : AN EFFECTIVE SOLUTION FOR WATER PURIFICATION

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Background: Two dimensional nano materials such as layered silicates like montmorillonite (MMT), graphene,LDH etc are widely studied due to their high aspect ratio which in-turn enhances the properties like flame resistance, mechanical properties, gas adsorption and gas barrier properties ,water purification etc.Among which clays especially montmorillonite clay either pristine or modified form, find its way as adsorbent of dyes from water due to its high surface area and high cation exchange capacity. These are also wildly used as fillers to improve mechanical properties of polymers.

Method: MMT clay is modified with polyphosphoric acid (PPA) by adding 0.2% PPA to aqueous dispersion of MMT. After 5h stirring the resultant clay washed, dried and named as PMMT. Its organic dye adsorption capability is analyzed by taking Methylene Blue, a cationic dye, as model dyeand the adsorption capability is compared with unmodified clay. PVA composite is prepared with MMT and PMMT also and it isevaluated for its dye adsorption capability and improvement in mechanical properties.

Results: PMMT synthesized is characterized using XRD and FTIR, TEM and TGA. The BET surface area is well improved when the modification established. Both MMT and PMMT is evaluated for its adsorption capacity using Methylene Blue dye and PMMT shows improvement in dye adsorption. The PVAcomposite thin films with both clays are also analyzed and PMMT/PVA composite almost removed 100% dye from the solution of concentration 50mg/l. The tensile properties of composites arealso improvedfrom 35.42 N/mm^2 (PVA alone) to 39.8 N/mm^{2}with only 0.5% PMMT and for MMT/PVA it is only 38.5 N/mm^2.

Conclusions: The chemical modification of MMT with poly phosphoric acid is established in this work. Modified clay found to be better for improving the dye adsorption from water. Its composites with PVA are also good enough for dye removal along with high tensile properties.

05-06

EXPERIMENTAL STUDIES ON MECHANICAL PROPERTIES OF FIBER REINFORCED BITUMINOUS MIXES

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Background: Over the past few years, several research efforts are being done on modified bituminous materials which had been developed to improve pavement performance. Fiber reinforcement refers to incorporating materials with desired properties within some other materials lacking those properties. It is a widely accepted fact that the addition of fibers to bituminous mix enhances material strength as well as fatigue characteristics. The effect of physical parameters of fibers and the quantity of fibers to be added has to be analyzed based on performance test of reinforced bituminous mixes. In the basis of continuous increasing in traffic loads in roads the usage of reinforced mixes makes sense as such mixes possess good resistance to deformation and stress strain characteristics.

Method: In this study, experiments were conducted to determine the characteristics of and performance of fiber reinforced bituminous mixes. The samples were prepared with varying quantities of coir fiber and polypropylene fiber and were analysed against control samples. The tests conducted are Marshall Test, Dynamic creep test and Dynamic modulus test.
Results: The test results show that the dosage and homogenous dispersion of fibers determines the strength of the resulting mixtures. The strength of the mixes is affected not only by different fiber concentrations and also by fiber length. Also optimum binder content of fiber reinforced mixes is more when compared to the control mix. This is due to the increased absorption area formed as a result of addition of fine fibers.
Conclusions: The use of fibers increases the stiffness of the mix without appreciable difference in cost of construction, thereby increasing the life of pavements.
Keywords: Marshall Test,Natural fibers, Reinforced bituminous mix, Dynamic creep test, Synthetic fibers

05-07

DEVELOPMENT OF RING ROAD AND NMT CORRIDOR FOR AN EMERGING TOWN IN KERALA

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Kondotty is a revenue village and municipality, and is also a developing town in the Malappuram district, state of Kerala, with an extent of 30.93 sq km, which is located near Calicut International Airport. The National Highway 966 which connects Kozhikode with Malappuram and Palakkad passes through Kondotty.
The pattern of inter-city vehicular movements through Kondotty Town was studied by analysing the origin-destination movements of vehicular traffic at the outer cordon survey locations. It is seen that, about 21percent of total traffic with their origin and destination points outside the Kondotty town are passing through the town with no purpose of halting. Therefore there is a scope for developing a ring road for the town, so as to segregate the divertible traffic in the future years.
This work deals with examining the need and scope of developing a ring road for the Kondotty town. The work recommends the various possible alternatives for the proposed ring road alignment for the town. This paper also deals with suggesting a non-motorized corridor for the Kondotty Town.
Methodology: Extensive traffic surveys were carried out to study the existing traffic scenario of the region. To study the travel pattern of vehicles traversing in and around the town, traffic surveys like Intersection turning movement surveys, Mid-block volume count survey, Origin-Destination surveys etc were conducted at the Kondotty Town. Secondary data were also collected from various sources.
Results and conclusions: The proposals of ring roads are made to moderate the mixing up of intra-city and inter-city traffic. It is evident from the findings; about 21% of traffic is by- passable. Since the through traffic which have no purpose of halting in urban area and having its origin and destination lying outside the urban area are divertible to the ring roads. This will help to reduce the congestion in the core area of the town where road widening is not possible. Thus to divert the traffic from major roads, alternative link roads have to be strengthened and developed within the area. Different alternatives for ring road development are proposed for Kondotty municipality. On south west side of NH 966 three alternative roads and on north east side two alternatives are identified. The ring road development is proposed with a ROW of 12m while the road stretches from Chirayil Chungam to Karipur Airport Jn with an additional cross sectional element of cycle track on both sides of the roadway in order to pave way for a NMT friendly corridor in the town. In Kondotty, there is a possibility of developing a walk way/ joggers path and cycle tracks along the sides of less congested roads. This will help in promoting non-motorised transport in Kondotty town which is a pace towards sustainable transport by inculcating a healthier habit and road culture of relying on NMT modes to the extent possible.
Keywords: inter-city travel characteristics, Ring Road development, non-motorized transport corridor.

05-08

PERFORMANCE ANALYSIS OF KSRTC DEPOTS IN THIRUVANANTHAPURAM CITY USING ANALYTICAL HIERARCHICAL PROCESS

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Introduction: Public transportation is an important contributing factor to urban sustainability. Improving the quality and efficiency of public transport is important in order to change the daily transport habits of the public. Evaluating the performance of a public transport system is essential for making suitable amendments in its improvement strategy.Thiruvananthapuram is one of the major cities in Kerala State and derives its importance being the capital city of the State. This paper compares the performance of the 19 KSRTC Depots in Thiruvananthapuram. Secondary data was collected from 19 KSRTC Depots to understand the existing public transport service characteristics which included operational details, revenue earned, number of buses, schedule of buses, route length etc. were collected.
Methodology: Analytic Hierarchy Process (AHP) was used for the performance analysis of the 19 KSRTC depots. Mainly four factors were considered for analyzing the performance of KSRTC depots: Safety, Revenue, Efficiency and Service coverage and to represent these four factors Number of Accidents per kilometre (NA), Average Earnings per kilometre (AE), Fuel consumption per kilometre (FC) and Average kilometre Operated per day (AO) respectively were selected.The overall efficiency of the KSRTC Depotswas obtained after model synthesis and respective rankingwere given to them.
Results and Conclusions: This study provides an approach for analyzing the performance of 19 KSRTC Depots in Thiruvananthapuram district for four criteria using AHP.In this hierarchical approach of the analysis, we initially computed the importance or weights for the four criteria considered. Then local priorities for the depots for each criterion were formulated. Using the local priorities and the criteria weights, we derived the overall efficiency for 19 depots.The overall efficiency or weights obtained were found to be varying between 0.099 and 0.024. The overall efficiency was then classified into Best performer, Good performer, Average performer and Poor performer. Neyyantinkara Depot was found to be the best performing depot with an overall efficiency of 0.099. is due to the higher average earning per km for Neyyatinkara depot which is the most influencing factor. Although this approach facilitates the decision-maker in understanding the performance of the depots and provides a benchmark, this study is not extensive. Considering more number of criteria can improve the accuracy of the performance analysis. This approach can be considered as an initial stepping-stone for effectively analysing the performance of various depots.

Keywords: Public Transport, Performance Analysis, Analytical Hierarchical Process

05-09

IDENTIFICATION OF MAJOR FACTORS INFLUENCING WORK TRIPS IN THIRUVANANTHAPURAM CITY

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Introduction: A proper analysis of the mode choice decisions in case of work trips can helps in addressing issues such as forecasting demand for new modes of transport, mitigating traffic congestion, allocating resources and examining the general efficiency of travel. The major objectives of the present study are to analyse the existing commuting pattern of work trips in Thiruvananathapuram city and also to identify the major socio-economic and travel variables influencing the mode choice behaviour of work trips in Thiruvananathapuram city.
Methods: Household survey was conducted to study the travel pattern of the commuters undertaking work trips in the Thiruvananthapuram city.
Analysis and Results: It was found that majority of work trips were made by using two-wheelers (56%) and the next higher portion of work trips were shared by bus (20%) and car (5%). The respondents who mainly preferred two wheeler and car were males whereas female workers preferred bus and two wheeler for their work trips. Among age groups greater than 30, two wheeler and car constituted the major mode shares whereas for the age group with age less than 30, two wheeler and bus were the modes chosen.By conducting linear regression analysis, it was found that the major independent variables that affected the mode choice behaviour of a commuter are monthly income, sex, age, no: of

vehicles, no: of workers, travel time and travel fare.

Conclusions: The present study observed that with increase in income, the commuterswere switching to personalized vehicles.In Trivandrum city, where there is a predominant share of private vehicle for work trips, improvingpublic transport is the only measure likely to attract more commuters to public transport and which will finally leadto significantreduction in traffic volume on the plying roads. Transport planners must ensure that travel timeand travel costs are kept to the minimum to win over more commuters to the public transport system. The study shows that more can be attracted towards public transport by improving service characteristics of transport such asreliability, cleanliness, comfort and safety.

Keywords: Linear regression, commuters, work trips

05-10

IMPROVEMENT PROPOSAL FOR RECTIFICATION OF TRAFFIC PROBLEMS IN CONGESTED JUNCTIONS USING RING ROAD CONCEPT – A CASE STUDY OF KUNNAMKULAM JUNCTION IN THRISSUR DISTRICT

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Background: Kunnamkulam junction, situated in the Thrissur District is one of the major junctions where two state highways, SH ٥٠ and SH ٦٩ intersect. Presently, the Kunnamkulam junction is heavily congested and the movement of vehicles and pedestrians across the junction is inefficient and unsafe. Based on various aspects like geometry of main roads, availability of space in junction area and utility of the nearby roads, the ring road concept has found as the best solution to implement at Kunnamkulam town. Finding the suitable roads as ring roads in Kunnamkulam town and implementing the concept considering the traffic conditions, alignment and space constrains are explained in this paper.

Methods:

- Conducting reconnaissance survey and identifying suitable roads for ring road.
- Traffic surveys and detailed Topographic surveys of selected areas.
- Design of alignment for the missing link.
- Preparation of least cost estimate for the proposed missing link.

Results:

Proposed alignment for missing link: A new alignment is proposed for missing link in the ring road that connects TK Krishnan road to Pattambi road using AutoCAD Civil 3D software.

Pavement design of missing link: Based on the CBR value obtained from the subgrade soil collected from the junction i.e. 17.1%, and traffic load of 132 msa, the pavement layer thickness is derived from the design charts provided in the IRC: 37-2012.

Cost Estimate for missing link: The estimate covers land acquisition cost, material and construction cost of cross-section elements, traffic sign board installation, road markings, cross drainage works and other road appurtenances.

Conclusions: The paper presented the salient features of the improvement plan adopted for the junction which include:

- Reconnaissance survey and necessary site visits to assess the existing problems and to identify the possible road stretches to connect as ring road.
- Details of traffic survey conducted at the junction and the bell-mouth of all the ring roads to assess the current traffic flow and have done detailed topographical survey to map the existing roadway features.
- The detailed description about the proposed alignment for a missing link in the ring road with alignment details, pavement design and cost estimate.

Key words: Ring road, alignment design, pavement design, cost estimate

05-11

HOLOGRAPHIC RECORDING OF MICROSCOPIC IMAGES USING PHASE SHIFT INTERFEROMETRY

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Background: Phase-shifting interferometry (PSI) is a holographic interferometric technique where multiple holograms are generated by giving appropriate phase shift to one of the beams. The amplitude and phase information of the object can be analyzed from the complex hologram. The proposed work is based on transmission type microscopic tissue imaging based on phase shifting interferometry and its reconstruction by angular spectrum method. The proposed method is evaluated by computing the Peak Signal to Noise Ratio(PSNR).

Proposed Transmission type Microscopic Imaging PSI: The proposed work is meant to record the hologram of transmission type microscopic tissue imaging based on phase shifting interferometry. The post operative collected specimen after processing is embedded in paraffin block. The paraffin block is cut into thin microscopic sections using microtome and fixed on a glass slide.

The microscopic tissue is placed as sample and a microscopic objective (MO) is used to magnify the microscopic tissue. The beam splitter splits laser beam into two parts-the reference beam and the object beam. One mirror is mounted with a Piezo Electric Transducer (PZT) which provide appropriate phase shift to the reference beam. The reflected object beam is again reflected by mirror and made to fall on microscopic sample. The MO helps to yield a magnified version of the sample. On the second beam splitter both the object beam and phase shifted reference beam are superposed and the corresponding interference pattern is observed in CCD which can be transferred to a PC.

The complex amplitude of the object light is referred to as the complex hologram because the amplitude distribution of the object light in the object plane is retrieved from by performing digital back-propagation. The reconstruction can be performed by angular spectrum method.

Simulation Results: To monitor the quality of the resulting reconstructed image of the hologram, the Peak Signal to Noise ratio between images is measured, which is defined as

Mean Square error, where $I_0(m,n)$ and $I_i(m,n)$ represents reconstructed and input image, M,N is the size of the image and R is the maximum fluctuation in the input image data type. The PSNR value is used to measure the quality of image after reconstruction and is found to be 12.03.

Conclusion: The proposed work implemented the hologram generation and reconstruction of microscopic sample tissue images by phase shifting interferometry. Phase-shifting interferometry provides a convenient method for computer analysis of interference patterns. The PSI technique can eliminate the influence of zero-order light and twin image, thereby improves the quality of the reconstructed images at the output.

Keywords: Phase-shifting interferometry, holographic interferometry, multiple holograms, phase shift, reconstruction.

05-12

ENHANCED PEDESTRIAN DETECTOR USING FIRST ORDER AND SECOND ORDER AGGREGATED CHANNEL FEATURES

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Background: Pedestrian detection is an active research area in computer vision field due to its significant role in

driverless cars, traffic surveillance using CCTV, anomaly detection in public spaces etc. Performance of a detection algorithm heavily depends on the discriminative nature of features extracted from the images. Aggregated channel feature (ACF) detector which uses low-resolution channels extracted from the first derivative of the images as features and AdaBoost as the classifier is widely accepted pedestrian detector due to its simple framework, better accuracy and computational speed. State of the art pedestrian detectors based on ACF framework, either adds more channels for feature extraction or they will apply some filters on existing channels.

Method: This paper introduces a new set of features termed as Second Order Aggregated Channel Features (SOACF) which used the second derivate of the image for feature extraction. Further, a new detector is proposed which employs both the first order channels of ACF and second-order channels of SOACF together. This was made possible by a merging algorithm based on weighted non-maximum suppression, which effectively merge the results of two separate AdaBoost classifiers trained using ACF and SOACF.

Results: The proposed detector achieved a miss rate of 24.56% on Caltech dataset against 28.10 % miss rate of baseline ACF detector. Similarly, for KITTI dataset, the miss rate of the proposed detector is 16.92% whereas for ACF detector, it is 18.52%. Also, in comparison with topmost pedestrian detector based on ACF methodology, the proposed detector is 100 times faster without any parallel computation.

Conclusion: This work proposes a new feature set SOACF based on the second derivative of the image. Also in this work, a new detector is proposed which make use of both ACF features and SOACF features by a merging algorithm based on weighted non-maximum suppression. The proposed detector achieved much better result than the baseline ACF detector and also has got high computational speed in comparison with state of the art detectors based on ACF.

Keywords: Pedestrian detection, Aggregated channel features, AdaBoost classifier

05-13

MODE CHOICE ANALYSIS OF WORKERS: A CASE STUDY FROM KOCHI CITY

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Background: Mode choice analysis is a method of arriving at a decision on which mode is chosen by a particular commuter to travel, under a set of circumstances.Influence of built environment characteristics, along with personal, household and activity-travel variables on an individual's daily activity-travelpattern is focused by recent researches.

Method: Data is collected from Kochi Municipal Corporation by direct interview method. Final data based is used for exploratory data analysis and modelling. Activity based approach, under disaggregate modelling methods is used in the present study. Multinomial logit modelling is used for mode choice analysis of workers for Home-Work-Home pattern.

Results: Disaggregate model shows that personal, household, activity-travel and mode characteristics can influence themode choice behavoiur of workers. From the model it is also evident that different residential location characteristics consideredalso have significant effect on the mode choice decision.

Conclusions: The model can be a good input to further transportation policy analysis, which can derive the appropriate policies such as to reduce congestion and increase the mode share of sustainable modes like walk, cycle and public transport.

Keywords: Activity based approach, Mode choice behaviour, Multinomial logit model, Residential location characteristics, Developing country

05-14

STUDY OF USE OF INDUSTRIAL WASTE MATERIALS FOR DEVELOPMENT OF AERATED MASONRY BLOCKS

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Background: Aerated masonry blocks can be used as an alternative to conventional concrete blocks, which possess high density which in turn results in increase in self-weight of the whole structure. Owing to its sustainability, low thermal conductivity and use of less mortar joints, now a days aerated masonry blocks has become a wide popularity. In Addition to the above advantages, aerated concrete can also incorporate cement replacementswith fly ash, waste rubber particles from retread and tyre manufacturing industry, shredded plastic etc., which can lead to the consumption of waste products which are otherwise leads to environmental pollution.
Method: This research work determines the suitability of aerated concrete incorporating industrial waste products like rubber particles and PVC granules for the development of masonry blocks. This is done by determining compressive strength and density. The target strength to be attained is fixed between 5 MPa and 10 MPa and density below 1600kg/m^3. The water- cement ratio is 0.45. The aerated concrete is developed by using Aluminum powder as air entraining agent. The aggregate content is omitted throughout the study.
Results: The cement is replaced with 20% of Fly ash. The optimum Aluminum content is found to be 0.5% by weight of cement which density and compressive strength which got increased on addition of PVC granules by weight of cement upto 75% and then decreases. In case of rubber powder incorporated aerated concrete, density and compressive strength decreased considerably.
Conclusions: This study reveals the use of industrial waste products in aerated concrete for developing masonry blocks which can make the construction more sustainable and economical. The use of PVC incorporated aerated masonry blocks exhibits more enhanced properties.
Keywords: Aluminum powder, Aerated concrete, Fly ash, rubber powder, PVC granules, density, compressive strength

05-15

PARAMETRIC RESPONSE ESTIMATION OF DIAPHRAGM WALL BEHAVIOURS FOR OPTIMAL SYSTEM CONFIGURATIONS

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Background: Recent upsurge in economic development necessitates need for more material space in urban areas. The growing demand is to utilise underground space more productively. Deep excavations and selection of appropriate support facilities have substantial impact on economy, time and performance. Hence, reliable estimates of excavation related responses are vital.
Method: This paper presents the results of parametric analysis performed on diaphragm walls to comprehend the effects of influencing factors like groundcharacteristics and support configurations. Diaphragm walls were analysed as plain strain problem using Plaxis 2d. Wall sections were modelled as elastic plate element and soil masses were simulated as elastic plastic material under Mohr-Coulomb failure criterion.
Results: Values of lateral deflections, bending moments, normal forces and shear forces were computed for all possible combinations of influencing factors of diaphragm wall system. The results are represented in comparative charts and tables so that effective combinations of wall and support criteria for any field conditions can be perceived easily.
Conclusions: Wall behaviours studied under different field conditions and support characteristics emphasize the necessities of accurate response prediction models. The results presented in terms of comparison charts and safety factors can assist a designing engineer to choose optimum design parameters for any proposed diaphragm wall project.
Keywords: Deep excavation, Diaphragm wall,Parametric analysis, Wall response

05-16

MECHANICAL PROPERTIES OF CHICKEN FEATHER FIBRE REINFORCED NATURAL RUBBER BIOCOMPOSITES

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Background: Chicken feather fibre (CF) is commonly described as a waste by-product and they are contributing to environmental pollution due to the disposal problems. The composite reinforcement application of the CF offers much more effective way to solve the environmental concerns compared to the traditional disposal methods (burning and burying).The CF as a composite reinforcement has certain desirable properties that includes; lightweight, high thermal insulation, non-abrasive behaviour and excellent hydrophobic properties. The present study is the development of a new class of composites with the CF waste as filler in natural rubber (NR) to solve the environmental problem and to develop cheaper filler for NR composites.
Method: Biocomposites of NR reinforced with CF were prepared using dicumyl peroxide (DCP) as vulcanizing agent. Composites with two series of CF were studied. i.e., raw (RCF) and alkali treated (ACF) fibres. Surface modification of the fibre was done by alkali treatment to improve the interfacial adhesion. The influence of fibre loading and chemical modification on the mechanical properties of composites was analysed. The composites were characterised by using FTIR and scanning electron microscopy (SEM).
Results: The mechanical properties such as tensile strength, tear strength and tensile modulus were found to be improved by the incorporation of CF in all forms. A fibre loading of 25phr has been found to be optimum for the best balance of properties. Better properties are shown by the composites with ACF. SEM studies support the results of mechanical properties. FTIR analysis confirms the interfacial adhesion of CF in the NR matrix.
Conclusion: Blends of natural rubber with acrylonitrile butadiene rubber (NBR) are used for many product applications like oil seals, hoses and automobile bushes etc. Hence a method of utilization of waste chicken feathers as reinforcing agents in NR offers a good ecofriendly modification. There are many other areas where the applications of these materials are to be tested and utilized.
Keywords: Chicken feather fibre, Natural rubber, Dicumyl peroxide, Mechanical properties

05-17

ROBUST HAND POSTURE RECOGNITION USING SVM CLASSIFIER WITH GABOR AND DWT FEATURES

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Background: Hand gesture recognition has got key attention of researchers due to its popularity in varied fields such as human machine interaction, robotics, medical therapy, sign language communication etc. This paper presents a static hand gesture recognition method using image features and multiclass support vector machine (SVM) classifier by addressing its application for the communication of people with speaking and hearing difficulty. The method works by extracting the visual features of the handsfrom the images of gestures.
Method: The method includes the hand segmentation, feature extraction and recognition phases. Hand segmentation extracts the hand palm region from the input image by eliminating the irrelevant pixels and body parts from the background. Then, the combination of the feature values obtained through Gabor and DWT (Discrete Wavelet Transform) descriptors are used to form the feature vector. Further reduction with PCA (Principal Component Analysis), selects the most discriminative feature values. The classification of the hand postures are done with multiclass SVM.
Results: The proposed method has been tested on the publicly available Jochen Triesh hand posture dataset. The sample images of the ten different static hand gesture classes with uniform background are used for the experiment. The dataset has been divided into two equal sets as training and validation sets. The obtained result has been compared with a previous work on the same dataset. The analysis shows that the proposed method is very effectual for static hand gesture recognition.
Conclusion: This work utilises the support vector classifier with image features extracted through Gabor and wave-

let decomposition for robust hand posture recognition. The method has been tested on the Jochen Triesh dataset and achieved better recognition accuracy.

Keywords: Hand Gestures, Sign Language, Visual Features, Gabor, Wavelet, Principal Component Analysis, Support Vector Machine.

05-18

A COMPARISON OF PERFORMANCE OF MARGIN INFUSED RELAXED ALGORITHM AND SUPPORT VECTOR MACHINE ON THE TASK OF WORD SENSE DISAMBIGUATION FOR MALAYALAM

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Abstract: Word Sense Disambiguation (WSD) for Malayalam is a challenging task due to the characteristic features of the language. In this paper, we presenting a comparative study of two sequential Algorithms viz. Margin-infused Relaxed Algorithm (MIRA) and Support Vector Machine (SVM). The System makes use of the contextual feature information along with the parts of speech tag feature in order to predict various WSD classes. We have used CRF++ for implementing the MIRA algorithm and Yamcha for implementing SVM algorithm. A small hand labeled Malayalam dataset of lexical sample examples were used and had a decent accuracy score on initial experiments. The results show the superiority of MIRA over SVM and are just little lower than the highest results achieved for this task. However, a further analysis and experiments on large standard sense-tagged data are necessary to make any significant claims on the models to disambiguating Malayalam word senses for lexical sample tasks. With more improvements, there is very good potential and the possibility for these models to be effective on the Malayalam language.

Keywords: Word Sense Disambiguation(WSD), Margin-infused Relaxed Algorithm (MIRA), Support Vector Machine (SVM).

05-19

EVALUATION OF GROUNDWATER QUALITY AT CHAVARA, KOLLAM DISTRICT, KERALA USING GIS AND MODFLOW

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Groundwater isa vitalsourceof water.Groundwater contamination occurswhenman-madeproductssuchas gasoline, oil, chemicals, etc. get into the groundwater and cause it to become unsafe and unfitfor human use. Kerala Minerals and Metals Ltd. (KMML) located at Chavara, Kollam district is one of the major industries in Kerala. It is the only integrated plant with Mineral separation, Synthetic Rutile plant with acid regeneration facility and Titanium dioxide pigment production plant in a single complex. People around this industrial area is mainly depend on ground water source, particularly the open wells for their domestic purposes.It was reported that groundwater and surface water around the KMML was affected due to effluents from the industry. In this project spatial distribution of ground water quality and groundwater flow pattern were studied for KMML industrial area. Water samples were collected from all around the taluk, and thespatial variation of each parameter was studied using GIS (Geographical Information System). The contaminant distribution of a large area was obtained with the help of few samples in the location. The surface water-groundwater interaction was simulated by using the MODFLOW model. MODFLOW was used to describe the movementof groundwaterof constant density through porous material.

Keywords: Geostatistical methods, Groundwater pollution, Geographical information system, MODFLOW.

05-20

SYNCHRONOUS GENERATOR EMULATION IN POWER ELECTRONIC CONVERTERS FOR IMPROVING THE GRID INERTIA

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Background: Dependence on renewable energy based distributed generators (DGs) has been growing rapidly in the recent years to relieve the burdened conventional utility grids and to reduce the environmental impacts of centralised thermal generation (based on coal or oil). Besides, researchers expect to achieve even higher penetration of DGs in the coming years. With the growth in renewable energy penetration, the amount of renewable energy interfaced to the grid via inverters is also ramping up. However, the interconnection of inverter-based DGs and utility grids has its challenges to be addressed. Unlike the conventional power plants, DGs reduce the total inertia of the system as they do not have any rotational inertia and damping properties.
Method: One feasible solution is to emulate the DGs as synchronous generators by adding virtual inertia using energy storage. The power electronic converter is controlled using a control algorithm based on the mathematical model of a synchronous machine. In this paper, Reduction in grid inertia is addressed by using a synchronverter based control framework to replicate the dynamics of a synchronous generator. A simulationstudy is carried out in the grid-connected mode in MATLAB/Simulink platform under different grid conditions. Simulation results are verified using experimental results.
Results: Simulation results and experimental analysis of the grid-connected synchronverter proves that it has the potential to improve the dynamic frequency response and the grid inertia. The resulting voltage and current waveforms were almost sinusoidal with considerably low distortion. The synchronverter was able to perfectly respond to and track the voltage and frequency changes in the grid similar to a synchronous generator. The frequency and voltage profile were maintained as the synchronverter independently controlled the active and reactive power.
Conclusions: Hence, it is evident from the results that the synchronverter was able to replicate the dynamics of synchronous generators to the desired level and improve the overall stability and inertia. The emulation of synchronous generator behaviour in power electronic converters helps in improving the grid inertia with the increasing penetration of renewable energy sources.
Keywords: Grid inertia, synchronverter, virtual synchronous machine

05-21

CHARACTERIZATION OF DC MAGNETRON SPUTTERED COPPER THIN FILM ON ALUMINIUM TOUCH SURFACE

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Background: Care Assisted Infections (HCAI) introduces problems like prolonged hospital stay, additional financial burden and excess death. Since, copper is registered by US Environmental Protection Agency (EPA) as the only solid antimicrobial metal, which could be used in hospital touch surfaces.
Method: In the present work, copper has been deposited on the aluminium substrate by DC magnetron sputtering method at different target powers. Prior to the coating, the substrate has undergone double zincation process. The coating has been characterized by XRD, SEM, TEM, scratch hardness test and microhardness test.
Results: From the TEM micrographs, the grain size is found to be decreased from 49 nm to 18 nm on increasing the deposition power from 50 W to 150 W. Along with the decrease in the grain size, the mechanical properties like scratch hardness and microhardness of the coating has been increased. The preferred growth along [111] direction observed in XRD analysis is responsible for the increase in the hardness of the coating apart from the presence of the nano-grains. The SEM image of the coating shows the nodular morphology which enhances the surface area.
Conclusions: The antimicrobial copper thin films deposited on double zincatedaluminium possess excellent mechanical properties due to its microstructural characteristics. Moreover, the nano-twins help to increase the scratch hardness

and microhardness of the coating. The film has special features like nodular morphology, the nodules being made up of extremely fine grains.

Key words: Sputtering, Copper coating, Microstructural characterization,Nano-grains

05-22

WHEN NATURE MEETS TECH: AUGMENTED REALITY FOR REBUILDING TOURISM AND HOSPITALITY

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Background: Tourism, especially Kerala tourism, has been widely recognized as a major tourist attraction for domestic and international visitors in many destinations.Numerous uncovered and enchanting hidden beauty of the places in many parts of Kerala. The divergence and personalization for tourists in demand and novel tourism approaches and deployments are expected to attract tourists. Therefore, an efficient and personalized service for tourists has become an essential issue in the development of new technological resources while rebuilding Kerala.Inspired by recent developments of virtual reality, an AR model for rebuilding tourism and hospitality in Kerala is proposed in this paper.
Method: Augmented reality is the research area that deals with the class of problems to enhance the reality of mobile users with virtual objects. Augmented reality in tourism has a great potential to enhance traveler's experiences and is generally experienced via smart phone camera. AR can be incorporated to develop mobile guides to tourist as key representatives of destinations playing a significant role on tourist satisfaction and re-visit intention. In this paper, we propose a novel sightseeing info system, through augmented reality and recommender engine using the information of the sensors which can offer sightseeing info based on the Context of Interests (CoI). COI info and contents triggered by signal from sensors are downloaded and overlapped on the real image on smart device to recognize virtual reality.
Results: Application architecture was simulated on the Android system using Java. Hence, the Java Virtual Machine (JVM) and Java Development Kit Application Programming Interface (JVM API) libraries and tools form the core technology. Higher layers include OpenGL ES 2.0 for graphics and the arcore-android-sdk-master Software Development Kit (SDK) to provide AR support. Execution of the AR algorithm for tourism information system has been evaluated by conducting various investigations on a variety of sites.
Conclusions: An AR model for rebuilding tourism and hospitality in Kerala is proposed in this paper. Unlike the existing tourism websites for Kerala, a new idea is proposed where an integration of the real world and the virtual world using high tech cameras with technology of augmented reality is presented and tested using different sites. Further enhancements suggested are- more sophisticated contents such as 3D objects and mobile augmented reality for flood visualization.The new idea of enhancing a Kerala Tourism enabled with AR technology, will in any way increase the revenue of the state , though it incurs not lesser initial expense.
Keywords: Augmented Reality, Recommender Engine, Kerala Tourism, Context

05-23

HIGHLY TOUGHENED NANOSTRUCTURED SELF ASSEMBLED THERMOSETS - AEROSPACE AND AUTOMOBILE APPLICATIONS

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Background: Epoxy resin is one of the promising thermosetting materials which play an important role in the field of nanotechnology and modern polymeric materials. But cured epoxy resins are highly brittle and have poor fracture toughness because of their extreme cross-linked structures when compared to other engineering thermoplastic polymers. To overcome these limitations, amphiphilic block copolymers have been used as modifiers in epoxy resin.
Method: This approach consists of the epoxidation of Poly butadiene (PB) block in the SBS (poly (styrene-b-butadiene-b-styrene) block copolymer and further mixing with DGEBA (Diglycidyl ether of bisphenol A). 4, 4' diamino diphenyl methane (DDM) was used as the hardner and later it was cured at certain intervals of time by using different

temperatures. Morphological, Spectral, Dynamic Mechanical and mechanical properties have been investigated.
Results: Epoxidation of SBS block copolymer and degree of epoxidation was confirmed by Fourier transform infrared spectroscopy (FTIR) and Nuclear magnetic resonance spectroscopy (NMR).The incorporation of epoxidized block copolymers in epoxy result in the formation of highly ordered and supertoughened nanostructured spherical blends. The morphologies of the blended polymers were confirmed by using field emission scanning electron microscopy (FE-SEM), transmission electron microscopy (TEM), and atomic force microscopy (AFM). Left shifting of loss modulus and Tg of the blended system can be observed through Dynamic mechanical analysis (DMA). Finally, the toughness of the blended systems was analyzed through fracture toughness measurements.
Conclusions: In this work, we have successfully fabricated a supertough highly ordered nanostructured spherical blend system. This as synthesized nanostructured thermosets will be expected as an excellent toughened material for floor adhesives, aerospace, automobile and other industrial applications.
Keywords: Epoxy, Block copolymer, Supertough, Nanostructured thermosets, Self assembled

05-24

GEOPOLYMER: A SUBSTITUTE FOR PORTLAND CEMENT AND SOLUTION FOR DURABILITY ISSUES OF CONCRETE

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Back Ground: Portland cement is a versatile binding material used world over in construction sector. Its universal availability, economy and water resistance made it a popular binding material. The plasticity of concrete in the wet state and high compressive strength in the hardened state make it the most desired building material of civil engineers. Statistics says that annual per capita consumption of concrete worldwide is one tone. Whatever the merits Portland cement have the demerits now weigh over them. The auto biography of cement proclaims that it liberates one tone of carbon dioxide while producing one tone of cement. Around 65% of greenhouse gas liberated is carbon dioxide of which 7% is contributed by cement industry. Cement is also a high energy intensive product. Its embodied energy (EE) is around 4.53 MJ/kg. On the other hand thermal power plants have become an unavoidable evil to meet the energy demands of the world. Since coal is abundant on earth compared to crude oil, it has become a common fuel in all thermal power plants expelling large quantity of fly ash as waste material. Due to the increasing production of iron, slag has also become another waste material. The use of these waste materials will not only save energy but will reduce carbon dioxide emission also; if it is used as a substitute for cement.
The strength and durability of concrete are the two major criteria to define a high performance concrete (HPC). Now techniques are available to achieve high strength concrete (HSC). Achieving required durability is the major challenge faced by the construction industry especially due to exposure condition. A host of environmental and pollution factors adversely affect the durability of concrete resulting in heavy economic losses, safety and serviceability aspects. Use of Geopolymer as a binder material in substituting cement is the best option to enhance the durability of concrete structures.
Method: The alkali activated inorganic polymer, popularly known as Geopolymer is derived from alumino-silicate based materials like F-class Fly ash, Ground granulated blast furnace slag (GGBS), Metakaiolin, Rice husk ash etc.; activated up on by an alkaline solution like sodium silicate and sodium hydroxide (8 to 16 Molar). The economically feasible solution is using a combination of Fly ash and GGBS as alumina-silicate material and using sodium silicate alone or a combination of sodium silicate and sodium hydroxide as an alkaline activator solution. If we use fly ash alone heat curing at 60° to 90° C is desirable. However if a combination of fly ash and GGBS with a mixture sodium silicate and sodium hydroxide as activator solution is used, itcan set and harden at ambient temperature. This is more practical.
Result: By using different combinations of Fly ash and GGBS as well as different mixed proportions of alkaline solution; sodium silicate and sodium hydroxide can evolve Geopolymer binder possessing different characteristic features suitable for different applications such as making Geopolymer concrete, Geopolymer grout for encapsulating cement concrete elements by spaying or guniting. Pressure grouting to fill the voids within the concrete mass by impregnating is another option.When a combination of Fly ash and GGBS is used as source material and sodium silicate alone as activator solution, it can set at ambient temperature, but may take around 72 hours. The slow setting process prevents thermal cracks and the Nano-sized particles impart lesser permeability, better durability and strength in the long run. The Si-O-Al bond in Geopolymer is more strong and stable than C-S-H bond in cement. Sodium silicate possesses corrosion inhibition property on steel reinforcement. Use of sodium hydroxide in combination with sodium silicate

as activator solution can impart early strength and can set at ambient temperature but may lead to carbonation effect.
Conclusion: Geopolymer binder can be used as a substitute binding material at par with Ordinary Portland Cement. It can be used to make high performance concrete having higher strength and better durability. By using Geopolymer as the building binding material we have the other advantages such as conservation of water, saving in energy, reduction in carbon dioxide emission, conserving lime stone and making use of waste material.
Keywords: Geopolymer, Geopolymer concrete, Durability of concrete, High strength concrete, High performance concrete, Grouting, Guniting, Pre-cast concrete

05-25

DESIGN, CONSTRUCTION AND APPLICATION OF VARIABLE DUTY CYCLE OPTICAL CHOPPER

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Background: Optical choppers are optomechatronic devices used for controlled modulation and attenuation of light beams.Presently available optical choppers do not have options to vary the duty cycle and are very costly. Present work is an attempt to design and construct a cost effective optical chopper with a variable duty cycle and study its effect on the thermal lens signal.
Method: The optical chopper wheels are designed to vary the duty cycle from 0 to 50% by using two chopper wheels of 50% duty cycles. Apulse width modulator based circuit is used to control the speed of a 12 V 100 rpm DC motor. Optical signals for different duty cycles are recorded by using an oscilloscope.The variation in thermal lens signalofwater with duty cycle is analysed by using thermal lens spectroscopy.
Results: The output optical signals for different duty cycle is verified from the oscilloscope. Thermal lens signal at 50% duty cycle shows an initial decrease due to self-defocussing, caused by the decrease in refractive index at beam centre. This initial decrease is followed by a gradual increase in the signal due to the rebuilding of the refractive index caused by the molecular movement within the medium. Thisrebuilding will create an error in the thermal lens parameters. But at 10% duty cyclethe thermal lens signal of water matches with the standard one.
Conclusion: The optical chopper with variable duty cycle is designed and constructed in a cost effective manner. The signals of the constructed optical chopper are recorded usingan oscilloscope. As an application, the effect of duty cycle on thermal lens signal is studied with water. At 10% duty cycle the effect of photothermal reaction and diffusion can be neglected and the accurate thermal lens parameters can be obtained. Thus optical chopper with variable duty cycle can be used for eliminating unwanted signals in thermal lens spectroscopy.
Keywords: Optical chopper, Variable duty cycle, Thermal lens spectroscopy, Thermal lens signal.

05-26

STRUCTURAL AND OPTICAL CHARACTERIZATION OF SOL-GEL SPIN COATED ZnO THIN FILMS

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Background: Transparent electronics is an emerging technology for the next generation optoelectronic devices. Transparent Conductive Oxides (TCOs) are the key stone of transparent electronic devices. ZnO is atypical example for TCOs as it is inexpensive and also shows better electrical and optical properties. Spin coating is comparatively low-cost, simple and widely used techniquefor deposition of thin films and it offers the best possibility for preparing small and large areacoatings. Due to these advantages, spin coating is preferred over other available deposition techniques.
Method: In the present work, ZnO thin film is prepared by the method ofspin coating. ZnO solution is prepared by adding Zinc acetate dehydrate Zn(CH3COO)2.2H2O to 2-Methoxyethanol ((CH)3CHOH) containing monoethanolamine (MEA) (H2NCH2CH2OH). Molar ratio of Zinc acetate dehydrate, the precursor and MEA, the stabilizer is taken as 1:1. The precursor concentration is maintained at 0.5mol/L. The solution is then stirred continuously for 3 hrs at 60°C using a magnetic stirrer.Solution is again stirred at room temperature for 24 hrs to yield a clear homogeneous and transparent solution. Inorder to obtain the ZnO thin film, the solution is dropped on to the glass substrate which is rotated at 3000 rpm for 30 sec and preheated at 250°C for 5mins. This helps to evaporate the solvents and organic residuals. The

process is repeated for ten times and the films are post-heated for 3hrs at 400°C.
Results: From the XRD results, the crystal sizeof thedeposited by Zno thin film is obtained to be 15.84 nm. The strong preferential growth is found along c axis (002) plane suggests ZnO shows wurtzite crystal structure.From the SEM micrograph italso observed that the grain size grains are continuous and are tightly packed.From the optical transmission spectra the average value of transmission is found to be 98% and the band gap is obtained to be 3.34eV.
Conclusion: ZnO thin films with a better crystallite size having continuous and tightly packed grains are obtained by the spin coating method. Inaddition to this the film shows better optical transmittance. As the mobility of charge is large in crystalline materials, the presence of small crystalline grains can be lead to the fabrication of high field effect mobility thin film transistors.
Keywords: Spin coated ZnO thin film, crystallite size, bandgap

05-27

MECHANICAL, DIELECTRIC AND MORPHOLOGICAL CHARACTERIZATION OF HDPE - CHTIOSAN - HYDROXYAPATITE COMPOSITES FOR ORTHOTIC APPLICATIONS

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Background: The use of biocomposites for medical applications offers numerous possibilitiesfor implants design. The present investigation focuses on introducing hydroxyapatite, the inorganic mineral resembling to the bone mineral into high density polyethylene (HDPE) chitosan(CS) bio-composites having properties resembling cortical bone.
Method: The fabrication of the HDPE-chitosan-hydroxyapatite biocomposites were carried out through a melt mixing process using maleic anhydride as compatibiliser by a peroxide initiated process at 160 ^{o}C. The plasticizing effect of palm oil was studied on the ternary system with better mechanical properties. Mechanical studies, dielectric properties, thermal studies and morphological analysis have been carried out on the developed composites.
Results: HDPE-chitosan-hydroxyapatite exhibits good mechanical properties. The impact strength showed an increase upto 9.34 % of the neat HDPE till 5 wt% CS loading and thereafter was found to decrease. Studies on the plasticizing effect of the oleic acid component of palm oil in the composite with highest impact strength showed strong interfacial interaction between the filler and matrix with little change in the mechanical properties. The incorporation of hydroxyapatite to the plasticised system has been found to increase the mechanical properties of the composites.An improvement in the dielectric properties was observed with the addition of palm oil, which has been attributed to the segmental mobility, as well as the increase in relaxing dipoles in the system. The results obtained were in close proximity with the human cortical bone.
Conclusions: Mechanical characterisation revealed that the prepared composites show comparable dielectric and mechanical properties as seen in human cortical bone. The prepared biocomposite system offers an economical way in developing a biomaterial with excellent potential in orthotic applications.
Keywords: HDPE, Chitosan, Hydroxyapatite, Dielectric properties, XRD, FESEM

05-28

FABRICATION OF FLEXIBLE, DISPOSABLE NANOCELLULOSE BASED SERS SUBSTRATES FOR TRACE LEVEL SENSING OF ENVIRONMENTAL CONTAMINANTS

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Background: Environmental pollution is growing at an exponential scale. The overuse of pesticides has caused serious health issues to humankind and environment. Kerala markets have shown alarming rates on the exceeding limits of pesticide usage. Strategic control over the dimension and architecture of noble metal nanostructures has led to the development of innovative techniques such as surface plasmon resonance, Surface enhanced Raman scattering (SERS), metal enhanced fluorescence, etc. of which SERS is a potent spectroscopic technique, which identifies the spectral fingerprint of molecules directly without labeling in solid and liquid state. The urge to develop sensitive and label free surface enhanced Raman active substrates is in great demand in the current scenario. SERS technique has immense

applications in point-of-care devices and for monitoring environmental contaminants.
Method: The present work investigates the fabrication of flexible, ultrasensitive SERS substrates with silver nanostructures reduced using TEMPO oxidized nanocellulose and trisodium citrate for the detection of various analytes such as 4-mercaptopyridine (MPY), Methylbenzene thiol (MBT), and Methylene blue (MB) and pesticides such as Thiram, etc. Nanocellulose synthesised from banana pseudo stem fibres has been used as soft template for development of highly stable silver nanostructures. The nanocellulose supported silver nanostructures were incorporated into a biocompatible polymeric substrate, poly (vinyl alcohol) by solution casting method for the fabrication of flexible, sensitive SERS strips.
Results: The SERS efficiency of the nanostructures and the substrates were evaluated for solid state trace level detection of MPY, MBT and MB. The regression analysis of MPY shows good sensitivity with detection limits at parts per trillion (ppt) level. Further, the synthesized nanostructures were analyzed for its sensitivity to detect Thiram, a fungicide and ectoparasiticide commonly used to prevent fungal diseases in seeds and crops. The lowest limit of detection of Thiram was found to be at parts per billion (ppb) level.
Conclusions: Herein we report a facile and cost effective method for the fabrication of free standing, ultrasensitive SERS substrates for the detection of pesticides and other important analytes. The nanostructures showed enhanced sensitivity to various environmental contaminants with detection limits at parts per trillion level.
Keywords: Nanocellulose, SERS, Silver nanostructures, Substrates, Detection Limit

05-29

A STUDY ON DRIVING BEHAVIOURAL ASPECTS OF GOODS VEHICLE DRIVERS

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Background: Crashes involving heavy vehicles have been on the rise over the years in Kerala. Even though the number of heavy vehicles plying on Kerala roads are less compared to two wheelers and cars, the proportion of crashes involving heavy vehicles is a cause of concern. Faulty driving behaviour is widely regarded as the major cause of such crashes.
Methodology: The work is aimed at identifying the characteristics affecting aberrant driving behaviour of goods drivers. Considering the drivers' perceptions and their socio-demographic background, their behavioural variations were noted. Analysis was done based on a questionnaire survey from which behavioural data were collected from more than 1200 goods vehicle drivers. The variations in violations, errors and lapses of the driver were noted based on various factors like experience, education, vehicle type and working hours.
Results and Conclusions: It could be observed that the driving behaviour exhibited by drivers on road are developed through years of driving experience and is found to be affected by the socio-demographic background of the driver. Driver's age, Experience of the driver, kilometers driven per day and the type of vehicle driven were found to have high influence in driving and non-driving behaviour of the driver.
Keywords: Driver behaviour, Road safety, Accidents.

05-30

PHOTONIC CRYSTALS OF CORE - SHELL COLLOIDAL PARTICLES AS APTA SENSOR FOR ENVIRONMENTAL MONITORING

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Background: Nowadays, pesticides have become an inevitable ingredient in modern agricultural practices. But the extensive use of pesticides can cause deleterious effects to the environment and hence to the living things. This has been a serious health concern over India and unfortunately no such indigenous, affordable, hand held sensing devices are available in the market. For this reason, development of simple color changing sensors for detection of pesticides

is essential in monitoring the levels of pesticides in the fruits and vegetables. Current methods for pesticide detection involve spectrophotometric and chromatographic techniques, which is time consuming, laborious and require expensive equipments and trained personnel. Therefore, researchers are trying to develop simple and cost effective sensors for pesticides.

Methods: The present work engineers a visual sensor for the rapid detection of pesticides. Responsive photonic crystals (PCs) are used as the sensing platform for incorporating pesticide specific aptamer sequences. In response to the specific binding of pesticide, the hydrogels in the photonic crystal will shrink and diffraction wavelength will shift resulting in a color change of the photonic crystal. Thus the pesticides can be detected with our naked eyes by a rapid color change.

Results: The PC was fabricated using PS@poly(MMA-EGDMA-AA) core-shell microspheres and it exhibited brilliant cyan color. In aptamer solution PC's color red shifted to green. But upon conjugation with pesticide, poly(MMA-EGDMA-AA) hydrogel underwent shrinking and hence the color changed to blue exhibiting a hypsochromic shfting of photonic stop band in UV-Vis spectra. Thus we have realized a simple and fast visual sensor for the pesticide, omethoate.

Conclusion: Core-shell based photonic crystals sensor has been engineered with polystyrene as core and poly (MMA-EGDMA-AA) as shell for the easy detection of a common pesticide, omethoate. The response was very quick and could be observed with our naked eyes. Since a simple and low-cost method have been adopted for the fabrication of photonic crystals, we are successful in realizing an economical optical sensor for selective visual detection of pesticides.

Keywords: Responsive photonic crystals, core-shell microsphere, pesticide, sensor

05-31

STUDY OF SEASONAL VARIATIONS IN OPTICAL SIGNAL ATTENUATION DUE TO TROPOSPHERIC EXTINCTION

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Background: Free Space Optical (FSO) communication has emerged as a powerful means of communication with better performance in data handling, bandwidth and cost effectiveness. FSO communication makes use of highly coherent laser sources for transmission and reception between the Earth and satellite or inter-satellite and also for establishing terrestrial links. It finds applications in fields ranging from remote sensing to radio astronomy.

Method: The micro pulse lidar (MPL) with AlGaAs diode pumped Nd-YLF laser (model MPL1000 of Science and Engineering Services Inc., USA) operating at 523.5 nm at pulse energy of 10 μJ and a pulse repetition frequency of 2.5 kHz is used in the present study for data collection.The MPL was operated at Bangalore (13°N, 77°E, 960 m msl) during 2017 – post-monsoon (October- November), winter (December- February), pre-monsoon (March- May), and monsoon (June- September) and the schedule was followed without interruptions. This work is an attempt to study the seasonal variations signal attenuation due to atmospheric extinction. In the present work, the variation of extinction coefficient with altitude is studied during the four seasons.

Results: During all the four seasons in the region near the ground, the aerosol extinction exhibits a linear relation for the altitude upto 0.25 km. Above 0.25 km the extinction coefficient drops rapidly upto an altitude of about 5 km and saturates thereafter. It is found that during all seasons except pre-monsoon the nature of variation of aerosol extinction coefficient with altitude is found to exhibit a logarithmic relation. But during pre-monsoon, the variation of aerosol extinction coefficient with altitude is found to exhibit a polynomial relation.

Conclusions: During the post-monsoon, winter, pre monsoon, and monsoon the value of molecular extinction coefficient hence total extinction coefficient is found to decrease for altitude above 0.25 km. The seasonal variation of aerosol extinction coefficient depends on boundary-layer dynamics, aerosol emissions, convection, direction and motion of the wind. The difference in the nature of variation of aerosol extinction coefficient with altitude during pre-monsoon period can be attributed to the enhanced and fluctuating atmospheric temperature and humidity during this season in South India. The sharp decrease of extinction coefficient with altitude can be attributed to the lowering of aerosol concentrations compared to the region below 0.25 km. As a result their concentration and the magnitude of extinction coefficient will be higher in the lower atmosphere and the FSO system face greater attenuation due to aerosol extinction.

Keywords: aerosol extinction coefficient, Free Space Optical communication, seasonal variations

05-32

COMPARISON OF DIFFERENT CONTROL STRATEGIES AND ITERATIVE METHODS USED FOR IMPLEMENTATIONS OF A PHOTOVOLTAIC EMULATOR FOR MICROGRID APPLICATIONS

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Background: Due to the increasing power demand, the conventional sources of energy are depleting at a faster rate. Solar energy is an environment-friendly renewable source of energy. Solar photovoltaic technology enables the direct conversion of solar energy to electricity. The field testing of solar photovoltaic systems is dependent on the ambient environmental conditions. The laboratory testing of solar photovoltaic systems require highly controlled conditions which are very difficult to achieve. A photovoltaic(PV) emulator is a non-linear power source which emulates the behaviour of a solar photovoltaic module. It is used for testing and comparing different solar photovoltaic systems.
Method: The control strategy of photovoltaic emulator consists of a photovoltaic model part and an iterative part. Direct referencing method and current resistance method are two methods used for implementing the Simulink model of photovoltaic emulator and a comparison of the two methods is made in this work. As the output current equation of the PV system is non-linear, root finding method involving iterations are used in this system to obtain the converged value. So, the commonly used Newton-Raphson and binary search methods are compared in this work for the photovoltaic emulator application.
Results: Two popular algorithms were checked for convergence for both PV model individually and for PV emulator. It was observed that the voltage and current values converge in less number of iterations when Newton-Raphson method is used than the binary search method. In addition, the current resistance model is less oscillatory and ripple free compared to conventional direct referencing model when resistive loads are used.
Conclusions: This work established that for a photovoltaic emulator, current-resistance model using Newton-Raphson algorithm is a better control strategy for resistive loads.

Keywords: Binary search algorithm, Photovoltaic emulator, Newton-Raphson method

05-33

DATA DRIVEN DEPENDENCY PARSING OF MALAYALAM LANGUAGE

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In Natural Language Processing, parsing specify how structures are assigned to a language. Malayalam is one of the four major Dravidian Languages. The language processing of free-word-ordered, morphologically rich and agglutinative language like Malayalam, always suffer from lack of the decorous syntactico-semantic analysis, which has a great impact in Natural Language Processing pipeline. Data-driven dependency parsing gives a platform for such experiments. The concept of dependency is derived from the fact that the syntactic structure of a sentence can be treated as the binary relations between the words in that sentence. In this work, a transition-based dependency parser is used for the exploration of evaluation of the Tree-bank with 55.9k tokens, in different stages. As an initial setup 10-fold cross validation is done. The accuracy of the parser is evaluated for different complex feature models through optimization, in both learning and parsing stages. After the best optimization, there was an increase in the labeled attachment score, unlabeled attachment score and label accuracy. In Malayalam, both cases and the semantic information are needed for the proper identification of the dependency relation. Mostly, the noun with accusative case takes the dependency role as k2 but for inanimate object, the case will be nominative for the same role, k2. These confusions in automatic labeling of the Karaka roles by the parser were also estimated. The non-projective characteristic of the Malayalam language is clearly tracked in through the results. With different feature combinations, further enhancement in the results can be obtained.
Keywords: Malayalam language processing, Dependency parsing, Karaka rules

05-34

SAFE AND SECURE HOMES FOR KERALA

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Background: Heavy rains lashed all over the state from august 9 to 15 causing huge damage in 12 out of 14 districts of Kerala. In this huge calamity the property damage cost was estimated to be around 25000 crores. Even as two months have gone by since Kerala's worst disaster in a century, the biggest challenge for the state has been to raise money for the relief and rehabilitation process. This brings in the need to look into the prospects of building more disaster resistant homes in our state for a safer future. Safety during natural calamities like: Floods, Landslides and Tsunami especially in the coastal areas of Kerala. Strength during disaster like earthquakes and forest fires.
Method: The perfect home has to be safe and stronger from the base to the top of the structure. Hence the factors of strength and safety has to implemented in the structure starting from the basement to the roof of the structureie the various methods of making a building disaster resistant should be dome at the foundation level, masonry walls, roofing , pavements and modern methods of constructions also other green materials for construction.
Results: The various methods adopted will make each and very component of the house disaster resistant and strong. Also it will increase the useful life of the structures thus paving way for a safer tomorrow.
Conclusions: The concept of a perfect home can be made into reality by incorporating the safety and strength aspects in all the components of the house starting from the base of the building ie the foundation till the top of the structure. By adopting these methods in the new house constructions and also in the houses which are being rebuild we can look towards a safer, stronger and a much more disaster resistant Kerala in the future.
Keywords: Disaster Management, Disasters, Floods, Earthquakes, Safe and Strong Homes (Structures).

05-35

COMPARATIVE STUDY OF 3D PRINTING AND CONVENTIONAL CONSTRUCTION PRACTICES

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Background: Today we are facing a lot of challenges in construction sector. Construction works have been increasing in developed and undeveloped countries over the past few decades. Unavailability of skilled labours and improper utilization of resources leads to cost and time over run. And Kerala has experienced largest disaster of flood and landslide.. According to ADB report, the World Bank has allocated an amount of 25,000crores for the rebuilding works of Kerala. For proper effective and tiely completion of all the works we require faster and safer construction practices with optimum use of resources and this can be achieved by 3D Printing technology. 3D printing is a construction technology in which the 3D models are prepared from a digital file.
Method: A mainstream onsite concrete printer costs 30,00000 INR ,though prices should fall. At less than 33 feet (10 meters) in height, and with a throughput of less than 550 pounds (250 kilograms) per hour, it is limited to printing fairly small buildings. Use of specially developed cement-based mortar with the addition of special additives, including reinforcing. According to its characteristics, the mixture is similar to fibre concrete M250, strength class B20.
Result: By reducing the costs associated with nonstandard shapes, 3D printing gives free rein to architects and designers. The technology can turn complex designs into real structures that are beyond the capabilities of traditional builders. The autonomous or semi autonomous 3D printers require minimal human surveillance. : By operating 24/7 and by reducing chances of on site issues and hence delays, 3D printers can cut construction times dramatically. Due to the additional feature of topology optimization we can use conical, hollow, or honeycomb structures depending upon the requirements.
Conclusion: Considering all these factors, 3D printing is a better technology than conventional practices. It ensures structural and environmental safety allowing the flexibility for a wide range of structures adding both economic and structural stability.

05-36

MALAYALAM PARTS OF SPEECH TAGGER

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The process of assigning one of the parts-of- speech (POS) to the given word in a sentence is called Parts-of-speech tagging. This paper presents a rule based method for parts-of-speech-tagging in Malayalam Language with suffix stripping approach. The system uses a dictionary containing root words, Uses the identified suffixes to find out the category and a set of orthographic rules to revert sandhi changes. As POS tagging is a very important preprocessing task for language processing activities, Annotated corpora serve an important tool for investigators of natural language processing.
Keywords: Malayalam Parts-of-speech tagging, tagset, rule based, stochastic, suffix stripping.

06 - ENVIRONMENTAL SCIENCE, FORESTRY & WILDLIFE

06-01

REDISCRIPTION OF THE BAGWORM MOTH *EUMETA CRAMERI* WESTWOOD (LEPIDOPTERA: PSYCHIDAE) WITH MORPHOLOGICAL AND MOLECULAR DATA FROM KERALA, INDIA

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Background: Bagworms were recorded as occasional pests from forest areas in Kerala but their polyphagous nature and deficient documentation from human-altered habitats present them as high potential pests in light of climate change and land use change. The study facilitates the identification of the species so as to facilitate easy identification of the species by laypersons/farmers without resorting to the help of experts.
Method: The bags of *Eumeta crameri* were collected by handpicking from the Host plants and details of host plants and bag attachment were recorded. Measurements of different morphological characteristics were taken. The molecular analysis of the species were done by using mitochondrial genome (Cox I) with a length of >700 bp.
Result and discussion: *Eumeta crameri* Westwood is the common bagworm species it has wide range of hostplants recorded from the study area especially from human habitations. It is a medium sized moth (only male) of length 19mm and females are vermiform with 8mm in length.the wing span is of 70mm. The complete redescription using modern tools since the original description of the moth will help in easy identification of this potential pest.
Conclusion: This study explains the characteristics of commonly occurring species of bagworm in Kerala Eumeta crameri Westwood and it has wide range of host plants including economically important plants.
Key words: Psychidae, Bagworms, *Eumeta crameri*

06-02

THREE-DIMENSIONAL RECONSTRUCTION OF TREES AND DIRECT ESTIMATION OF LEAF AREA INDEX OF A TROPICAL FOREST USING TERRESTRIAL LASER SCANNER LiDAR POINT CLOUD

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Background: Light Detection and Ranging (LiDAR) technology has the potential to offer accurate and precise three-dimensional information of forests with high spatial resolution. Terrestrial Laser scanner (TLS) can be used to obtain essential information of individual trees such as tree height, crown width and diameter at breast height. The

retrieval of Leaf Area Index (LAI) by TLS is a promising concept, due to its ability to extract structural parameters of forest canopies.

Methods: The present study introduces a novel method for the estimation of Leaf Area Index from terrestrial laser scanned LiDAR point cloud. The goal of the present approach is the direct estimation of LAI of tropical forests using TLS point cloud by means of a new algorithmic approach named Point Spatial Density (PSD) algorithm. Three-dimensional reconstruction of individual trees was done by the implementation of segmentation approaches from point cloud library (PCL).Reconstructed trees are then extracted individually to implement PSD algorithm so that LAI values are accurately estimated.

Results: Based on the number of points and the point spacing, the value of LAI is found to be varied in sparse and dense forests. Consistent correlation (r^2=0.98) is evident while comparing the estimated LAI with in-situ measurements. There is a significant connection between number of points in the tree point cloud, points spacing and height of the trees using TLS data.

Conclusions: The results show that LAI can be accurately reproduced by the point spatial density algorithm approach enabling the capture of LAI of dense and heterogeneous forests with complex ecosystems, thus minimizing the cost and speed of the retrieval of multiple forest parameters using other field-based equipment.

Keywords: Terrestrial Laser Scanner, Point Cloud, Leaf Area Index, Point Spatial Density Algorithm.

06-03

UHLA PROCESS FOR THE EFFECTIVE UTILISATION OF IRON OXIDE WASTE FROM TITANIUM INDUSTRY

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Background: Titanium products find many applications in our day to day life and it is considered as the metal of 21st century. The Kerala Minerals and Metals Ltd (KMML) is the world's fully integrated titanium dioxide manufacturing plant via chlorideroute. The Acid Regeneration Plant of factory expels acidic iron oxide with high chloride content as a solid byproduct. The hazardous iron oxide is slurried and stored in large ponds(15 acres)in the premises of factory. Slow leaching ofacidic chlorides from these ponds to the surroundings cause appalling threat to the environment. The corrosive nature of high chloride content in iron oxide hampers its end use application in steel industry. The iron oxide can be made saleable by reducing the chloride level below 0.2% . Hence it is highly imperative to find a cost reductive process to significantly reduce the chloride levels in the iron oxide and enable its end use applications.

Method: Ultra High Lime with Aluminium (UHLA) processis an advanced lime softening process use to remove scalants from the cooling water. In this work we are trying to use UHLA process to precipitate out the chloride content of iron oxide by the addition of $Ca(OH)_2$and sodium aluminate. After achieving the optimized parameters of the process the same is tried in large scaleto check the efficiency of the process. The obtained precipitate is characterized through XRD and SEM elemental mapping.

$$4Ca^{2+} + 2Al^{3+} + 2Cl^{-} + 12OH^{-} \rightarrow Ca_4 Al_2 Cl_2 (OH)_{12}$$

Results: The characterization techniques confirm the obtained precpitate is calcium chloro aluminate comes under the category of layered double hydroxides. The optimized process works fine in the higher scale too which cofirms the efficiency of process.

Conclusion: Ultra High Lime with Aluminium (UHLA) process was fine tuned for the removal of chloride from the iron oxide wash solution and an efficiency of 85% is reported.Intervention of cost reduction strategies are under progress by selecting cheap aluminium source and finding out potent use for the UHLA process precipitate.

Keywords: UHLA Process, Hazardous waste management, Layered double hydroxides

06-04

NAKED - EYE COLORIMETRIC SENSOR FOR THE DETECTION OF CYANIDE IONS IN AQUEOUS MEDIA USING GREEN SYNTHESIZED SILVER NANOPARTICLES

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Cyanide ion (CN^-) sensing is of pronounced interest due to its extreme toxicity in physiological systems, as well as environmental concerns arising from its widespread applications in various industrial processes such as electroplating, metallurgy, mining and polymer synthesis. Even though a number of analytical methods have been developed for the detection of cyanide,a simple, cost-effective and highly selective sensing method for cyanide in aqueous media is still a great challenge. The present study introduces a naked eye colorimetric sensor for the detection of cyanide ions in aqueous medium using green synthesized silver nanoparticles (AgNPs). This is the first report on the exploration of biosynthesized AgNPs as a sensing probe for the highly facile, selective and sensitive detection of cyanide in aqueous media. In this work, highly stable and monodispersed AgNPs were prepared in a completely green manner by using aqueous extract of brown marine macroalgae (seaweed) *Padina Tetrastromatica*. The bioactive metabolites in the seaweed extract itself acted as the reducing agent for Ag^+ ions and stabilizing agent for the formed AgNPs. Since no additional reducing and stabilizing agents were used in the synthetic protocol, it is absolutely a green chemistry approach. In addition, this method is facile, fast and cost-effective. The biosynthesized AgNPs were characterized using UV-Visible spectroscopy, High resolution Transmission electron microscopy (HR-TEM) and X-ray diffraction (XRD) techniques. The biogenic AgNPs are dark brown in colour due to the intense surface plasmon resonance absorption band. In the presence of CN^- ions, the brown AgNPs solution changed to colourless accompanying the vanishing of absorption maximum at 414 nm.The selectivity and sensitivity of biogenic AgNPs towards CN^- ions were also evaluated and the limit of detection was found to be 1µM.The cyanide sensing mechanism is also suggested based on TEM analysis. Furthermore atest strip approach is developed for real time detection of CN^- ions.The proposed method has been successfully used for the determination of cyanide in water samples.
Keywords: Biosynthesis, silver nanoparticles, *Padina Tetrastromatica*, colorimetric sensor, cyanide ions.

06-05

LINEAR INTRUSIONS AND NATURAL DISASTERS INCREASE SPREAD OF INVASIVE ALIEN SPECIES - A CASE STUDY FROM THE FORESTED LANDSCAPES OF CENTRAL KERALA.

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Background: Arrival and establishment of an invasive species into a country is well studied compared to their spread ecology within the country.
Method: This study looks into the various linear intrusions in the Athirapilly – Vazhachal – Sholayar forest area and their role in the spread of the alien invasive species to the forest area. The paper also looks into the preliminary study on the impact of landslides and flood witnessed in August 2018 on the spread of invasive species. Plots were laid in the forested landscape to identify the species composition, abundance and ecological history.
Results: From the 60 plots laid, 17 invasive species could be recorded. In forested landscapes, the invasive species were abundant and dense along the linear intrusions like roads, coupe roads and powerlines. Alien species covered a maximum of 41.5% of the ground area at linear intrusions while in the rest of the forest area the maximum coverage was 2.87%. Unlike the forest areas, the linear intrusions provide open areas favouring quick spread of alien species into forests, while they also provide high impetus to developmental aspirations of the State like providing revenue, means of travel and transport, source of power generation and forest protection. The flood and landslides have assisted in the spread of species to new locations. A number of seedlings of *Mimosa diplotricha, Mikania micrantha* and *Senna torra* were recorded from the flood prone areas. The landslides have led to canopy opening where invasive species have be-

come the primary occupants. The seedlings of *Mimosa diplotricha, Mikania micrantha, Merrimia vitifolia, Pteridium aquilinum* and *Ageratina adenophora* were recorded from the landslide areas.
Conclusions: We argue that unless management of invasive species is built into the construction and maintenance of linear intrusions, natural forests and plantations will be in danger of losing their biodiversity and will result in sharp decline in ecosystem services they provide.
Keywords: invasive species; linear intrusions; flood

06-06

BIOREMEDIATION STUDY OF BIOSURFACTANT PRODUCING BACTERIAL BLOOM FROM OIL CONTAMINATED SITES AFTER FLOOD IN KERALA

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Abstract: Petroleum spillage around the world have played major role in generating the solidWastes during the tanker accidents and stocking of crude oil. The ecology of hydrocarbon degradation by microbial populations in the natural environment is analysed, highlighting the physical, chemical, andbiological factors that cause the biodegradation of petroleum and individual hydrocarbons. Therefore, The present study has shown that the indigenous Bacillus sp.,isolated from the polluted study sample (Kochi) possessed the capacity to produce suitable biosurfactant. The effectiveness of the bioremediation mediated by the biosurfactant extract was studied by finding out the germination percentage of a fast growing leguminous plant (Pisumsativum).Therefore the findings of the study revealed that the bacillus sp., isolated from Kochi possesses remarkable oil degrading properties and can be effectively employed in the bioremediation of oil contaminated soils. It can be considered as one the effective clean-up technologies of the future

06-07

THE IMPACT OF FLOOD ON MICROALGAE ALONG THE LOWER REACHES OF PERIYAR AND CHALAKKUDY RIVERS

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Background: Microalgae play a significant role in the maintenance of ecology in aquatic systems through the process of primary production. The change in phytoplankton assemblages represents a good measure of the state of an ecosystem and hence it is an important group to consider as a valuable bioindicator for water quality assessment. Flood changes the biodiversity, mainly in plankton communities, responding to nutrient dilution via high water content. The hydrology after the flood has changed and this influenced the distribution of microalgae.
Methods: This investigation was conducted during different seasons along the lower reaches of River Periyar and Chalakkudy during 2016-2018. The stations include, Pathalam (10° 04' 17N, 76°18' 18E), Manjaly (10° 08' 35N, 76° 16' 26E), Kanakkankadavu (10° 10' 16N, 76°16' 26E), and Kathikudam (10° 15' 24N, 76° 19' 04E). The physical parameters like pH temperature, salinity estimated *in situ.* Dissolved oxygen, Chlorophyll *a* and turbidity were also measured *in situ.*. Chemical variables (Nitrate, Nitrite, Phosphate and Silicate), pigment analysis, and productivity estimation were estimated as per standard methods. Sampling carried out during December 2016 to September 2018 in which post monsoon 2017, pre monsoon 2018 and two sampling were done after the flood 2018 (September and October 2018). A comparative analysis has been done with that of flood and normal samplings.
Results: A total of 70 species of microalgae have been identified amongst 10 species were representatives of Cyanophyceae, 31 species of Chlorophyceae, 26 Bacillariophyceae, 2 Dinophycean species and a single species from Chrysophyceae. The maximum species diversity was recorded from Kathikudam (50sp) followed by Manjali (49 species) while minimum from Kanakkankadavu (45 species). In all the stations the abundance (biomass) of microalgae diminished two week after the flood. However, there was intensive growth of diatoms species like *Melosira* and *Nitzschia* was observed in Pathalam and Manjali stations which are part of Periyar River. In Kanakkankadavu and Kathikudam Cyanophycean diversity was high which may be due to the high nutrient sedimentations.
Conclusion: The phytoplankton diversity lowered after flood. N:P ratio determines the growth and survival of microal-

gal composition, in general. The lowered N:P ratio obtained after the flood has influenced the sustenance of microalgae as evidenced by Pearson Correlation Analysis. The alteration in the nutrient characteristics might be due to higher habitat heterogeneity and hydrological change. We hypothesize that the alteration of the nutrient status of these two rivers was due to the hydrological change occurred by the devastating flood, which in turn lowered the diversity of the microalgae

Keywords: Diversity, Habitat heterogeneity, Hydrological change, N:P ratio

06-08

AQUATIC BUGS (ORDER: HEMIPTERA) AS POTENTIAL BIOINDICATOR OF TWO DIFFERENT POND ECOSYSTEMS: A CASE STUDY

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Background: Ecologists studying Heteroptera have long been seeking the use of aquatic bugs for biomonitoring as well as biocontrol agents. Prior to the development of monitoring models, many studies have been conducted in the past to ascertain bug species association with environmental parameters. In our state, Kerala, no serious attempts have been made to use these aquatic insects to study the aquatic health. In this context, the present study aims at to assess the biomonitoring of aquatic heteropterans with reference to physico-chemical parameters of two different ponds of rural and urban areas of Palakkad District, Kerala.
Method: The water bugs were collected from two different selected ponds of rural and urban areas by using hand picking method, pond net, small sieve, etc. All the collected specimens were preserved in 70 % alcohol and identified with the help of standard taxonomic keys. A total of 16 physico-chemical parameters were analysed in the field as well in the laboratory such as water temperature, Turbidity, Electrical Conductivity, $P^{H,}$ Total Dissolved Solids, Acidity, Alkalinity, Total Hardness, Calcium, Magnesium, Chloride, Fluoride, Iron, Nitrate, Sulphate, and Dissolved Oxygen.
Results: A total of 8 families comprising 10 genera and 12 species of water bugs were observed in Pond I (Rural area); and 5 families consisting of 5 genera and 5 species were recorded in Pond II (Urban area). The aquatic bugs such as *Ranatra filiformis Fabricius, Diplonychus rusticus Fabricius, Paraplea sp., Mesovelia vittigera Horvath,* and *Neogerris Parvula Stal* were found in both the ponds of rural and urban areas, but *Microneta scutellaris scutellaris Stal, Anisops paragrilincatus Brooks, Ranatra elongata Fabricius, Limnogonus fossarum Fabricius, Gerris spinolae Leithierry and Severin, and Hydrometra vittata Stal* were observed only in Pond-I. So, those water bugs may found only in non-polluted water and they were used to indicate the water quality. This particular group of aquatic bugs can be regarded as good bioindicator species. From the study, it is clear that the pond II has low transparency, highly alkaline in nature (pH 9.05) and somewhat polluted when compared to Pond I, which might be the result of anthropogenic activities such as bathing, washing, garbage disposal, etc. and the scarce of vegetation. The present study observed that the diversity of water bugs was greatly influenced by the physico-chemical parameters of aquatic habitat. They respond to the stress of aquatic habitat either by changing their diversity and abundance or presence/absence of these particular water bugs.
Conclusions: The use of bio-indicators is essential for environmental monitoring and to study the health of aquatic habitat. The water quality of ponds plays a crucial role in the maintenance of diversity and richness of water bugs.
Keywords: Aquatic Hemiptera, Bioindicators, Biomonitoring, Water quality.

06-09

FOREST DEPENDENCE AND COMMUNITY WELL BEING IN PARAMBIKULAM TIGER RESERVE, KERALA

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Forest ecosystems that covers 31 per cent of the total land area, are vital refugees for terrestrial biodiversity and the effective management of these natural resources are essential as humans depend on them for their subsistence needs. *The resources derived from the forest ecosystem meet multiple needs for different sub groups of people.* On a macro

perspective, the vulnerable group comprising mainly the tribal communities depend on forest resources for meeting their employment and livelihood requirements. The Forest DependencyIndex, a numeric indicator of the social and economic dependence of the community in Parambikulam Tiger Reserve highlights a high socio-economic dependence indicating the significance of the forest in the livelihood of the community residing within the Reserve.The study indicates a total forest dependence of 69.6 per cent, which is a high dependence level on the forest resources. Assessing the dependency of the community on the forest will help in creating awareness on the resource dependence and provide indicators for sustainable forest management. Moreover the policy changes from the colonial to the post-colonial period had its role to play in maintaining the forests. This paper analyses the forest dependency of the tribal communities residing within the Parambikulam Tiger Reserve, which is one of the well-protected ecological niche of Anamalai sub unit of the Western Ghats and the policy implications on the livelihood of the forest dependents.
Keywords: Forest Dependency Index, tribal community, socio-economic dependence, Tiger Reserve, policy

06-10

BIODEGRADATION OF CHLORPYRIFOS PESTICIDE USING AUTOCHTHONOUS *BACILLUS* CONSORTIUM

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Background: Modern agriculture is highly dependent on agrochemicals in order to obtain a sustainable yield. The threat posed by the neurotoxic organophosphate pesticide, Chlorpyrifos (CP), due to its soil persistence, is highly alarming. The only possible eco-friendly and cost-effective alternative for Chlorpyrifos residue abatement from soil would be Bioremediation using microorganisms. Hence, the current study utilized a bacterial consortium assembled from autochthonous soil isolates and analyzed its Chlorpyrifos degrading ability.
Method: CP degrading bacteria were isolated using soil enrichment technique from CP-contaminated soil. The isolates were further screened for the CP degrading ability using GCMS analysis and the percentage of degradation was calculated. 16 different combinations of the isolates were then assembled into consortia and the GCMS analyses of the consortia, in which all the isolates survived, were done. The isolates of the consortium showing highest percentage of CP degradation were identified.
Results: Five morphologically distinct bacterial isolates (CP28, CP30, CP31, CP33 and CP34) were obtained after the isolation procedures. The percentage of degradation of each isolate falls in the range 65-70%. The consortium CON11, containing four isolates, showed the highest CP degradation percentage (91.9%). The individual isolates of the consortium are identified as *Bacillus amyloliquefaciens* (CP28), *Bacillus pumilus* (CP30), *Bacillus marisflavi* (CP31) and *Bacillus subtilis* (CP34).
Conclusion: The autochthonous bacterial consortium CON11 showed 91.9% of CP degradation compared to the individual isolates (65-70%). Thus, the consortium can effectively be used in the bioremediation of Chlorpyrifos-contaminated agricultural soil.
Keywords: Autochthonous bacteria, Biodegradation, Chlorpyrifos, Consortium, *Bacillus sp.*

06-11

AN ALL KERALA STUDY CONDUCTED ON THE EFFECTS OF MOBILE TOWER AND MOBILE PHONE RADIATIONS ON HUMAN

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Background: There are over 35000 base stations in Kerala and our state has the largest population density in India .People using cell phones are more compared to most other states. The cell phone providers are now changing their towers from 3G to 4G (using much higher frequencies). In a very near future we are going to catch up 5G services all over Kerala. Not much relevant studies are made in our state to enlighten the dangers caused by the microwave radiations. Such careful studies will enable the governments to make laws to control the tower parameters (radiating power, tower height, antenna specifications, multiple antennas etc.) according to our own state's conditions.
Method: We divided the examination area into two; Core Zone (CZ), which is the area within a radius of 300 metres of any cell tower and Radiation Free Zone ,outer zone (OZ) at a distance more than 300 metres from any cell tower. Power

density, electric field intensity and magnetic field intensities were measured and a survey was conducted in more than 60 houses to find out the effects of human health. Statistical tests have been conducted to conclude the assessments. The device used for measuring the exposure parameters was MECO's 9720 three axes radiation metre. The main objectives of this study are, to identify, the exposure faced by the people in Kerala, living in varying distance from the tower antenna, the ill-effects caused by the radiation in different categories and frequencies and to study the hazards caused by cell phones and phone habits.

Results: Ten groups were examined and 800 samples were collected from all over kerala to discover if any relation exists between human health and the RF exposure levels. Our observation is that out of ten groups, nine of them definitely have some connection with the mobile tower exposure. Various hone habits are also studied and it is found that such mobile habits are harmful to human health.

Conclusions: For this study we divided the entire Kerala state in to three regions; North, Central and South. The north and south regions consists of five districts each and the Central region consists of four districts. We conducted survey in different areas in each of these district spread over both CZ and OZ zones, measured radiation levels in terms of power density (P). More than 800 samples were taken from all over these areas. Conducted statistical tests using the software SPSS. Out of the ten groups, nine found to have some serious relation with the mobile tower exposure. In the case of study on phone habitat related diseases, it is found that many phone habits, namely keeping phone close to body, keeping phone near to bed while sleeping and talking in phone more than one hour per day are harmful for the human health.

Keywords: Mobile tower radiation, Human health, RF exposure, Radiation level.

06-12

APPLICATION OF UP-FLOW ANAEROBIC BIOFILTER AND HORIZONTAL FLOW SUBSURFACE CONSTRUCTED WETLAND IN KITCHEN GREYWATER TREATMENT

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Background: The wastewater of domestic origin is broadly divided into two categories, viz., greywater and blackwater. 'Greywater' is defined as the "Wastewater generated from bathroom showers, sinks, washing machine or laundry, dish washers and kitchen sinks". Discharge of greywater can result in nutrient built up in water bodies and thereby leading to eutrophication.Long term exposure to pathogenic microorganisms in greywater can cause diseases leading to mortality and morbidity. Kitchen greywater with its higher organic content and oil and grease concentration makes it unsuitable for direct discharge into water bodies.Development of low-cost decentralized greywater treatment systems is a cost-effective strategy for the management of kitchen greywater.

Methodology: The current study evaluates the efficiency of up-flow anaerobic biofilter (UFAB) combined with horizontal flow subsurface constructed wetland (HFSCW) in treatment of kitchen grey water. The treatment system consists of four units viz; an up-flow anaerobic treatment biofilter (UFAB), a granular activated carbon (GAC) filter and two horizontal flow subsurface constructed wetland (HFSCW) systems.

Results: Trail runs were carried to evaluate the performance of treatment system. Removal efficiencies of 97.5%, 93%, 87%, 70% and 78.5% were observed for oil and grease, BOD, COD, TDS and TSS during treatment. There was also an appreciable reduction in total coliform and E. coli number.

Conclusion: The continuous flow system developed during the study was found efficient in removal of BOD, COD, TSS, TDS, oil and grease, turbidity, total coliform and E. coli.

Keywords: Greywater, Up-flow anaerobic treatment biofilter, Granular activated carbon filter, Horizontal flow subsurface constructed wetland

06-13

EFFECT OF PHYTOSYNTHESISED SILVEROXIDE NANOPARTICLES ON THE DEGRADATION OF AN ANIONIC DYE – COOMASSIE BRILLIANT BLUE

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Background: One of the major sources behind the increase in environmental pollution can be attributed to the broad application of dyes in various industries and imperfection in the removal of dyes. The promising potential of nanotechnology can be exploited for catalytic degradation of dyes.The present study deals with the phytosynthesis and characterizationof silver oxide nanoparticles (Ag_2ONPs) and its photocatalytic degradation efficiencyon the textile dye CoomassieBrillaint Blue (CBB).
Method: The prepared aqueous extract of Curcuma rhizome was added to silver nitrate solution, followed by irradiation of sunlightfor the synthesis of Ag_2ONPs. The bioreduction of silver ions was characterizedusing UV-Visible spectrophotometer, Fourier Infrared Spectroscopy (FTIR), Powder X-Ray Diffraction (PXRD), High Resolution Transmission Electron microscope (HR-TEM), and Field Emission Scanning Electron microscope (FESEM). The photocatalyticactivity of Ag_2ONPs against CBB was evaluated by UV- Vis Spectroscopy.
Results: The UV- Visible spectra of the reaction mixture showed maximum absorption at 413.5 nm, with a single surface plasmon resonance band revealing the formation and spherical shape of Ag_2ONPs, which wasin agreement with the XRD results, and TEM, FESEM micrographs. From the FTIR spectrum results, it can be attributed that the amide linkage of proteins could be likely to form a coat over the Ag_2ONPs, stabilizing them in the aqueous medium. The percentage degradation of CBB was 98.7%.
Conclusion: This study, presented a green, biosynthetic route for the synthesis of Ag_2ONPsnanoparticles, which exhibited a very good photocatalytic activity against molecules of dye, paving an effective and economic way to environmental bioremediation.
Keywords: Photocatalytic degradation, UV-Visible Spectroscopy, Rhizome extract

06-14

A DETAILED REDESCRIPTION OF *JAMIDES CELENO* (LYCAENIDAE, INSECTA) FROM A MORPHOLOGICAL, ANATOMICAL AND MOLECULAR PERSPECTIVE

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Lycaenidae, the second largest family of butterflies is characterized by sexual dimorphism, inter specific similarity of colouration and wing markings and intra specific differences in seasonal broods leads to confusions in identification by non experts. *Jamides celeno* a very common Lycanid was selected for morphometric, morphological and molecular study. .*Jamides celeno* were collected from in and around the paddy fields of Malappuram. Preservation, morphometric measurements and wing and genitalia slide preparation was done using standard protocols. The DNA was extracted from single individual (thoracic and abdomen region) using DNA extraction kit (Origin DNA isolation kit). The extracted DNA was amplified in PCR by using insect primers and sequenced.The molecular analysis of the species were done by using mitochondrial genome (Cox I) with a length of >700 bp. The identification of species was confirmed by checking the sequence in NCBI BLAST. Morphological and morphometric observations did not show any significant differences from previous data. The antennal length has mean 7.3 and fore wingspan has a mean value of 36.The anatomical structures revealed the typical anatomy of wing venation and genitalia of a butterflies. The venation include typical veins like costa, sub costa+radial1, radial 2, 3 and 4, median 1, 2, 3, cu1, cu2 and 1 and 2 anal in the fore wings and sub costa + radial 1,radial, medial 1,2,3,cubitus1,2 1 anal+ 2anal,and 3 anal in the hind wings. The query sequence showed 100% similarity with *Jamides celeno* voucher and entries when compared using nBLAST of NCBI.
Key words: *Jamides celeno,* Lycaenidae

06-15

A PRELIMINARY QUANTIFICATION OF THE MOTH ASSEMBLAGES IN HUMAN HABITATIONS IN AN URBAN AND RURAL AREA OF THRISSUR DISTRICT WITH EMPHASIS ON POST, PRE AND FLOOD SEASON

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Lepidoptera are widespread in habit and distribution yet studies on moths have lagged behind both in terms of taxonomy and ecology. In this paper we present the results of observations taken for 12 months (9 before the flood, one month of flood (August) and two post flood months) in an urban and rural area of Thrissur district. Moths were collected using light trap method by operating light traps from7 pm to 10 pm. Opportunistic sightings were also recorded A total of 27 and 47 morphs were recorded from the urban and rural areas respectively. Five families of moths were common to both study areas while three each were found only in either of the study areas. Three species were common to both the study areas. While the rarefaction curve obtained from both rural and urban areas were very steep curve, the curve obtained from the rural area showed signs of reaching an asymptote. Based on the moth assemblages sighted no specific patterns could be discerned from the dendrogram obtained from the rural region, but the months of august, September and November seemed to be similar in species composition based on the clusters formed by the dendrogram. Another interesting observation was that while the mean sightings of moths were higher for the preflood period when compared to the post flood and flood period in the rural area, the trend was reversed in the urban area with maximum sightings being recorded just before and after the flood in the month of August. Mean sightings in post flood period was greater than the preflood period but less than the flood period.
Key words: Moths; comparing biodiversity;, pre-flood, flood and post flood period

06-16

FATE OF PHOSPHORUS FRACTIONATION IN CORE SEDIMENTS OF MANGROVE ECOSYSTEM - MALIPPURAM, COCHIN, SOUTHWEST COAST OF INDIA

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Background: Sequential chemical extraction scheme is used for the fractionation of phosphorus in the mangrove ecosystem (Cochin region, Southwest Coast of India). This study helps to understand the biogeochemical cycling and bioavailability of various forms of phosphorus. Sediments were analyzed for major P species such as Iron bound P, Calcium bound P, Acid soluble organic P, Alkali soluble organic P and Residual organic P.
Methods: The core sediment was collected from Malippuram, Cochin, South west coast of India. The Sequential chemical extraction scheme is used for the fractionation of P in the sediment.
Results: Alkali soluble organic phosphorus is the dominant fraction (15-418 mg/kg) followed by Acid soluble organic P (21-226 mg/kg), Fe bound P (8.47-470 mg/kg), Ca bound P (4.59-115 mg/kg) and Residual P (13-44 mg/kg) respectively. The high value of alkali soluble-OP may be due to the flocculation and precipitation processes involving humic acids. The high organic P contribution in the sedimentary P pool may indicate high organic matter load with incomplete mineralization, as well as comparatively greater percentage of humic substance and resistant organic compounds. Second dominant phosphorus fraction is acid soluble organic phosphorus which is associated with apatite-bound phosphate and includes biochemical components such as nucleic acids, lipids and sugars. The third dominant Fe bound phosphorus is due to the high reducing nature of the mangrove ecosystem and also the presence of sulfur reduction in the sediments.
Conclusion: The present study reveals that mangroves act as an important sink which can trap significant quantities of P.
Keywords: Mangrove, phosphorus fractionation, Organic phosphorus, Humic materials, Organic matter.

06-17

AN ANALYSIS OF FUNCTIONAL FEEDING GROUPS OF BENTHIC MACRO INVERTEBRATES IN BIOMONITORING OF PAMPA RIVER

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Background: Functional feeding groups are a feeding approach of an organism which provides information about the balance in food acquisition strategies. It reflects the adaptation of organisms to environmental factors. It is a measure that enhances the knowledge of trophic dynamics.
Methods: To evaluate the functional feeding groups (FFG) in Pampa River, benthic macroinvertebrate samples were collected from five different stations. FFG recorded were assigned by using previous literature and mouth parts morphology of benthic macroinvertebrates.
Results: In the study four major functional feeding groups were represented: Collector Gatherers (CG), Shredders(S), Predators (P) and Collector Filterers (CF). The most dominant functional feeding group was Collector Gatherers which constitutes 90.9% of the total population. The family Chironomidae constitutes the most abundant Collector Gatherers in the study area.
Conclusion: The present study propose that the use of functional feeding groups along with evaluation of nature of habitat type is effective tool to determine diversity of benthic macroinvertebrates in the river ecosystem and its importance in biomonitoring
Key words: Pampa River, FFG, Macroinvertebrates, Biomonitoring

06-18

ENVIRONMENTAL IMPACT OF MINING AND QUARRYING IN NETRAVATI - GURPUR RIVER BASINS: A GEO - ENVIRONMENTAL APPRAISAL

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Background: Mining and quarrying for minor minerals imparts significant economic, environmental and social impacts in and around the regions where it is being carried out. The activity accounts for a significant proportion of GDP and a large share of foreign exchange earnings. The environmental impact of mining can be significant and long-lasting. The problem is severe in the small catchment rivers because such rivers are more responsive to socio-environmental changes. Sustainable mining/quarrying strategies areto be adopted to minimize the negative impacts and ecological impairments to the barest minimum. A micro level survey of literature shows that systematic studies on the impact of minor mineral extraction especially that of building materials, are meagre in Indian context. Here we report a case study the environmental impact of mining and quarrying in Netravati-Gurpur twin basins in Karnataka as an example.
Method: Minor mineral locations were identified using Landsat TM and Landsat TM+ images. Landuse/Land cover map has been prepared for the year2018 to understand the present landuse. Systematic field surveys were conducted for the collection of primary data on mining and quarrying activities. The locations of mines/quarries, environmental critical areas, etc., were mapped for detailed studies. The quantity of resource extractionwas estimated from number counts of the loaded vehicles moving out of the locations. Census data were usedfor understanding the urbanization trend. Maps and figures were prepared for understanding the spatial inter-relationship.
Results: The study shows that minor mineral extraction for hard rock, laterite, sand and soil quarrying is wide spread in the basin. Mining and quarrying is a very destructive activity which impacts severe environmental problems in the area. Hard rock quarrying has made marked changes in natural landscape and ecology of the region. The total production of hard rock in Dhakshina Kannada district is 0.535 million metric tons/year. Abandoned hard rock quarries are left present as wastelands. Laterite quarrying in the basin often provides a positive benefit in the region as removal of the hard laterite cap enhances water percolation and make the area good for agriculture activities. Indiscriminate sand mining can cause irreparable and irreversible damages to the river ecosystem. Analysis of the gauge data of Bantwal-gauzing stationreveals thatthe river bed at this station is lowering in alarming rate over the years. The rate of channel incision is about 13 cm per year. The frequency of occurrence of mines increases towards urban centers. Production of aggregates in the urban centers has a strong correlation with population density and affluence of the people of the area.
Conclusion: Unscientific mining in the study area causes severe degradation of land and water environment of the area.

Lowering of water table, ecological impairments and impose land use changes are some of the environmental consequences noticed in the area. The study reiterates the need for sustainable mining and alternatives to the present variety of building materials that are in use in the area.

Key words: Mining and quarrying, Netravati-Gurpur river basin, Sustainable developments

06-19

IMPACT OF FORESTRY PRACTICES ON PRIMARY NATURAL FORESTS IN THE WESTERN GHATS: A CASE STUDY FROM VAZHACHAL FOREST DIVISION, KERALA

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Natural forest degradation refers to reduction in productivity and/or diversity of a forest. Major reason in the degradation of primary natural forests in India are the 'colonial legacy' which allowed large scale clear felling for timber and conversion of forests for commercial and industrial plantations in the name of 'Forest management' and allocation of forest areas for developmental projects in tune with post-colonial 'Conservation' strategies.

The major reasons for the post 1980 forest clearances were massive conversion of forests for Dams, mining and other Industries. The remaining primary forests are not exactly primary in nature. Most of these natural forests were interrupted with timber extraction in the past such as clear felling, selection felling and selected removal of saplings. All these are the foundations for the present study to understand the History and impact of degradation in the primary natural forests taking the Vazhachal Forest Division of Central Kerala as a case study.

The history of forest degradation started prior to during 1944 with conversion for plantations and felling for timber. Observations of Abdul Kareem (2007), Bachan et al., (2014) also agree with that. Maximum timber extraction happened in the 1970-1980 period, it is followed by 1980-2016 for plantation, social forestry and silviculture purpose. The overall study using forest conversion maps from 1939 to last working plan period 2017 shows a positive correlation with the hypothesis that the forestry and non-forestry practices in natural forest area contributed significantly in degradation of primary forest. The phytosociological assessment conducted in selected locations systematically showed a serious impact of these activities in the composition of saplings.

The result of the study based on details of working plan ,vegetation mapping and phytosociological assessment conclude that primary forest are degrading and it support the latest argument that the forest management policy's and forest management plans give more priority for commercial forest management than conservation of primary forests and this study is a material evidence for that argument

06-20

ROLE OF TERMITES IN LIGNOCELLULOSIC WASTE MANAGEMENT

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Background: Lignocellulosics form the major part of agricultural wastes. Burning of this waste causes severe air pollution currently being experienced in Punjab, Haryana and Delhi. On the other hand, Lignin and Cellulose of this waste are resources to be utilized and not to be combusted. The termites have the ability to degrade lignin and cellulose and convert this to usable materials like nutrient rich soils etc.

Methods: An attempt was made to study the termite degradation capability and feeding preference using five lignocellulosic wastes including: three varieties of Paper, Dung, Leaves and two varieties of Grass and single variety of cardboard. Totally 10 sites in Mahatma Gandhi University Campus in Kottayam chosen on the basis of level of human disturbances (Core, Buffer and Transition) and visible termite activity. The substrates were weighed and placed on the field covered with plastic boxes (Bioreactors) and kept undisturbed for 30 days.

Results: All varieties of paper waste namely office waste, newspaper waste and magazine waste showed more termite activity and maximum amount of substrate consumption rate compared to other substrates. The overall termite activity on the substrates are in the order of Paper > leaves> dungs> grasses> Cardboard. Zone wise the activity was found more in Buffer, followed by Transition and core zone but the consumption rate was found more in buffer zone, then Core zone and Transition zone.

Conclusions: The lignocellulosic waste especially the paper and leaf litter waste along with dung and grasses can be

degraded by termites and converted in to useful products thus help in managing these wastes and at the same time reduce the pollution especially air pollution arising out of combustion of such wastes.
Keywords: Lignocellulose waste, Termite, degradation,

06-21

AN INTEGRATED APPROACH FOR RAW DRUG AUTHENTICATION IN *SARACA ASOCA*

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Background: The global economy of international herbal products is increasingrapidly. Owing to huge market demand, many of the medicinally important plant species are subjected to over exploitation and unscientific extraction leading to the extinction of its natural resources. According to International Union for Conservation of Nature (IUCN), 15000 medicinally exploited plant species worldwide is listed under the threatened category. Non-availability of potential ayurvedic raw drugs resulted in the adulteration of the existing resources with cheap inferior quality plant materials with different medicinal principles altogether. Medicinally important plant parts are traded in powdered, dried or shredded form which is difficult to identify using the traditional taxonomic means. Global standards or protocols for the authentication of ayurvedic raw drugs are currently not recommended/ practiced. Proper identification or authentication of the potential raw drug is thus is a major concern of quality assurance in the herbal drugindustries.
Methods: An integrated method of DNA barcoding and HPTLC weretried for the authentication of the selected potential raw drug, *Saraca asoca* from its common market adulterants. Nuclear and plastidgene regions wereinitially tried to identify a barcode gene region to differentiate original drug from itsadulterants. Different solvent systems were used in HPTLC to develop a standard chromatogram.
Result: The studied four barcoding region(two coding regionsviz. *rbc*L, *mat*K and one intergenic spacer region viz. *psb*A-*trn*H), and Nuclear ITS (Internal Transcribed Spacer) regionshowed inter specific variation and no intra specific variation. Among the four analyzed barcodes, Nuclear ITS region showed greater interspecific variations among*Sarca asoca*, and its adulterants. In HPTLC Toluene: Ethyl acetate: Acetic acid (10:8:0.1) gives a standard chromatogram to authenticate *Saracaasoca*from its adulterants.
Conclusion: Nuclear *ITS* (Internal Transcribed Spacer) region was most effective in discriminating *Saraca asoca* from its adulterants.Similarly, HPTLC profile revealed.An integrated method involving DNA barcode and HPTLC could be used to authenticate *Saraca asoca* from its adulterants
Keywords: *Saraca asoca*, adulterants, Barcoding, HPTLC

06-22

ADAPTIVE PRIVATE ALLELES IN THE GEOGRAPHICALLY DISTINCT NATURAL TEAK POPULATIONS OF KERALA

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Background: Genetic diversity is highly influenced by environmental gradients. Geographic barriers and environmental variables tend to alter the genetic diversity structure of populations and play an important role in the long term survival of the species in extreme environments. The presence of rare alleles specific to each population could be a means of adaptation to specific geographic conditions**.**
Methods: Three teak populations from different geographic zones of Kerala (North, Central and South) were selected. Phenology of each population was studied followed by SSR genotyping for genetic diversity and structure analysis using softwares GenALEx, Power Marker and STRUCTURE
Results: Nine loci showed polymorphism among three populations with a total of 82 alleles. Average observed and expected heterozygozities were almost similar (0.553 and 0.598 respectively) across the markers. A total of 52 private alleles (*Np*) were identified. Maximum rare alleles found in Konni population. High gene flow was evidenced (3.170). Konni population was genetically more distant from Idamalayar (0.567) as compared to Wayanad (0.286). Genetic variation within populations was found to be more than between populations. Three populations divided into two ancestral

sub populations based on the K value. Genetic admixture was evident in Konni and Wayanad but the genetic structure of Idamalayar was highly distinct.

Conclusion: Altitude based gradations with consequent changes in temperature and humidity affected the phenology of natural teak populations. High amount of genetic diversity within populations showed that the genetic distinctiveness of the populations with Idamalayar population as most distinct forming a separate cluster. A clear overlap of Konni and Wayanad population was also evident, must be related to the historical origins of the populations.

Keywords: Teak, Phenology, SSR, gene flow, genetic structure, genetic diversity

06-23

SYNTHESIS AND CHARACTERIZATION OF NANO HYDROXYAPATITE DECORATED CARBOXYL FUNCTIONALIZED GRAPHENE OXIDE / ZINC OXIDE NANOROD COMPOSITE FOR THE EFFECTIVE DEGRADATION OF CHLORPYRIFOS FROM AQUEOUS SOLUTIONS

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Background: Chloropyrifos (CP) is a crystalline organophosphorus insecticide, is highly toxic to non-target organisms including human beings. The maximum admissible quantity of CP in individual and drinking water are 0.1 and 0.5 ppb, respectively. Therefore, it is very urgent to develop efficient technologies for the removal of organic pollutants such as pesticides from water.Photocatalysis was considered as a green and sustainable technology, has attracted considerable interest because it simultaneously tackle the energy crisis and environmental contamination by using solar energy.

Method: A novel nanohydroxy apatite decorated carboxyl functionalized graphene oxide/zinc oxide nanorod (nHAP@CFGO/ZnR) composite was designed and fabricated. The photocatalytic activity and adsorption performance of the nHAP@CFGO/ZnR were evaluated. The composite exhibits improved photocatalytic degradation of CP under visible light irradiation having the light intensity 100 mW/cm^2.

Results: Nanohydroxy apatite decorated carboxyl functionalized graphene oxide/zinc oxide nanorod (nHAP@CFGO/ZnR) composite was prepared and well characterized by FTIR, XRD, SEM, XPS, Raman, DRS, PL and EIS.The band gap of the prepared photocatalyst was found to be 2.8 eV which is in the visible region. The maximum adsorption occurs at pH 3.5. The adsorption kinetic and isotherm data were described using pseudo-second-order kinetic model and Sips isotherm model, respectively. The photocatalytic degradation of CP was found to follow first-order kinetics and optimum pH for degradation was found to be 3.0. The regeneration and recyclability of the photocatalyst was examined upto five cycles that confirmed the relative stability of the photocatalyst.

Conclusions: A visible-light-driven photocatalytic degradation of CP was done using nHAP@CFGO/ZnR composite. The nHAP@CFGO/ZnR composite showed good reusability and stability as a promising photocatalyst for water purification. The solution pH was closely related to the adsorption of CP on the photocatalyst. Therefore, our work reveals that CFGO and nHAP as excellent supporting material for strengthening the photodegradation performance of ZnR in the visible region. Thus nHAP@CFGO/ZnR composite can be considered as a promising material in degradation applications for the treatment of water pollution.

Keywords: Graphene oxide; Zinc oxide nanorod; Nano-hydroxyapatite; Chlorpyrifos

06-24

PARMELIOID LICHENS OF KERALA, CURRENT STATUS AND NEED OF TAXONOMIC AND PHYLOGENETIC UPDATION OF THE FAMILY PARMELIACEAE

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Background: Kerala regions have high diversity of Parmelioid lichens. The lichen exploration of this area is still incomplete. Current study suggests an extensive survey, taxonomic and molecular phylogenetic analysis to solve taxonomic and nomenclatural problems of Parmelioid lichens, Kerala.

Method: The present paper is mainly based on the collections made by the second author during 1998-2005 and the literature pertaining to the Parmelioid members reported from the Kerala part of Western Ghats, India.

Results: Lichen exploration is still incomplete in Western Ghats regions. Many of the newly reported species in India are known to have their distribution in Kerala region also. Several among the collected species from the region exhibit endemism and two Parmelioids species are reported as extinct which were previously collected from Kerala. Kerala possess many vulnerable and rare Parmelioid memebers. Phylogenetic and taxonomic amendments underwent within the family Parmeliaceae causes many nomenclatural issues.
Conclusion: Kerala region need extensive survey of its Parmelioid lichen diversity. Taxonomic documentation using molecular phylogenetic tools may be helpful to solve current taxonomic and nomenclatural problems.
Keywords: Diversity, Parmelioid lichens, Molecular Phylogeny

06-25

ARECANUT AND COCONUT TREES, THE UNIQUE HOSTS PREFERRED BY EPIPHYTIC LICHENS IN LOWER ALTITUDE: A CASE STUDY FROM ERNAKULAM DISTRICT, KERALA

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Background: Epiphytic lichens are most sensitive non vascular cryptogams showing a dynamic distribution patterns and are most popular subject of indication ecology.The fundamental objective of this study is to determine if coconut and arecanut plantations, which are the extensively cultivated cashcrops in Kerala, can provide efficient micro habitat for lichen flora.
Methods: Survey of lichens was conducted in different parts of Ernakulam during 2018. Lichens were collected from Coconut and Arecanut trees upto an height of 2.5 m from the base and herbarium were prepared by standard methods. Species were identified with the help of various keys by observing morphology, chemical colour tests and TLC.
Result: Critical analysis of the 1000 specimen collected during the period showed 71 species under 29 genera belonging to 18 families were found distributed on trunks of Coconut and Arecanut trees. The family Graphidaceae dominates with 16 species under 4 genera followed by Physciaceae, Pyrenulaceae, Arthoniaceae, Parmeliaceae, etc. The genus *Pyrenula* dominated with 13 species followed by *Graphis, Dirinaria, Cryptothecia, Hypotrachyna, Caloplaca, Pertusaria*, etc. Among the 71 species recorded, about 18 species were found to be new report to Kerala and 4 species are new record to peninsular India.
Conclusion: Present study is thepioneerinformation about the lichens on cultivated land, there is an ample scope for further extensive studies and document correct status of lichen flora of the state.
Keywords: Epiphytic lichens, Arecanut and Coconut trees, Ernakulam district.

06-26

ANALYSIS OF ECO-PHYSIOLOGICAL AND ALLELOPATHIC EFFECTS OF TWO SPECIES OF REED BAMBOOS IN THE RESERVE FORESTS IN THIRUVANANTHAPURAM DISTRICT, KERALA.

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Background: Reed bamboos are thin, tall shrubby grass belonging to Poaceae family. The species belonging to *Ochlandra* are endemic to Western Ghats and provide numerous ecosystem services and thereby add to forest stability. The aim of the study was to analyse the inhibitory effect of reed bamboos on nearby vegetation.
Method: This work explores the reason why other vegetational growth is limited near the bamboo species. The two species selected for study were *Ochlandra travancorica* and *Ochlandra wightii* from the protected forest areas of Thiruvananthapuram district in Kerala. The area of study were visited and analyzed for vegetational growth. Primary data collection was done by taking 3 plots of size (3m*3m) and a control site. The list of plants was documented from the plots and control areas and analysis for chlorophyll was also done with 80% acetone in spectrophotometer.
Results: The preliminary analysis of the reserve forest areas in Thiruvananthapuram where theses bamboos are flourishing, confirms that there is some effect of these bamboos on the neighbouring plants. The Allelopathic effect can be due to the presence of some toxins or can be due to any biochemical interactions. The inhibitory effect of bamboos can be directly or indirectly affecting the growth and survival of other plants. The plants present in both the areas were

documented and compared with the control site. The sites showed scarce vegetation but the control plots were rich with different types of plants. Analysis for chlorophyll was also done and the chlorophyll content of plants in the sample sites were less when compared to the control plots. The results clearly indicate that there is an allelopathtic effect of bamboo which suppresses the growth of other plants.
Conclusions: From the present study it can be concluded that the release of some chemicals to the plant environment by the Ochlandra species can be the reason for low growth of other plant species.
Keywords: Reed bamboos, Ecophysiology, Chlorophyll, Allelopathy.

06-27

ANALYSIS OF HEAVY METAL POLLUTION ON PARVATHY PUTHANAR, AN ARTIFICIAL RIVER CANAL IN THIRUVANANTHAPURAM DISTRICT, SOUTH KERALA

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Background: Water in Parvathy puthanar is black and polluted. Drains at several places empties into this canal. The aim of this study was to determine the heavy metals (Nickel, Cadmium, lead, Fluoride) in different water samples collected from different sites in canal and nearby ground water sources.
Method: Samples were collected during Pre monsoon, Monsoon and post monsoon season. For heavy metal analysis all the collected samples were prepared and digested. Atomic Absorption Spectroscopy (AAS) is a very common and reliable technique for detecting metals in environmental samples.
Results: All stations shows high concentration of heavy metals during pre-monsoon period due to the low concentration of water in the canal and high evaporation rate. During rain the water content in the canal increases and dilution of minerals occur. So the value of heavy metal concentration shows decreasing during AAS. The level of fluoride is very high in all stations.
Conclusion: The obtained result shows that heavy metal concentration is very high in both canal water and nearby ground water.
Keywords: Heavy metals, Parvathy puthanar, Pollution

06-28

TRACKING BIODIVERSITY WITH CITIZEN SCIENCE - A CASE STUDY OF eBird IN KERALA

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Background: In this era of advancement in science and technology, public participation in scientific research through citizen science have become an inevitable strategy. The partnership between scientist and public can definitely expand the scope and field of scientific research.eBird as a citizen science project integrates public in collection of information, researchers for analysing the data, agencies which develop polices and the managers who actively involved in conservation action. In the context of this paradigm shift in the way at which we look at science, we dissect out the current use of eBird tools and the prospects and lacunae in its working concept.
Method: 2018 GBBC ranked Kerala as a topmost birded state among 29 states in India reporting 60% of the birds of Kerala within four days of birding participated by 221 individual birders across the state which accounted for more than 25% of Indian contribution in GBBC. By the completion of Kerala Bird Atlas project by 2020 Kerala will be the first Indian state to have an atlas of Avifauna. Around more than 500 citizens are participating in this prestigious event along Kerala by a current completion of 78% of the wet season and 66% of the dry season.
Results: The credibility of e Bird has been under question due to the underlying assumption of the citizen science initiative that the people providing inputs to the platform are trustworthy. Personal bias in identification, clumped data, temporal skewness in data due to peak birding season, technical difficulties for laymen in using the platform, unhealthy competition amongst bird-watchers and free access to details of threatened/ sensitive species are some of the key issues in context of Kerala. Generation of seasonality charts, prediction of migration trajectories, heat map preparation, species distribution modelling, baseline data for quantifying population-level estimates of Data Deficient birds for aiding in the Red-Listing process, free information availability through open-access and the provision for using the platform

in vernacular languages makes this platform universal.
Conclusion: Citizen science as a tool in scientific research is unique because of the fact that here we are not only focussed on scientific output from the perspective of a scientist but also it addresses broader societal impacts by involving public in the research team.eBird in Kerala is only one of the examples of citizens being part of scientific process, making available large volume of data on biodiversity that would otherwise be unavailable. The potential of such huge data across different habitats over a long span of time has made statistical analyses possible like never before. By way of involving common man in such actions aimed at inventorying biodiversity, the scientific community has at large been able to drive home the message of conservation to a larger audience.
Keywords: eBird, citizen science, bird atlas, GBBC

06-29

LOGISTIC REGRESSION MODEL AND TEMPORAL ACTIVITY PATTERN OF STRIPE - NECKED MONGOOSE OF SILENT VALLEY NATIONAL PARK

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Background: The lesser known mammals engage in significant ecological roles in the ecosystem functioning in tropical forests and their exclusion has a cascading effect on entire communities. Most of the Protected Areas of the country in general and Kerala in particular do not have many comprehensive inventories of the small carnivores especially Stripe-necked Mongoose *Herpestes vitticollis*. Even though *Herpestes vitticollis* is endemic to Western Ghats in India and Sri Lanka its distribution along Western Ghats is not yet studied well. No studies have done on the habitat preference and prediction of the presence of this species using a model in India and very small studies are there on the temporal activity pattern of Stripe-necked Mongoose.
Methods: Silent Valley National Park (SVNP) was the study area. Camera trap survey was done to identify the presence of Stripe-necked Mongoose in SVNP. Twenty microhabitat parameters that are crucial for the survival of the small carnivores from each camera trap stations were used for the prediction model for Stripe-necked Mongoose of SVNP. Camera trap images were used to establish the temporal activity pattern of this species.
Results: Logistic regression analysis was done for predicting the presence *Herpestes vitticollis* based on 20 habitat parameters recorded from the camera trap stations. From that it was found that all the parameters like canopy height, litter depth, density of buttressed trees, climbers, shrubs, canes, distance to largest tree, width of water body, Girth of the largest tree, slope, and presence of water body, holes, rocks, fruiting tree, swamp, roots, and fallen logs except canopy cover have significant influence on the presence of Stripe-necked Mongoose. From the evaluation of logistic regression model for Stripe-necked Mongoose it is found that the percentage of correct predictions of this species is 100% in SVNP. From the analysis of temporal activity pattern of Stripe-necked Mongoose it was found that it is a diurnal species with a peak active period during 09:00hrs to 10:00hrs.
Conclusion: This work establishes the relationship between microhabitat parameters and presence of Stripe-necked Mongoose in SVNP. Microhabitat parameters are used to understand the habitat preference and to create the prediction model for the presence of Stripe-necked Mongoose. Stripe-necked Mongoose is a diurnal species.
Keywords: Stripe-necked Mongoose, Camera traps, Logistic Regression model, Temporal activity pattern

06-30

DEVELOPMENT OF AN INDEX FOR SOIL QUALITY ASSESSMENT OF MANGROVES IN KERALA

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Background: Mangroves are a productive ecosystem that supports various goods and services. A quantitative assessment of the soil quality of these systems would help develop suitable management strategies or policy interventions. The present study aims to develop a soil quality index to quantitatively assess the mangrove soils of Kerala.
Methods: Surface soil samples (0-30 cm) were collected from mangrove areas of Thrissur, Kannur and Kollam districts of Kerala. In each of the selected sites the mangroves were classified into undisturbed, medium disturbed and disturbed based on the canopy cover. The collected soil was characterised for their physicochemical parameters and heavy met-

als using standard protocols. Soil quality assessment was done by principal component analysis (PCA).
Results: The calculated Soil Quality Index (SQI) of the mangrove areas ranged from 0 to 3.0 for disturbed, 3.1 to 9.0 for medium disturbed and >9.1 for undisturbed soils. Relative soil quality index of these mangrove soils varied from 0 to 27% , 28 to 80%, > 80 % for disturbed, medium disturbed and undisturbed soils respectively.
Conclusion: The SQI values can be used for the categorization of existing mangrove sites and mangrove species – site matching when taking up new planting. Sites with low SQI should be planted with mangrove species with high adaptation and bioremediation potential As for the existing sites, low SQI mangroves (0 – 3.0 SQI values) should be maintained through strict monitoring as further pollution in these sites could have adverse effects on the adjoin systems linked to it. Further research is needed for development of successful restoration strategies based on degradation level in these areas.
Keywords: Mangroves, Soil, Soil quality index

06-31

ZOOPLANKTONS AS INDICATORS IN THE SEASONAL ECOLOGY OF THREE PONDS OF ERNAKULUM DISTRICT OF KERALA

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Background: Zooplanktons are feebly floating microscopic organisms of aquatic systems. They mediate the transfer of energy from producers to consumers. They are also bio indicators of water quality and serve as sensitive, inexpensive, efficient and early warning and control systems. The paper describes the ecology and bio indicator species of three ponds viz. Irumbakulam (Kadungallor) Aluva, Nelanattukulam (Sreemoolanagaram) Kaladi and Chathankulam (Allapra) Perumbavoor, of Ernakulum District.
Method: The physical and chemical parameters such as temperature, turbidity, dissolved oxygen and carbon dioxide, salinity, nitrates, phosphates, total dissolved solids and pH of samples were measured for monsoon and post monsoon seasons. The preserved zooplanktons were identified, numerical abundances determined and biological indices estimated.
Results: All the ponds in both the seasons had normal temperature, pH, salinity and nitrate values but elevated dissolved oxygen, carbon dioxide, total dissolved solids and phosphate values. Altogether, a total of 109 species, including 21 rhizopods and ciliata, 41 rotifers, 25 cladocera, 17 copepods and 5 ostracods have been identified. Statistically, there is adequate abundance, diversity, evenness and richness both pond wise and season wise. Many pollution indicator zooplanktons like *Arcella vulgaris, Centropyxis aculeata, Difflugia oblonga, Brachionus spp, Asplanchna spp, Lecane spp*, *Testudinella patina*, *Platyias quadricornis*, *Diaphanosoma sarsi*, *Kurzia latissima, Thermocyclops hyalinus, Mesocyclops hyalinus*, and nauplii have been observed in Aluva and Kaladi ponds.
Conclusions: Physico-chemical features support abundant and diverse zooplanktons in different seasons, particularly postmonsoon. Study of biological indices and pollution indicator species reveals that Aluva pond is polluted with urban waste water runoff, Kaladi pond is polluted with risk of eutrophication and dryness in summer, whereas Perumbavoor is a non polluted pond. All three ponds fall in meso-eutrophic status range.
Keywords: zooplankton, kulam, physico-chemical parameters, diversity index, bioindicators.

06-32

ECO - PHYSIOLOGICAL STUDIES IN RELATION TO HEAVY METAL CONTENT IN DIFFERENT STRATEGIC AREAS / PLANTS OF KADALUNDI VALLIKKUNNU COMMUNITY RESERVE

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The mangrove ecosystems are economically valuable and they are under increasing threat of being wiped out by rapid human encroachment and environmental pollution and it is considered to be one among the highly endangered ecosystems of the world. This work is an assessment on the effect of different anthropogenic activities on the mangrove vegetation of Kadalundi-Vallikkunnu Community Reserve (KVCR) by analyzing the heavy metal content in soil/plants and physiochemical characterization of water and soil sediments. Concentration of seven metals such as Mn, Zn, Cu,

Fe, Ni, Pb and Cd were analysed in soil sediments, water and root tissues of *Acanthus ilicifolius, Avicennia officinalis* and *Rhizophora mucronata* plants of the KVCR. Except Cd, all other metals were detected from these samples. Fe was detected in higher levels in all the samples. Higher content of heavy metal was recorded in *A. ilicifolius* as compared to *A. officinalis* and *R. mucronata.* Accordingly it was ascertained that, *A. ilicifolious* is a hyper accumulator of heavy metals as compared to *A. officinalis* and *R. mucronata* in KVCR region. The physiochemical properties of soil and water as well as the heavy metal content in different regions of KVCR regions are varied and might have an influential role in the species dominance in the particular region.

06-33

NOVELTIES FROM MATHIKETTAN SHOLA NATIONAL PARK, KERALA, INDIA

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Background: Mathikettan shola National Park is rich in biodiversity and plays a vital role in safe guarding wild life in the region. Being rich in floristic diversity and presence of many RET plants, there is ample scope for novelties in the area.
Method: Fresh specimens were collected and pickled in 4% formalin and 70% ethanol for detailed study. Photographs of habitat and habit were taken with a Sony α A55 DSLR Camera and floral details were studied with a stereo microscope (Leica EZ4HD). Illustrations were drawn by using a stereomicroscope with Camera Lucida attached. Herbarium sheets were prepared by conventional methods (Bridson & Forman, 1991). The identity of the species was confirmed with type material/ protologues and descriptions were prepared after proper diagnosis by examining wide range of specimens. The specimens of related taxa in CALI and MH were also examined. Drupe micromorphology was examined using Scanning Electron Microscope (Zeiss Gemini SEM 300 Microscope).
Results: The newly described species of Piperaceae, *Peperomia ekakesara* Syam & S. Nampy is morphologically close to *Peperomia heyneana* Miq., but can be easily distinguished by its glabrous, procumbent habit and having one stamen in each flower contrasting with pubescent, erect habit and two stamens in the latter. *Memecylon idukkianum* S. Nampy & Syam (Melastomataceae) is allied to *Memecylon varians* Thwaites but differs in having quadrangular branchlets, acute or obtuse leaf apex, 5–9 mm long petioles, 15–20 flowered cymes, pale green calyx with ovate lobes, white corolla, 0.5 mm long anthers and deep blue fruits. *Kalanchoe dinesii* Syam & S. Nampy is morphologically allied to *Kalanchoe bhidei* T. Cooke but differs in size, obovate to obtrullate sessile leaves, not spreading 6–8 cm long inflorescence, 1.5 mm long bracts, 3–5 mm long pedicel, widely ovate calyx lobes and greenish white corolla lobes with caudate apex. *Embelia mathikettanensis* Syam & S. Nampy is very rare plant found in the park and it is similar to *Embelia adnata* Bedd. ex C.B. Clarke.
Conclusions: During floristic surveys in 2014–2017, more than 500 angiosperm taxa were collected from the park. Critical field observation and microscopic study recognized four novelties: *Peperomia ekakesara* Syam & S. Nampy (Piperaceae), *Memecylon idukkianum* S. Nampy & Syam (Melastomataceae), *Kalanchoe dineshii* Syam & S. Nampy (Crassulaceae) and *Embelia mathikettanensis* Syam & S. Nampy (Myrsinaceae), which are described as new to science. The present study indicated the species richness of this region. The unprecedented flood and landslides that devastated the state of Kerala recently, had its maximum impact on Idukki district causing considerable loss to biodiversity. Thus it is imperative to protect this ecologically sensitive area with rich and natural biodiversity from both natural and anthropogenic calamities.
Keywords: Angiosperms, taxonomy, *Peperomia, Memecylon*, *Kalanchoe, Embelia,* endemic, IUCN

06-34

EVALUATION OF WATER QUALITY STATUS OF PARVATHY PUTHANAR CANAL, THIRUVANANTHAPURAM, KERALA, SOUTH INDIA

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Parvathy Puthanar is a man-made canal, runs parallel through the west coast of Thiruvananthapuram district, Kerala state. It is a portion of Thiruvananthapuram-Shoranur Canal (TS canal), and connectsthe Karamana river, Akkulam-Veli

lake & Kadinamkulam lake. The study aims to assess the current water quality status of the Parvathy Puthanar using Water Quality Index (WQI). The canal water samples were collected from ten selected sampling stations extending from Thiruvallam to Kadinamkulam (total distance of about 26 km) during December 2017 (postmonsoon season) and March 2018 (premonsoon season). The physico-chemical and bacteriological analysis of canal water were carried out following the standard procedures of APHA. Concentration of heavy metals such as Fe, Mn, Cu, Cd, Cr, Zn and Pb in canal water were determined after acid digestion by Atomic absorption spectrophotometry. Water Quality Index was calculated following the procedure of National Sanitation Foundation (NSF) WQI. For this, the values obtained for water quality parameters pH, DO, turbidity, faecal coliforms, total phosphorous, nitrates and BOD of Parvathy Puthanarwere used.Results of the analysis of surface water quality of the canal water show thatmost of the sampling stations of the canal belong to bad and moderate category. The colour intensity of canal water ranged from 10 to 20 Hazen Units and the heavy metals Fe, Mn, Cu, Cr, Cd, Zn and Pb were detected in Parvathy Puthanar. The concentration of majority of heavy metals in canal water except Cdare within the permissible limits of BIS surface water quality standards. It reveals that the canal is facing pollution due to various anthropogenic activities such as illegal discharge of sewage from houses, offices, apartments, wastewater from hospitals, hotels, disposal of garbage, wastes from slaughter house, effluents from sewage treatment plants etc. Thestudy suggests that Parvathy Puthanar canal can be conserved only through implementing strict laws and human participation.
Keywords: Coliforms, Heavy metals, Parvathy Puthanar, Pollution,Water Quality Index.

06-35

DETECTION OF WATER POLLUTION INDICATORS AND OTHER MULTIDRUG RESISTANT PATHOGENIC BACTERIA IN THE DRINKING WATER SOURCES OF CHENGANNUR AFTER FLOOD - A MAJOR THREAT

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Background: Beginning on -15 August 2018, severe flood affected Kerala, due to unusual high rainfall during the monsoon season. It was the worst flood in Kerala in nearly a century. The flood affected most of the drinking water sources of all affected places. The major source of pollution is the flood water which carried the sewage and deposited in drinking water sources.
Method: This work aimed for the detection, isolation and antibiotic sensitivity analysis of water pollution indicating coli forms and other multi drug resistant pathogenic bacteria from the drinking water sources of different Panchayath of Chengannur after flood. Well Water samples collected from homes were evaluated for the presence of faecal coli forms by most probale number technique. The total number of colonies was detected by standard plate count method. Antibiotic resistance pattern of the isolates were studied by Kirbey Bauer agar disc and well diffusion methods.
Results: The result indicated that most of the water bodies were polluted with faecal coli forms and other antibiotic resistant pathogens. *E.coli, Streptococcus, Klebsiella* were isolated from the drinking water sources of which some strains were found multidrug resistant. Present study showed a notable increase in the total coli form bacteria in the well water after flood. Antibiotic resistant strains were observed from the water sample collected from various sites and this is alarming and serious threat to the human and animal inhabitants.
Conclusion: The study has led to conclude that the quality of water samples from different wells subjected to study was not acceptable from bacteriological standards. Hence the water needs to be treated before using for any domestic purposes. Based on the results of analysis, it is suggested that detailed routine analysis of the drinking water sources, storage tanks and pipe lines is needed. Moreover strict monitoring and awareness may be carried out for the public to access safe water for drinking and house hold uses.
Keywords: Bacteria, coli forms, multidrug resistant, indicator organisms, water pollution.

06-36

SOIL HEALTH STATUS OF SELECTED LAND USE SYSTEMS IN A REGION OF ACHENKOVIL WATERSHED, KOLLAM DISTRICT: A STUDY ON THE IMPACTS OF LAND USE AND MANAGEMENT

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Background: Conversion of forest land to plantations such as teak, rubber, coffee, tea, cardamom, eucalyptus etc. were the main types of land use change happened in Kerala in the last several decades with respect to plantation development. Most of plantations were raised in the ecologically sensitive region of Western Ghats. But the impact of this land use conversion on soil properties and soil quality have not been carried out properly. Hence, an attempt has been made to assess the soil quality status of a selected region of Achenkovil watershed, Kollam district, part of Western Ghats comprising three major land use systems of the area- natural forest (NF), teak plantation (TP) and rubber plantation (RP).
Method: 42 composite soil samples (0-20 cm depth) were collected from three land use systems in July- August 2017. The physico-chemical parameters analyzed were soil temperature, moisture, soil bulk density, texture, pH, EC, soil organic carbon (OC), total nitrogen (TN), available Nitrogen (Av.N), available phosphorous (Av.P), available potassium (Av.K) , sodium and soil respiration. Soil quality index (SQI) maps were prepared using Arc GIS 9.3 software.
Results: The present study revealed that, most of the physico – chemical properties of soil were found either varying or declining between forests and plantation systems. Climatic factors including rainfall, temperature, soil erosion and vegetation type can be considered the main factors for these variations in soils. Excessive soil erosion has observed in the area. The soils in general had a sandy to loam texture, acidic pH, high organic carbon, and available nitrogen and potassium contents. Available phosphorus was found to be low. Soil microbial activity indicated by soil respiration rate showed declining trend in plantation systems compared to forest. Soil respiration rate was found to be having positive correlation with soil organic matter availability. SQI values were high in forest soils compared to plantation soils.
Conclusion: This work confirmed the hypothesis that soil quality declines when natural forests undergo massive conversions to less managed plantation systems. The predominantly monocrop plantation systems have adversely affected the soil health status of the land use systems in the study area.
Keywords: Soil quality index, land use change, soil respiration

06-37

DIVERSITY AND DISTRIBUTION OF BIRDS IN MIDLAND LATERITIC BIOTOPES OF NORTHERN KERALA, INDIA

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Lateritic hillocks of Kerala are often considered as ‘wastelands’ due to the scarcity of woody species and less agricultural productivity. But in reality they are landscape units having high biodiversity value and ecological significance. Birds use these lateritic biotopes as their roosting, breeding and feeding grounds. The lateritic biotopes provide ample refuge for many birds including migratory ones. Some birds use this place as stop-over sites for a short time during their seasonal migration (Passage migrants). The unique topographic setting of these lateritic hillocks, an elevated table like plateau surrounded by the wetlands and agro-ecosystem has been a very distinct land mark for the migratory birds. These lateritic biotopes constitute Lateritic vegetation, Sacred Groves, Kanams, Agro-ecosystems and Plantations. These ecological subunits provide a diverse habitat for birds. During this study, 196 species of birds were recorded. Two near Threatened and one vulnerable species were listed in the study. Four birds are endemic to Western Ghats. Birds were identified and checklist was prepared with reference to the available literature.

06-38

MACRO-PROLIFERATION OF THE BLACK BAMBOO, *GIGANTOCHLOA ATROVIOLACEA* WIDJAJA

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Background: Bamboos are generally monocarpic, seed only once, at the end of long years of vegetative growth. There is no easy method available to predict when a bamboo, that we come across, may seed; and hence could not relied for immediate propagation.There is poor supply of planting materials of this species, at present, as against heavydemand. An improvised macro-proliferation method for the Black Bamboo,*Gigantochloaatroviolacea*Widjaja, is describedhere.
Methods: Cuttingsfrom live clump conserved in theBambusetum of JNTBGRIwere usedfor the propagation experiments.Pre-rooted branches and 2-node branch cuttingswere planted to begin the experiment. Rooted cuttings were grown adequately in polybags and subjected to further proliferation.
Results: A four-month macro-proliferation schedule is developed, which ensure continuous production of handy propagules, of *G. atroviolacea*(@2.5 tillers/ bag). This macro-proliferation method stands notable, because it remediates the planting material shortage. The method is easy to practice; saplings resulted easily portable, suitable for multiplication andreplaces laborious propagation practices.
Conclusion: So far known, the Black Bamboo could be propagatedonly through vegetative means. The modified macro-proliferation method described herefinds relevance in the continuous production of planting materialsof thishigh-endbamboo. The high productivity of thepre -rhizomed branches and the methodology described to obtain themare of relevance in bamboo propagation studies.
Keywords: Black Bamboo, Macro-proliferation, Pre-rhizomed branches, Culm cuttings

06-39

TiO_2- REDUCED GRAPHENE OXIDE NANOCOMPOSITE: A NOVEL CATALYST FOR SOLAR DECONTAMINATION OF WATER FROM DRUG POLLUTANTS

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Background: Diclofenac (DCF) is an extensively used anti-inflammatory drug in human and animal health care. The metabolites from DCF are highly stable and toxic and get accumulated in the environment. Hence it is included in the list of 'priority pollutants' by the European Union. Conventional waste water treatment systems are inadequate for the total elimination of DCF. In this context, Solar Photocatalysis – based Advanced Oxidation Process (AOP) using in-house synthesised nanocomposite TiO_2-reduced graphene oxide (T-RGO) as catalyst is explored for the removal of last traces of DCF from water.
Methods: T-RGO nanocomposites of varying composition were prepared by solvothermal treatment of titanium isopropoxide and graphene oxide (GO) in isopropanol. The catalysts were characterised by various spectroscopic and physico chemical methods. Photocatalytic experiments under sunlight and UV irradiation were made using standard procedures. The DCF concentration at various intervals of irradiation was estimated using UV-Visible spectrophotometry (274.6 nm) and total organic carbon (TOC).
Results: The solar photoactivity of T-RGO was established from preliminary experiments. Relevant photocatalysis parameters such as catalyst loading, RGO content in the composite, concentration of DCF, pH etc were optimised. The degradation of DCF is facile under solar irradiation in presence of T-RGO thereby establishing its potential for economic commercial application. The degradation follows Langmuir– Hinshelwood mechanism and pseudo first order kinetics. Reaction intermediates are identified by using LC/MS technique. Eventually they also get mineralized as seen from the complete disappearance of TOC. The role of graphene in the superior photocatalytic performance of T-RGO composite is experimentally verified and confirmed. Relevant mechanistic details are also discussed.
Conclusions: In-house synthesised nanocomposite T-RGO is identified as a highly efficient solar photocatalyst for the removal of even traces of the highly recalcitrant DCF pollutant and its metabolites from water.
Key words: Diclofenac, Photocatalysis, TiO_2-RGO nanocomposite

06-40

FOOD AND FEEDING HABITS OF SCHNEIDERS LEAF - NOSED BAT, *HIPPOSIDEROS SPEORIS* (SCHNEIDER, 1800) FROM PEECHI - VAZHANI WILDLIFE SANCTUARY

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Background: Knowledge of the dietary composition can provide better understanding of the ecology and behavior of a species, and dietary information is essential for effective management of any species. Dietary analysis and understanding of feeding behavior of insectivorous bats enables to identify insect pests consumed by bats and publicizing the importance of insectivorous bats in controlling agricultural pest population can be a very powerful conservation tool.
Method: Fecal matter analysis using microscope was done to identify and quantify dietary components of insectivorous bats.150 fecal pellets collected were analyzed to study the feeding habits of *Hipposiderosspeoris.*
Results: Fecal matter analysis of *Hipposiderosspeoris* shows that the diet includesLepidoptera, Coleoptera, Diptera, Isoptera,Odonata, Hemiptera, Hymenoptera, Orthoptera, Neuroptera, Ephemeropteraand Araneae with different percentage volume and percentage frequency.
Conclusions: The dietary analysis of *Hipposiderosspeoris* reveals that these bats feed on insect orders which include potential pests in Agriculture, Forests and Human inhabitations. This indicates that *Hipposiderosspeoris*play a crucial role in insect pest suppression in Agriculture lands, Forests and Human inhabited areas.
Keywords: Bats, Microchiroptera, Feeding habit, Biological control

06-41

PHYCOREMEDIATION OF PULP AND PAPER MILL EFFLUENT USING PLANKTOCHLORELLA NUREKIS

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Background: The release of untreated wastewater poses serious environmental challenges to the receiving water bodies such as eutrophication. The pulp and paper industry uses large quantities of water and generates enormous quantity of wastewater. Bioremediation is an alternative eco-friendly technique with low economic and energy input. Phycoremediation is a type of bioremediation which use microalgae for the treatment of wastewater. This technique is an option for the remediation of cashew nut processing wastewater (CNPW) subsequently produced biomass can be used as source of renewable energy.
Methods: In the present study, fresh water microalga, *Plantochlorella nurekis* was isolated from Kuttanad wetland ecosystem, Kerala, India. The main objective of this study was to provide suitable concentration of PPME for the efficient treatment of nutrients in pulp and paper mill effluent. The collected PPME effluent was filtered separately and diluted to different concentrations of test solutions viz., 25%, 50%, 75% and 100%. All the experimental flasks (reactors) were placed in the culture room at 27 ± 2^0C with a constant illumination of 45µmol photons m-2 s-1.The study was conducted for 25 days in three experimental sets of reactors. The physico-chemical analysis of wastewater was carried out before the inoculation of microalgae and also at the end of the experiment.
Results: The results of the present study indicated that maximum cell growth of *P.nurekis* was observed on the 20thday in 75% PPME. Lowest cell growth was observed concentration with 25% and 50% PPME. The higher cell concentration was attained in the following order 75%>100%>50%>25%. 75% PPME showed more biomass, lipid (22%) and nutrient removal efficiency than other concentrations.
Conclusions: The study suggested that among the four different PPME concentrations, 75% PPME was suitable for the production of biomass and lipid. Hence it can be concluded that the native microalgae, *P.nurekis*can be used as a potential candidate for the treatment of PPME.
Keywords: Phycoremediation, microlage, PPME

06-42

FLOOD INUNDATION ANALYSIS USING DEM AND LAND COVER MAP

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Abstract: In the month of august 2018 heavy monsoon rainfall triggered floods along Kerala's coast as well as in different parts of the state in the hardest hit areas along the banks of the rivers Periyar, Chalakudy, and Muvattupuzha. Floods are considered to be one of the catastrophic weather-related natural disasters. This paper presents the influence of elevation and land-use on flood inundation in Aluva, Kerala which forms a part of Periyar river basin using Geographical Information System. Flood inundation data (Ground Control Points/GCPs), Digital Elevation Model (DEM) and landcover map were used in the study. Results indicate that in the chosen study area low lying areas are at lower risk than midlands. Moreover, the flood inundation was found to be higher in the region of built-up and settlements and the minimum inundation was observed in wetlands.
Background: About 14.8% of the state is prone to flooding (CESS, 2010). Apparently, there is a serious dearth in the number of studies conducted to understand the vulnerability of Kerala to natural hazards especially floods. Aluva has been one of the worst affected during the recent floods. During the course of the study, around 5m flood water height was observed in Aluva and the reason for which can be attributed to unplanned land-use, illegal encroachments and wetland reclamation. With the advent of GIS based technologies spatial analysis of such environmentally unsustainable practices are made easier.
Method: The following datasets were used to perform the study:ASTER-Digital Elevation Model -15m resolution, Flood height ground control points from flooded sites and land-use land cover map generated from landsat image using isocluster-unsupervised classification.After extracting the DEM values using the flood water levels from GCPs, the water levels for the corresponding raster values were compared and analysed. Land use land cover map was generated from the recent landsat data using isocluster unsupervised classification in ArcGIS. Using zonal statistics tool from arcgis toolbox the average water inundation and elevation for each land cover class was estimated
Result: average water level in the low lying lands is higher than that in mid land. In mid-land region the frequency of water levels is the highest for the range 1-2 m while in the low-land the frequency of the range 0-1 m is the highest. From the obtained results it can be concluded that the low lying regions are relatively at lower risk than the mid land region. It is observed that regions with higher built-up intensity have maximum water inundation compared to the other regions. Whereas, in wetland regions the water inundation is the lowest
Conclusion: The lowest water inundation occurred in the wetland region. This can be attributed to the fact that wetlands act as water retainers that do not allow flooding to exceed beyond a certain level. This fact also emphasises on the significance of wetlands in flood control and management.
Keywords: Flood inundation, GIS, DEM, unsupervised classification

07 - FISHERIES & VETERINARY SCIENCES

07-01

SUPPLEMENTATION OF PROBIOTIC *PAENIBACILLUS POLYMYXA* HGA4C INDUCES MORPHOMETRIC, ENZYMATIC AND GENE EXPRESSION CHANGES IN A TELEOST FISH *OREOCHROMIS NILOTICUS*

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Background: Probiotics have been using in human as well as other animals as food supplements for improved health status and disease resistance. The beneficial effect of probiotics on growth and immunity is a hot topic among nutritionists. The exact mechanism behind the host-probiotic interaction is not well understood. Hence, the present study was designed to evaluate the mechanism involved in the probiotic mediated health status improvement in a teleost fish *Oreochromis niloticus.*
Method: In this study, the fish *Oreochromis niloticus* was supplemented with two concentration (1×10^6 and 1×10^8 CFU/g) of the probiotic bacterium and subjected to analyze its growth promoting effects, modulation of digestive and

antioxidant enzymes and up-regulation of growth-related and immune-related gene expression. Growth parameters such as FW, WG, SGR, FCR and HIS were calculated. Digestive enzymes in the intestine and antioxidant enzymes in the liver and the intestinal tissues were assayed. Relative gene expression using qPCR for the growth related and immune related genes were done.

Results: The investigation revealed that the fish supplemented with two levels of the probiotic bacterium significantly improved morphometric parameters, digestive enzymes and antioxidant status of *Oreochromis niloticus.* Gene expression studies in the fish supplemented with $1x10^8$ CFU/g showed that the probiotic bacterium could effectively modulate the expressions of growth hormone binding receptors (GHR-1 and GHR-2) and insulin-like growth factors (IGF-1 and IGF-2) in the fish. Furthermore, the probiotic bacterium upregulated Toll-like receptor (TLR-2) gene expression along with the pro-inflammatory cytokines (IL-8 and TNF-α) and anti-inflammatory cytokine (IL-10) in the intestinal tissue of the fish. Intestinal MUC 2 up-regulation by the bacterium has indicated the mucosal remodeling of the host fish.

Conclusion: The probiotic *Paenibacillus polymyxa* HGA4C in the diet of *Oreochromis niloticus* is capable of improving morphometric growth parameters, digestive and antioxidant enzymes, and gene expression. The results have indicated the possible mechanism of action involved in the probiotic mediated growth regulation and immunomodulation in *Oreochromis niloticus*.

Keywords: Probiotics; *Oreochromis niloticus*; growth; antioxidant; immunity.

07-02

NATURAL ANTIOXIDATIVE EXTRACTS FROM FRUIT PEEL WASTES FOR SEAFOOD PRESERVATION

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Background: Fish or seafood is considered as the highly perishable commodity due to its very nature. Higher moisture content, native enzymes and bacteria accelerate the spoilage during the postharvest period of seafood. To retard the spoilage and to ensure the perishables have a long shelf life, artificial preservatives are used and proved to be effective. Harmful levels of Illegal additives such as formalin and ammonia or its combinations with other preservatives are reported recently from domestic fish markets of India. Considering the potential health hazards due to the use of chemical additives and synthetic preservatives, natural products, particularly natural antioxidants and antimicrobial agents need to be popularized for ensuring the safety of food consumers.

Method: In the present study fruit peel wastes of lemon and promagrante were collected from the different fruit-juice shops in Ernakulam, Kerala. Peels were washed, dried, powdered and the concentrated natural antioxidant was extracted. The characterization of fruit peel extracts -total phenolic content, total flavonoid content and DPPH radical scavenging properties of the extracts were analyzed. Standard concentrations of extracts were applied in filleted fish and in un-deveined shrimp respectively to understand the antioxidative effects and shelf life. Changes in the biochemical parameters such as PV, TBA and pH were recorded.

Results: The results of the present study revealed that the fruit peels of lemon and pomegranate contain good quantity of natural extract having excellent radical scavenging activity, phenolic and flavonoid contents. The antioxidative study had given significant results in terms of pH, PV and TBA values of selected seafood items under chilled storage. Biochemical quality was better and rancidity recorded was minimum in the coated samples compared to controls.

Conclusions: Fruits peel that are often thrown as agro-wastes from juice shop, household usage and many other food processing industries contain natural antioxidants. Coating of seafood with natural fruit peel extracts and stored under chilled or refrigerated condition had given promising results. Synthetic or illegal preservatives presently in use need to be discouraged and natural alternatives need to be popularized for ensuring healthy and safe diets for the growing population of our country.

Keywords: Antioxidant, Fruit Peel Extract, Lipid Oxidation, Rancidity, Phenolic content, Flavonoid content

07-03

EVALUATION OF RUMEN METAGENOME AND METHANE EMISSION LEVELS BETWEEN VECHUR AND CROSSBRED CATTLE OF KERALA

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Background: The rumen microbial community plays a critical role in methane emission from ruminants and had higher correlation with physiological parameters such as milk yield, milk composition. However, there is a lack of data comparing the composition of the rumen microbial community and methane emission levels of Vechur and crossbred cattle of Kerala. Present study was undertaken with the objective of assessing rumen microbial composition and methane emission levels of Vechur cattle and crossbred cattle under similar diet and management condition using a relatively new whole metagenomic approach.
Method: All the experimental animals were maintained under 50:50 (forage: concentrate) diet on dry matter basis for a period of three weeks. Whole metagenome sequencing and further bioinformatics analysis was done in two pooled DNA samples, each obtained by pooling DNA isolated from rumen liquor of five Vechur and five crossbred cattle. The concentrations of methane (percentage) in rumen gas samples collected from six Vechur and six crossbred cattle were determined using a methane analyser.
Results: Whole Metagenomic analysis showed that bacteria were most dominant taxonomic domain followed by archaea, eukaryota and virus in the Vechur as well as the crossbred rumen. Results revealed the existence of a core rumen microbial community in Vechur and crossbred and also the presence of distinct microbial community in each genetic group. Diversity analysis revealed that evenness and diversity indices for microbial species were higher for Vechur cattle indicating its adaptability. Significantly higher level of *Firmicutes* and lower level of *Bacteroidetes* was observed for Vechur compared to crossbred suggestive of one of the reason behind high fat yield in Vechur. Higher methanogen diversity was observed in Vechur cattle. Abundance of specific methanogen species were found to be significantly different between genetic groups. Comparison of methane emission levels between Vechur and crossbred cows reported a significantly higher mean percent of methane emission in Vechur.
Conclusion: Current study generated the rumen metagenome profile of Vechur and crossbred cattle of Kerala and compared the methane emission levels between them. Results confirmed the influence of genetic group on total rumen microbial species profile and methane emission levels. This also suggested an association between rumen microbes with milk fat percentage and methane mission.
Keywords: Rumen metagenome, methane emission, methanogen composition, Vechur cattle, crossbred cattle

07-04

VALIDATION AND ASSOCIATION STUDIES OF SINGLE NUCLEOTIDE POLYMORPHISMS IDENTIFIED IN PROLIFICACY RELATED GENES OF GOATS USING DOUBLE DIGEST RESTRICTION ASSOCIATED DNA SEQUENCING

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Background: Malabari and Attappady Black goats are the two native goat breeds of Kerala which differ significantly in prolificacy. Double digest restriction associated DNA sequencing (ddRADseq) is one of the successful modern reduced representation sequencing techniques, which apply Next Generation Sequencing (NGS), for discovery of Single Nucleotide Polymorphism (SNP) markers across population. In Current study ddRADseq was applied for identification of polymorphism markers affecting prolificacy in goats.
Method: Double digestion of genomic DNA (1µg) was done using *SphI* and *MlucI* restriction enzymes in two pooled DNA samples, each obtained by pooling DNA, isolated from whole blood of 10 highly prolific Malabari and 10 low prolific Attappady Black goats, respectively. PCR-RFLP was done in 100 Malabari and 50 Attappady Black goats for validation studies of selected variants in *BMP6* and *SERPIND1*.
Results: ddRADseq discovered 4140 SNPs and 126 INDELS in Malabari and 2192 SNPs and 59 INDELS in Attappady

Black goats. 25 SNPs were discovered in 20 candidate genes affecting prolificacy and another set of 11 genes were identified based on the difference in allelic distribution of SNPs between the two groups, which might have an effect on prolificacy. From candidate gene group, *BMP6* was chosen for validation and PCR-RFLP revealed all three genotypes for the variant c.614-32789C>T, thus confirming the robustness of SNPs discovered by ddRADseq. Variant c.1259T>C identified in exon three of *SERPIND1,* showed significant association with litter size, thus emphasising the significance of this novel gene in prolificacy.
Conclusions: Current study emphasized the relevance of ddRADseq in identifying novel SNPs in candidate genes and also promises the possibility of discovering SNPs in unexplored genes which might affect complex traits.
Keywords: Single Nucleotide Polymorphism, ddRADseq, Serpind gene, goats

07-05

A COMPREHENSIVE APPROACH FOR DIAGNOSIS OF PORCINE EPTOSPIROSIS: AN UNDER-REPORTED THREAT TO HUMANS

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Background: Leptospirosis, a worldwide zoonotic disease is indeed a major concern in the tropical state of Kerala, which has suffered several outbreaks of the disease so far. While most animals play a major role in the transmission of the disease to human beings, rodents and companion animals are the prime subjects of study and the role of farm animals is still far from knowledge to the society. A major underdiagnosed condition is swine abortion, which may be caused by zoonotic agents such as *Leptospira* or *Brucella*. Under this circumstance, the present study was performed to develop a comprehensive diagnostic methodology for porcine leptospirosis.
Methods: Samples were sourced from organised and private pig farms in Thrissur district, Kerala. Serum samples (n=108) were tested using microscopic agglutination test (MAT). Samples of blood (n=108) and aborted foetus (n=7) were subjected to *lipl32* gene specific polymerase chain reaction (PCR). Two antigen detection methods, latex agglutination test (LAT) and fluorescent antibody test (FAT) were also standardised and used for the diagnosis of acute cases of porcine leptospiral abortions. Attempts to isolate *Leptospira* from positive samples were also made.
Results: An overall seropositivity of 37.04 per cent could be detected using MAT with serovar Pomona being the most prevalent one. On *lipl32* gene specific PCR, three whole blood samples and tissues from one aborted foetus amplified the gene producing an expected 767 bp amplicon. Antigen detection LAT and FAT could be standardised for the detection of *Leptospira* using live cultures of different serovars.
Conclusion: In the present study, even though PCR was found to be the most sensitive method for directly detecting the presence of *Leptospira* in clinical samples, a combined diagnostic methodology can assist researchers and diagnosticians in interpreting the prevailing cause of swine abortions. In the present scenario, this is extremely important, owing to the zoonotic potential and the existing global burden of the disease.
Keywords: Swine, abortion, *Leptospira*, microscopic agglutination test, polymerase chain reaction, latex agglutination test, fluorescent antibody test.

07-06

BIODIVERSITY OF PLAKOBRANCHIIDS (GASTROPODA: PLAKOBRANCHIDAE) FROM SOUTH-WEST COAST OF INDIA

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Background: Plakobranchidae is the largest family coming under the order Sacoglossa of the Phylum Mollusca. The family Elysiidae was considered to be a synonym of the family Plakobranchidae, among which the genus *Elysia* comprised of 87 species worldwide. They are specialist feeders mainly feed on single species or specific macroalgae and they are living in the intertidal rocky-reef region and shallow water coral reef ecosystems.

Methods: The samples were collected by snorkelling to a depth of 3 m and also by hand picking. Live specimens were photographed and described in the laboratory. Smaller specimens were observed under Stereo Zoom Microscope (Leica S6D). Samples were dissected from both dorsal and ventral side of the organisms under Stereo Zoom Microscope (Leica S6D). Species were identified using standard keys, several published literatures and comparison of the radula.
Results: A total of seven species of sacoglossan molluscs from the family Plakobranchidae was recorded during the present study from the rocky intertidal regions of Thirumullavaram, Kovalam, Vizhinjam, Muttom and Kanyakumari along the south-west coast of India. They are *Elysia bangtawaensis*, *Elysia* cf. *hirasei*, *E. expansa*, *E. grandifolia*, *E. pusilla*, *E. tomentosa*, and *Plakobranchus ocellatus.* No authentic record of *E.* cf. *hirasei* from India, hence the present study adds the new distributional record from India. Except *P. ocellatus* all other species are new distributional records from southwest coast of India. Relative abundance of sacoglossans was also recorded. From the present study it is evident that the *Elysia grandifolia* and *Plakobranchus ocellatus* are the most abundant species than rest of the species of the regions.
Conclusions: Sacoglossans are among the least studied marine organisms with interesting chemo-ecological and pharmaceutical importance. The assessment of diversity of sacoglossan sea slugs along the southwest coast of India has been overlooked. Detailed exploration of least studied regions of west coast would reveal the presence of more unknown Plakobranchid molluscans.
Keywords: Sacoglossa, Plakobranchidae, *Elysia*, *Plakobranchus.*

07-07

EFFECT OF VARYING DIETARY PROTEIN AND LIPID LEVELS ON GROWTH AND REPRODUCTIVE PERFORMANCE OF ORANGE CHROMIDE *ETROPLUS MACULATUS* (1795)

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Back ground: A feeding trial was conducted to determine the suitable dietary protein and lipid levels on the growth and reproductive performance of orange chromide (*Etroplus maculatus)*. This fish has potential for both food and ornamental value. Its small size, bright orange colour and black spots on the body, calm nature etc., make them attractive candidates for the tropical aquariums.
Method: Four protein levels (30%, 40%, 50%, 60%) with two lipid levels 9% and 15%) within each protein levels were tested through formulation of practical diets labelled as 30P9L, 30P15L ,40P9L, 40P15L, 50P9L, 50P15L 60P9L, and 60P15L respectively and the proximate analysis was done. Broodstock performance was evaluated based on growth parameters, proximate content and egg production.
Results: The results showed that a significant interaction between dietary protein and lipid level was detected and influences the final weight gain and reproductive performance of fish. Numerically, growth parameter and total egg production values were higher in 50P15L diet when compared with other low protein and lipid diets.
Conclusion: Based on this study the dietary protein and lipid requirement for the optimized growth and reproductive performances of orange chromide to be at 50% protein and 15% lipid.
Keywords: Broodstock nutrition, protein, lipid,orange chromide (*Etroplus maculatus)*.

07-08

ANTIBIOTIC RESISTANCE AND VIRULENCE FACTORS OF *AEROMONAS* SPP. ISOLATED FROM DISEASED *XIPHOPHORUS HELLERII*

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Background: *Xiphophorus hellerii* or sword tail is a popular ornamental freshwater fish. But its growth has been limited by diverse bacterial infections due to poor quality of water and other environmental factors. Here the antibiotic resistance mechanisms and virulence factors of fish associated bacteria can expect to have an impact on fish health Hence the study was conducted to analyze diversity of bacteria associated with *X.hellerii* and its virulence and

antibiotic resistance properties.
Methods: in the study bacteria were isolated from the surface, gill and intestine of diseased *X. hellerii.* The obtained isolates were then screened for its antibiotic resistance and all the isolated bacteria were identified by 16S rDNA based method. Then the isolates were screened for virulence properties both by *in vitro* and molecular methods.
Results: The study has resulted in the isolation and identification of 12 bacterial isolates. Antibiotic resistance analysis of all the isolates against 17 antibiotics showed its 100 % resistance to oxacillin followed by 94 % resistance to teicoplanin. The isolates were identified as *Aeromonas* spp. and upon screening for virulence factors, 3 isolates were found to be positive for more than 2 virulence properties both by *in vitro* and molecular methods.
Conclusion: All of these data suggest the presence and distribution of bacteria with diverse virulence factors in the aquatic environment.
Keywords: *Xiphophorus hellerii*, Antibiotic sensitivity, Virulence factors

07-09

MOLECULAR PHYLOGENY OF PORCINE REPRODUCTIVE AND RESPIRATORY SYNDROME VIRUS CIRCULATING IN KERALA

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Background: Porcine reproductive and respiratory syndrome virus (PRRSV) belongs to the genus *Arterivirus*of the family *Arteriviridae*. In India, the disease was reported for the first time from Aizwal district of Mizoram in 2013. In North Kerala, during the year 2017, there has been a steep rise in mortality of sows and piglets due to respiratory and reproductive problems resulting in wiping out of entire groups of animals. A pioneer study was conducted to detect and elucidate the lineage of PRRSV viruses in pigs in Kerala.
Method: A total of 48 samples were tested for the presence of PRRSV employing reverse transcriptase polymerase chain reaction (RT-PCR) targeting the ORF6 of the virus. From representative samples, partial region of ORF7 of the virus was sequenced.
Results: Of the samples tested 21 (43.75 per cent) were positive for the virus. On BLAST analysis, it was seen that the sequences showed 98 per cent similarity to PRRSV sequences from China. On phylogenetic analysis, it was observed that all the PRRSV circulating in Kerala were of Genotype 2 (North American Genotype) and that they formed a separate cluster along with Chinese sequence NVDC-CQ-2008 (KP771755). It was also observed that the nucleotide sequences of the Kerala isolates were very closely related to each other. The Kerala isolates also showed similarity to PRRSV isolate MZ/IND/1/15 (KT696491) obtained in 2015 from Mizoram, India.
Conclusions: The results of the study indicate that PRRSV infection is present to a great extend among pigs in Kerala and that the isolates share a close genetic relationship.
Keywords: Porcine reproductive and respiratory syndrome virus, reverse transcriptase polymerase chain reaction, ORF6, ORF7, phylogenetic analysis

07-10

WHOLE MITOGENOME SCANS PROVIDE EVIDENCE FOR LOCALLY ADAPTED POPULATIONS OF INDIAN OIL SARDINE, *SARDINELLA LONGICEPS* IN THE INDIAN OCEAN

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Background: Presence of locally adapted populations of marine fishes has been reported in some of the recent investigations using molecular markers. We investigated the possible presence of locally adapted populations in Indian oil sardines by whole mitogenome analysis as mitochondrial Oxidative Phosphorylation complex (OXPHOS) has recently been assigned functions providing adaptive potential to environmental fluctuations in many marine organisms. Indian oil sardine, *Sardinella longiceps* is an ecologically sensitive and commercially important small pelagic fish of the

Indian Ocean.

Method: Whole mitogenomes of fishes collected from three eco-regions (South East Arabian sea, North Arabian Sea and Bay of Bengal) were analyzed for signals of selection and adaptation by approximate hierarchical Bayesian method (FUBAR, MEME) and TreeSAAP. control region was analyzed with its folding potential, number of substitutions/rate of evolution in paired sites and Tajim's D statistics.

Results: Our analysis revealed the role of purifying selection as the dominant force shaping evolution of sardine mitogenomes. In spite of these, signals of diversifying selection were observed in key functional regions involved in OXPHOS and which were more prevalent in individuals collected from South East Arabian sea which may be due to the effects of complex oceanographic features in this region and these findings point towards the presence of locally adapted populations. *S. longiceps* has a characteristic control region (D-loop) with a 30bp tandem repeats unit (palindromic sequences within it) and which is under strong selective pressure. Intrastrand secondary structures with low free energy (-0.101 to -0.384 ΔG (kcal/mol)) were observed in the repeat unit, haplotypes with one repeat unit has a greater folding energy and which is the most abundant. Two and three repeat units are less abundant and which is restricted to Western Indian Ocean

Conclusions: these findings point towards the presence of locally adapted *S. longiceps* populations in Indian Ocean. These sites could be used for further investigations by employing them as genetic tags of locally adapted populations which have implications in conservation and management of *S. longiceps* in the Indian Ocean.

Keywords: Local adaptation, Oxidative phosphorylation complex, Positive selection, Purifying selection, *Sardinella longiceps*

07-11

MOLECULAR CHARACTERIZATION OF ANTIVIRAL RADICAL - SAM PROTEIN VIPERIN HOMOLOGUE IN ASIAN SEA BASS *(LATES CALCARIFER)*

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Background: Viperin is a multifunctional interferon inducible gene that interfere with viral budding through inhibition of specific enzymes, and inhibiting viral genome replication through binding to viral proteins required for replication and assembly. Viperin associates with the cytosolic face of the endoplasmic reticulum (ER) until viral infection and then relocates to the cytoplasm, in lipid droplets or foci in the cytoplasm to inhibit virus replication. Asian seabass is a fish of high economic value which is succeptable to certain viral infections like beta noda virus infections. Better understanding about the antiviral immune mechanisms of *Lates* is important for disease control and improved health status of fish.

Method: *Lates calcarifer* was challenged with *lippopolysachride* (0.5 µg/ g of fish) and spleen tissue was dissected out .Molecular cloning of *Lates calcarifer* viperin gene (*Lc*-viperin) was carried out through PCR based amplification and the amplicon of size 1054 bp was cloned and sequenced. The sequences were aligned by multiple align software clustalW and phylogenetic analysis were carried out by using MEGA 6 software. The signal peptide was predicted by SignalP software. The domains and motifs were predicted by SMART tool and motif finder. The 3D Homology model were predicted by Swiss-model software.

Results: The *Lc*-viperin contain an orf of 1056 bp that codes for 351 amino acid protein (Genbank accession ID: **MH423325**).The deduced *Lc*- viperin protein has a predicted molecular mass of 40.3 kDa and an isoelectric point of 7.01. *Lc*-viperin contains a signal peptide (residues from 1-31), conserved domain of elongater protein 3(Elp3) (residues from 63 to 271) and radical SAM domain (residues from 67 to 210) which carries four motifs including the highly conserved CxxxCxxC motif (^{73} CNYKCGFC ^{80}). The *Lc*-Viperin also contains a highly conserved C-terminal domain (resides from 221 to 351) and an N terminal amphipathic α-helix domain (residues from 9 to 42) that varies among species. Viperin is evolutionary conserved protein and phylogenetic analysis by neighbor joining method showed that these homologue proteins could be divided into fish, bird and mammalian branches. *Lc* Viperin predicted 3D Homology model of contains 9 beta sheet and helices.

Conclusion: In this study, we sequenced and characterized the *Lc*-Viperin in *Lates calcarifer*. Sequence analyses

suggested that the *Lc*-Viperin was evolutionary conserved in protein sequence, with functionally significant domains. Our results indicated that the *Lc*-Viperin is involved in the innate antiviral immune response in *Lates calcarifer*. Sequence and expression studies of the antiviral genes will pave new ways for prophylactic measures in *Lates calcarifer* againt viral infections.

Keywords: Viperin, antiviral, Interferon inducible genes.

07-12

INFLUENCE OF TOMATO, LADIES FINGER AND SPINACH ON THE TILIZATION OF INORGANIC NITROGEN IN MEDIA BASED EBB-AND-FLOW AQUAPONICS SYSTEM

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Background: The biochemical engine that drives the aquaponics system is the nitrogen cycle. This symbiotically provides fertility to plants and cleans the water for fish in an aquaponics system. The advantages of linking crop production and fish production help to reducing the water usage and waste discharge to the environment and increased profit potential from the system. The nutrient-rich effluent from the fish tanks is used to fertigate hydroponic production beds. Maintenance of water qualityparameters isimportant for the survival of both fish as well as the plant growth in aquaponics.

Method: This study analysed the influence of Spinach, Ladies finger and Tomato on the inorganic nitrogen utilization and water quality maintance.Spinach, Ladies finger and Tomato were planted independently in different aquaponics unit (4 plants in one trough) and Pacu (*Piaractusbrachypomus* Cuvier, 1818) as candidate fish. Analysis of Ammonium nitrogen (NH_4-N), Nitrite Nitrogen (NO_2-N) and Nitrate nitrogen (NO_3-N) were measured using standard procedures in each system.

Results: The results showeda reduction in the nutrient concentration in all three systems after 30 days experiment. Tomato showed a slight reduction than other two in the case of NH_4-N ammonium nitrogen while the ladies finger had the lowest value in the case of NO_3-N and the NO_2-N concentration was fluctuating with all the three.

Conclusions: The study proved that different plants have a varying role in aquaponics in the scenario of water quality maintenance. The nutrient requirement, absorption pattern, etc. is to be optimised per plantfor a better efficiency for the commercial scale aquaponic systems.

Keywords: Inorganic nitrogen, aquaponics, water quality

07-13

EVALUATION OF TOTAL MIXED RATIONS CONTAINING UNCONVENTIONAL FEED INGREDIENTS IN CROSSBRED CATTLE

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Background: The common feeding regimen followed by farmers from good old days was to feed their livestock with concentrate and roughage as separate allowances. This method was found to be inadequate due to limited control over the proportion of concentrate and roughage intake, the selection done by the livestock while ingesting and the unavailability of feed and fodder throughout the season. Feeding of livestock with total mixed ration (TMR) found to be beneficial since it stabilizes rumen fermentation, minimizes fermentation losses, ensures better nutrient utilization and allows incorporation of various unconventional feed ingredients while formulating rations. The objective of the study was 1) Evaluation of rumen fermentation pattern and nutrient utilization of crossbred cattle maintained on various TMRs 2) To suggest suitable total mixed ration for crossbred cattle for efficient nutrient utilization.

Methods: The study was conducted in two phases using six crossbred animals of 9- 12 months age of either sex. Phase I (control period) - A feeding trial was conducted using TMR prepared with conventional feed ingredients and green grass for a period of one month and Phase-II – Two separate feeding trials for a period of one month each were conducted using total mixed rations containing unconventional feed ingredients such as dhanwantharam thailam residue and rape seed cake. The parameters assessed were nutrient utilization and rumen fermentation parameters. The data gathered on the various parameters, in the control trial, Trial-I and Trial- II were analyzed statistically as per Snedecor and Cochran (1994) by analysis of variance (ANOVA) technique, using the software, statistical programme for social

sciences (SPSS) version 24.0.
Results: The statistical analysis revealed that the crude protein, crude fiber and ether extract digestibility were significantly ($p<0.01$) higher in TMR-I & II when compared to control TMR, whereas NFE digestibility was significantly ($p<0.01$) higher in control TMR than TMR-I & II and there were no significant difference in dry matter and organic digestibility among control TMR, TMR-I and TMR-II. The rumen fermentation parameters such as pH, rumen ammonia nitrogen, rumen trichloro acetic acid precipitable nitrogen and total nitrogen were similar among animals during control, trial I and trial II periods. The rumen acetic acid concentration of animals in control and Trial I was significantly ($P<0.05$) higher than animals maintained in Trial II, propionic acid concentration was higher ($P<0.05$) in animals maintained in Trial II but no difference between animals belonging to Trial I and II and Trial I and control trial. The rumen acetate: propionate ratio was significantly higher in animals of control trial and Trial I when compared to animals maintained in Trial II. Rumen butyric acid and total volatile fatty acids were similar in animals maintained in all the trials.
Conclusion: On thorough examination of results, it can be concluded that crossbred cows fed with TMR containing dhanwantharam thailam residues showed improved nutrient digestibility than animals fed with TMR containing rape seed cake and control TMR without any difference in rumen fermentation parameters and hence can be recommended.
Keywords: TMR, Dhanwantharam thailan residue, Nutrient digestibility, Rumen fermentation parameters and Volatile fatty acids

07-14

DEVELOPMENT OF SYNBIOTIC ICE CREAM FROM GOAT MILK

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Background: Synbiotic ice cream was developed from goat milk by using inulin as a prebiotic and *Lactobacillus plantarum* (UBLP-40) as a probiotic. The treatment mix was formulated to contain more than 10% fat, 8.6% milk solids not fat, 2% inulin, 15% sugar, 0.4% stabilizer-emulsifier combination and 0.1% *Lactobacillus plantarum*culture.
Method: Ice cream was prepared as per the procedure suggested by Akin *et al*. (2007). First step was figuring of mix. The proportionate quantity of different ingredients to meet the minimum standard for fat (ten per cent) and total solids (36 percent) as per Food Safety and Standards Act was calculated for the preparation of ice cream. Ingredients selected for the preparation of ice cream were weighed. Solid ingredients (skimmed milk powder, inulin, sugar, stabilizer and emulsifier) were mixed together and kept separately. The liquid ingredients (milk and cream) were heated with stirring.
Results: Physico-chemical, microbiological and sensory qualities of control and synbioticice cream were compared. Synbiotic ice cream showed higher whipping ability ($p<0.05$) than control. Synbiotic ice cream was superior in sensory qualities than control during 30 days of storage. There was no significant difference in fat, protein, meltdown time, weight per litre and sensory parameters.
Conclusions: Synbiotic ice cream was successfully developed from goat milk by using inulin as a prebiotic and *Lactobacillus plantarum* UBLP-40 as a probiotic. This ice cream showed higher whipping ability and superior sensory quality than control. There was no significant difference in pH, titratable acidity, total solids, fat, protein, meltdown time and weight per litre. The probiotic count could be maintained above the minimum recommended level until 30 days of storage.
Keywords: goat milk, synbiotic ice cream, *Lactobacillus plantarum*, inulin, quality evaluation

07-15

SEROPREVALENCE OF LEPTOSPIROSIS IN THRISSUR DISTRICT OF KERALA – A RETROSPECTIVE STUDY

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Background: Leptospirosis is a transmissible disease of animals and humans caused by infection with pathogenic members of the genus *Leptospira*. It is a zoonotic disease with worldwide distribution having high endemicity in Kerala. It almost affects all the domestic and wild mammals causing severe renal and hepatic damage and leads to fatal conditions if untreated. The disease is mainly associated with season and occupation and is highly prevalent in

population with poor sanitary conditions. The present study deals with incidence of leptospirosis in Thrissur district of Kerala.

Method: Diagnosis of leptospirosis is based on serological and/or molecular detection methods. The present study was conducted to analyse the incidence of leptospirosis in humans and animals in Thrissur district over a period of one year (Aug 2017 – Aug 2018), based on the detection of anti-leptospiral antibodies using Microscopic Agglutination Test (MAT).

Results: A total of 324 serum samples were analysed in the study. Among these samples, 73 samples were found positive with a percentage of 22.53 per cent. The per cent positivity in dogs, cats, cattle, goats and humans are 17.28, 0.31, 0.31, 0.62 and 4.01 per cent respectively. It was also found that there is a noticeable increase in the incidence of clinical cases of leptospirosis during the monsoon period.

Conclusion: From this study, we concluded that there is a high prevalence of leptospirosis among both the human and animal population. For effective prevention of the disease, one must follow the proper sanitation and routine vaccination of pets and proper waste disposal to control the rodent population, that place a major role in transmission of leptospirosis.

Keywords: Leptospirosis, Zoonosis, Retrospective study

07-16

MOLECULAR DETECTION OF INFECTIOUS BURSAL DISEASE VIRUS (IBDV) IN KERALA

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Background: Infectious bursal disease (IBD) is one of the highly pathogenic immunosuppressive viral diseases of poultry. The disease causes heavy economic losses to the poultry farmers throughout the world by causing heavy mortality and increasing the susceptibility to other diseases. Infectious bursal disease virus (IBDV) belongs to the family *Birnaviridae.* Infectious Bursal Disease (IBD) is a highly contagious disease of young chicken caused by IBDV, characterized by immuno suppression and mortality generally at 2 to 6 weeks of age. Two serotypes of the virus are recognized, of which serotype 1 viruses are pathogenic to chickens and are classified into six subtypes ranges from mild to very virulent. But the serotype 2 viruses are non-pathogenic.This study was conducted with the aim of molecular detection of the Infectious Bursal Disease Virus (IBDV) strains from poultry in Kerala.

Method: A total of 27 IBD suspected samples (bursa of fabricius) was collected. Total RNA was isolated from the tissue samples using Trizol reagent (Invitrogen, USA) as per the manufacturer's protocol. The extracted RNA was treated with dimethylsulphoxide (DMSO) before synthesis of Complementary DNA (cDNA).cDNAwas synthesized from the RNA using random hexamers utilizing Revert AidFirst Strand cDNA Synthesis Kit (Thermo Scientific, USA) as per the manufacturer's protocol. The samples were tested for presence of IBDV by reverse transcription polymerase chain reaction (RT-PCR) using VP2 gene specific primers.

Result: It was observed that eighteen (66.66 percent) samples were positive for IBDV.

Conclusions: The result from this study indicates that VP2 gene amplification using RT-PCR is rapid and sensitive for IBDV detection. This study will add to the scientific knowledge of the viruses circulating in poultry in Kerala. This will also help in early detection of IBD and taking effective control measures which in turn will reduce economic loss to the poultry farmers.

Key words: Poultry, Infectious bursal disease virus (IBDV), VP2 gene, Reverse transcriptase polymerase chain reaction (RT-PCR)

07-17

MOLECULAR DETECTION OF ROTAVIRUS OF PIGS IN KERALA

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Background: One of the important health problems in suckling and recently weaned piglets is neonatal diarrhoea. Rotaviruses belonging to Group A are one of the most frequently detected viral agents associated with diarrhoea in swine. Group C rotavirus can be considered as a common enteric pathogen in both humans and animals and would be an emerging zoonotic infection in humans. Rotaviruses are classified under the *Reoviridae*family and the *Rotavirus* genus, which includes atleast seven serogroups (groups A to G). Rotaviruses have a genome of 11 segments of double -stranded RNA with genes that encode six structural viral proteins (VP) and six nonstructural (NS) proteins. This study was conducted with the objective of molecular detection of the rotavirus of pigs in Kerala.
Method: A total of 15 diarrhoeicfaecal samples (in virus transport medium) were collected from piglets in organized farms in Wayanad, Thrissur, and Palakkad districts of Kerala. Viral RNA was extracted using TRIzol method (Invitrogen) according to manufacturer's protocol. Complementary DNA (cDNA) was synthesized from the RNA using randomhexamers utilizing RevertAid H Minus First Strand cDNA Synthesis Kit (Thermo Scientific, USA) as per the manufacturer's protocol. Reverse transcriptase polymerase chain reaction (RT-PCR) was used for rapid detection of rotavirus in the sample employing VP4 gene and VP6 gene specific primers.
Result: A total of 3 (20 per cent) diarrhoeicfaecal samples were positive for VP4 and VP6.
Conclusions: The result from this study indicates that VP4 and VP6 gene amplification using RT-PCR is rapid and sensitive for rotavirus detection. Hence, the detection of these viruses will add to the scientific knowledge of the viruses circulating in pigs in Kerala and effective control measures like strict biosecurity measures, restriction of animal movement, vehicle sanitation *etc*. which in turn will reduce economic loss to the swine farmers.
Key words: Rotavirus, VP4 gene, VP6 gene, Reverse transcriptase polymerase chain reaction (RT-PCR)

07-18

A PRELIMINARY EVALUATION OF *SAUROPUS ANDROGYNOUS* (L.) MERRILL LEAF MEAL AS A PARTIAL REPLACEMENT OF FISH MEAL IN THE DIETS FOR PACIFIC WHITE SHRIMP, *LITOPENAEUS VANNAMEI (*BOONE, 1931*)*

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Background: Fish meal (FM) is the most preferred protein source for aquafeeds because of its nutritional superiority. However, limited availability and high demand make fish meal a costly ingredient. One factor considered to reduce shrimp production costs and increase producers profitability, is the production of feeds with reduced amount of fish meal by incorporating high quality plant protein sources, without compromising the nutritional quality of the feed.
Method: Eight isontrogenous diets (30% crude protein) were prepared to contain different concentration of *Sauropus androgynous* leaf meal (SALM) as replacement to fish meal (FM) at various levels (0% - control, 10%, 20%, 30%, 40%, 50%, 60% and 70%). Post larvae of Pacific white shrimp (PL - 15; Initial weight, 1.4±0.14 mg and Initial length, 7±0.00 mm) were stocked in 100 L plastic tubs, at a stocking density of 5 lakh / hectare, i.e, 50 shrimps/m^2, for a period of 90 days. For each diet, triplicate of tanks were maintained. The growth performance was assessed by studying the parameters such as average weight gain (AWG), specific growth rates (SGR), survival rate (SR %), performance index (PI), feed conversion ratio (FCR), feed conversion efficiency (FCE), protein efficiency ratio (PER) and protein content of shrimp carcass.
Results: The AWG and SGR were comparatively lower at higher levels of fish meal replacement (60% and 70%). SR% was not significantly different among treatments. The PI showed no significant difference among treatments, with best PI observed in organisms offered diet with 40% fish meal replacement. All the feed utilization parameters, FCR, FCE and PER, were either improved or similar to the control diet. The protein content of shrimp carcass was significantly

lower at higher level (70%) of FM replacement.
Conclusions: The results suggest that up to a 40% of fishmeal can be replaced with *S.androgynous* leaf meal in diets for *L. vannamei* without adversely affecting the growth of the shrimps.
Keywords: *Litopenaeus vannamei*, *Sauropus androgynous* leaf meal, specific growth rates, performance index, survival rate, protein efficiency ratio, feed conversion ratio, feed conversion efficiency .

07-19

EFFECT OF PHYTOADDITIVE COMBINATIONS ON CONTROL OF *MUSCA DOMESTICA* POPULATION IN POULTRY SHED

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Background: *Musca domestica* (House fly) nuisance in poultry farm and residents located near the poultry shed. House fly is a carrier for bacteria, virus and fungai and spreads many diseases to both humans and animals. Many commercial insecticides and fly repellents are used to control the fly problems in livestock sector and human dwelling areas also. Commercial insecticides lead to the presence of residual particles in both egg and meat and also develop resistance against the particular insecticides. Herbal based preparations didn't produce any undesirable influence on both egg and meat and ensure the human health.
Method: The fly trap filled with Rice bran (80%), Jaggery (10%), Eucalyptus oil (20ml) along with 10% Tobacco powder (*Nicotiana tabacum*) and 10% Vasambu powder *(Acorus calamus*) and 10% *Custard apple* seed powder (*Annona squamosa*) and kept in ground floor near the poultry shed. During experiment time, end of the twelve hours period, quantum of trapped house flies were assessed qualitatively.
Results: No significant difference was observed in control areas. The significant difference were observed in Vasambu *(Acorus calamus*) incorporated groups ($P<0.05$). Custard apple (*Annona squamosa*) incorporated group control the house fly population in better way, when compared to Tobacco powder (*Nicotiana tabacum)* incorporated group and control groups.
Conclusions: The vasambu powder effectively repels the housefly in poultry shed. The custard apple and tobacco powder also repels the house fly in minimum quantity.
Keywords: Phytoadditives, house fly, Vasambu, Tobacco, Custard apple

07-20

OCCURRENCE OF INTESTINAL LESIONS IN CHICKENS – A ONE - YEAR PROSPECTIVE STUDY IN PURE LINE CHICKENS

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Background: Chicken farming is one of the rapidly growing sectors in India which provides employment and most affordable protein rich foodto millions. Chicken rearing will be suitable income generating farming even for small land holding people as in Kerala and will be helpful for people under financial distress like those affected with natural calamity. For profit,good feed conversion ratio is important which in turn require good intestinal health of chicken. Prior knowledge on different intestinal affections will be of great use in maintaining intestinal health. Hence, this study aimed to ascertain the occurrence of various intestinal affections in naturally dead chickens.
Methods: Post-mortem examination of 17978 chicken carcasses of 15 lines and 304 flocks including that of layer(white leghorn), broiler(PB1, PB2, Krishibro,CB), synthetic (PD1, PD2, PD3) and desi (Aseel, Nicobari and Ghagus) breeds were examined during the period of one year at ICAR-Directorate of Poultry Research, Hyderabad. After detailed gross examination, tissues of intestines with lesions collected for histopathology and for screening of microorganisms. Enteric viruses such as Chicken parvovirus(ChPV), Chicken Astrovirus(CAstV), Avian rotavirus(AvRtV), Avian nephritisvirus(ANV), Fowl Adenovirus-1 (FAdV-1), Infectious bronchitis virus (IBV), oncogenic viruses such as Marek's disease (MDV) and Avian leucosisvirus (ALV), necrosis inducing bacteria such as Clostridium perfringens

and *Clostridium colinum* and protozoa *Eimeria* sp were screened using polymerised chain reaction (PCR) with species specific primers.

Results: Gross intestinal lesions were noticed in 1405 (7.82%) out of 17,978 birds examined.Intestinal lesions could be grossly classified in to haemorrhagic enteritis, catarrhal enteritis, necrotic enteritis, neoplastic lesions, and miscellaneous conditionsDesi breeds that were consideredto be more resistant to infections, also affected with various intestinal lesions. No significant difference observed between different breeds in intestinal affections.Catarrhal enteritis occurred more in chick age group while neoplastic intestinal affections were restricted to adults only. All viruses except IBV was identified in intestines affected with catarrhal enteritis. ChPV affection found alone in chicks affected with runting and stunting syndrome. Coccidiosis was by infestation of E.tenella and E. necatrix. Clostridium colinum, not common in chicken, was associated with necrotic enteritis. MDV and ALV were identified as cause of the intestinal tumours, where occurrence of MDV was more.

Conclusion: Intestinal affections are a major problem in chicken rearing. Multiple viral infections play a crucial role in intestinal diseases which may be a taken to considetation in good rearing practices. MDV still creates problems even after vaccination.

Keywords: Chicken, intestinal lesions, enteric viruses

07-21

OCCURRENCE OF ESBL *ESCHERICHIA COLI* FROM LAYER BIRDS OF ORGANIZED POULTRY FARM IN WAYANAD DISTRICT, KERALA

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Background: Antibiotic resistance in poultry industry remains a major public health threat, because of its irrational use in feed to improve feed efficiency. Of late, the extended spectrum beta-lactamase (ESBL) pattern among several public health pathogens is reported to increase in an unprecedented manner within the poultry industry. Antibiotic resistant pathogens from layers may enter the food chain primarily through the eggs and hence, the present study was envisaged with an objective to study the occurrence of ESBL *E. coli* recovered from layer birds belonging to an organised poultry farm in Wayanad district of Kerala using phenotypic and genotypic assays.

Methods: Thecloacalswabs (n= 30) and egg samples (surface wash, albumen and yolk; n= 15 each) were collected aseptically from cross-bred layer birds of more than 32 weeks of age. The samples were subjected to the isolation and identification of *E. coli* following standard protocol. The recovered *E. coli*isolates were then confirmed by PCR assay employing *uidA*gene. Further, antibiotic susceptibility testing for the confirmed *E. coli*isolates was carried out using phenotypic double disc testing (Ceftazidime and Cefotaxime with/without Clavulanic acid) as well as PCR assays employing ESBL genes (*bla*CTX-M, *bla*SHV and*bla*TEM).

Results: Out of the 26 isolates of *E. coli*recovered from cloacal swabs, 24 were confirmed positive by *uidA* using PCR assay. However, out of 14, 2 and 1 *E. coli*recovered from egg surface washes, albumin and yolk respectively, 10, 2 and 1 tested positive for *uidA* gene from the aforesaid samples. Moreover, out of 26, 14, 2 and 1 *E. coli*recovered from cloacal swabs, egg surface washes, albumin and yolk respectively of the confirmed *E. coli* isolates 12,8,1,1 were found ESBL by double disc testing from cloacal swabs, egg surface washes, albumen and yolk respectively. Besides, a diverse genotypic pattern was observed by PCR assays employing ESBL genes (*bla*CTX-M, *bla*SHV and*bla*TEM).

Conclusion: From the present study, it is imperative that the ESBL genes are circulating at an alarming rate within thepoultry industry and warrants strict vigil.Hence, it necessitates further characterization and moleculartyping using more number of samplesin a 'One Health' approach with an ultimate objective to study its transmission dynamics and further to control its occurrence.

Keywords: ESBL, *Escherichia coli*, layer, PCR.

07-22

MICROPLASTICS IN THE GUT CONTENT OF *PLANILIZA MACROLEPIS*, FROM POONTHURA ESTUARY: BEFORE AND AFTER THE CYCLONE OCKHI

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Background: Inflow of microplastics from fresh water systems to the Ocean is a recently identified environmental issue. Microplastics may enter the food chain when ingested by benthic and demersal fauna. Ockhi, the first severe cyclonic storm happened in the Indian Ocean for the last 40 years, suspected to have physical influence in the distribution of microplastics. Poonthura estuary was one among the sites in the Kerala coast most seriously hit by the cyclone Ockhi. Main rivers through Trivandrum also discharge to ocean through Poonthura estuary. The present study tried to address the possibilities of the presence, abundance and types of microplastics in the gut content of *Planiliza macrolepis* fish in Poonthura estuary before and after the cyclone Ockhi.
Methods: *Planiliza macrolepis* is an indigenous, detritus feeder fish widely marketed in the study area for consumption was selected purposively. Samples were collected one month before and one month after the cyclone Ockhi. Morphometric studies, followed by the Microplastic studies were conducted by following standard protocols of Avio et al., (2015). The separated microplastics were observed under a microscope and sorted and total number of each type of microplastics was counted. Thermo Fisher Scientific Nicolet iS50 FT-IR Spectrophotometer was used for Polymer identification of the abundant type microplastic.
Results: Length, breadth, body weight and weight of digestive tracts in post Ockhi fish samples increased in all the samples studied. The weight of microplastics +other substances and the weight of microplastics alone showed an increasing trend in post Ockhi samples. Threefold rise in the abundance of microplastics in post Ockhi fish samples compared to that of the Pre Ockhi. This pointed to the physical influence of Ockhi for the distribution of microplastics. The study could identify microfiber, microfragment, microfilm and micropellet types of microplastics in fish samples, which is alarming. The abundant type was microfiber, while foam type was totally absent. FTIR spectra studies revealed that the polymer type of the abundant microfiber is the polyamide Nylon.
Conclusions: Pre and Post Ockhi samples showed the presence of microplastics in fish. Post Ockhi samples showed higher microplastic abundance and weight compared to Pre Ockhi samples. This revealed that the cyclone Ockhi has a significant physical influence in the distribution of microplastics in the study site. Major types of microplastics identified include microfiber, micropellet, microfragment and microfilm. Abundant type is microfiber. Microfoam is totally absent. Presence of microplastics in fish body is alarming. FTIR studies revealed that the Polymer type of the abundant type microfiber is Nylon. The main sources of Nylon in aquatic systems are synthetic clothing. Microfibers get released into the drains while washing the synthetic clothes. Hence, along with plastic carry bag banning and green protocols, there is a need for sensitizing the society to abstain from the excessive use of clothes made of synthetic fibres.
Keywords: Estuary, Microfiber, Microplastics, Nylon, Ockhi

07-23

IMPACT OF FREQUENCY OF TRANS - VAGINAL OOCYTE RECOVERY AND REPEAT BREEDING ON YIELD AND QUALITY OF OOCYTES

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Background: Repeat breeding is one of the most common causes of infertility in cattle; failure of fertilization and early embryonic mortality are the two major causes of repeat breeding. Transvaginal oocyte recovery (TVOR) is a non-invasive technique for harvesting oocytes from live animals.The present research work was designed to assess the effect of reproductive status (normal and repeat breeding) and the frequency of TVOR on oocyte yield and quality in crossbred cattle of Kerala.
Method: A total of 12 normal and 12 repeat breeding crossbred cows were selected for the study and were subjected to TVOR for a period of two months at once weekly or twice weekly intervals. All the visible follicles above 3 mm

diameter were aspirated.Quality of oocytes was assessed based on the number of layers of cumulus cells and characters of ooplasm. Nuclear maturation was assessed using Hoechst 33342 stain and oocyte viability by Fluorescein Diacetate (FDA) stain.

Results: There was a significant increase in the number of follicles aspirated, number of oocytes retrieved, yield of culture grade, matured, fertilized and cleaved oocytes from twice weekly TVOR when compared to once weekly collection. However, no association was observed between frequency of collection and oocyte quality. A significantly higher number of oocytes retrieved, yield of culture grade, matured, fertilized and cleaved oocytes was observed in normal breeders when compared to repeat breeders. Oocyte quality and viability was also found to be higher in normal breeders.

Conclusion: It can be concluded from the present investigation that twice weekly TVOR provides maximum yield of oocytes than once weekly TVOR. Also oocyte yield, quality and viability in normal breedersare significantlyhigher than repeat breeders.

Keywords: Transvaginal Oocyte Recovery, TVOR, Repeat breeding, Oocyte quality

07-24

OCCURRENCE OF *CAMPYLOBACTER* SPP. IN A PIG FARM IN THRISSUR DISTRICT

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Background: *Campylobacter* is a well recognized leading cause of bacterial foodborne diarrheoal disease worldwide. An ubiquitous organism, this zoonotic pathogen is frequently isolated from poultry, animal and environmental samples. *Campylobacter jejuni* and *Campylobacter coli* are recognized as the most frequent causes of acute diarrheal diseases in humans with symptoms usually ranging from mild to serious infections in children and the elderly, and long-term sequels such as Guillain-Barre syndrome, reactive arthritis and irritable bowel syndrome. Despite being an important zoonotic disease, the prevalence of Campylobacter is largely unknown in many parts of India.

Method: A total of 25 samples, comprising of 20 rectal swabs, fresh faecal samples from apparently healthy animals, two soil and one water sample were collected from a private pig farm in Erumapetty in Thrissur district. Of the 20 rectal swabs collected, 15 were from adult pigs including two boars, and five were from piglets. Swabs were collected aseptically using Cary-Blair medium (Himedia); and water (one sample), soil (two samples) and faecal samples (three samples), including two diarrhoeic samples were collected in suitable aseptic containers and transported immediately to the laboratory under chilled conditions. Samples were processed for isolation by culture and multiplex PCR for species confirmation. Bacteriological culture was performed in accordance with OIE (2017) to detect *Campylobacter* spp. using blood free enrichment broth and modified charcoal cefoperazone deoxycholate selective agar plates (mCCDA) and incubated at 42°C for 48 h. *Campylobacter*-like colonies were purified and identified to species level by multiplex Polymerase chain reaction (PCR). DNA isolated from both the enrichment broth after 48 h and from colony cultures were subjected to multiplex PCR.

Results: Based on isolation by conventional culture method, the overall occurrence rate of *Campylobacter* spp. from rectal swabs was 90% (18/20). Direct PCR assay showed the overall occurrence rate of *Campylobacter* spp. to be 95% (19/20) from rectal swabs. While most of the isolates were identified as mixed infections with both species (*C.jejuni* and *C. coli*), a few *C. coli* were also seen. The organism is a cytochrome oxidase positive, microaerophilic, curved Gram-negative rod exhibiting corkscrew motility and is carried in the intestine of many wild and domestic animals, particularly avian species including poultry. Thermophilic Campylobacter spp. have been isolated from the intestinal tracts of a wide variety of healthy and diseased warm-blooded animals, including poultry, swine, and captive and free-range wild animals. Campylobacters are much more sensitive to hostile conditions than other major food pathogens. Thirteen of the 15 rectal swabs from adult animals including the two boar samples and all the 5 piglet samples were found to be positive by the conventional culture technique. All the 20 rectal swabs following enrichment except one, including the five piglet rectal samples were positive for 16SrRNA by PCR. Thirteen of the 20 rectal swab samples were positive by PCR for the *C. jejuni* specific mapA, *C. coli* specific ceuE and virulence specific cadF genes, indicating co-infection with both the species (*C. jejuni* and *C. coli*), while 1/20 samples had ceuE and mapA genes only. Five of the 20 samples were positive for the ceuE and the cadF genes. All samples were positive for the colony PCR. Of the three faecal samples, only one of the diarrhoeic samples was positive by culture method, while both diarrhoeic samples were positive for *C. coli* by PCR. The water sample was negative for Campylobacter. Low-level of biosecurity, mixing of feed with chicken waste as was observed in the farm and mixing of age groups could be attributed to be the reasons for the higher incidence of Campylobacter in the farm.

Conclusions: The overall occurrence of *Campylobacter* in pigs (95 %) in this study was higher. It is predicted that

intensification of animal production systems and increased urbanization will result in a further increase in the incidence of this infection and a change in the epidemiology in animals and humans. To reduce the risk of *Campylobacter* infections among consumers, control measures and intervention strategies should be adopted to reduce prevalence of *Campylobacter* in foods and associated environment. Future interventions targeting a reduction in the prevalence of *Campylobacter* in farmed animal populations worldwide will become increasingly important.

Keywords: Campylobacter, Occurrence, Pigs, PCR

07-25

VACCINATION FAILURE AND OUTBREAK OF INFECTIOUS BURSAL DISEASE IN AN ORGANIZED POULTRY FARM

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Background: Infectious bursal disease (IBD) is a highly contagious acute viral diseases of young birds which causes immunosuppression by damaging bursa of Fabricius and causes significant economic losses in poultry industry. IBD can be prevented by regular vaccination strategy, but sometimes vaccination failure occurs and results in outbreak of disease in the vaccinated birds.

Materials: Sixty birds were presented to the Department of Veterinary Pathology from the University Poultry and Duck Farm, Mannuthyfor postmortem with the history of huge mortality of about 400 birds after 28th day booster dose of IBD vaccine during February, 2018. Detailed postmortem was done and gross lesions were recorded. Tissues showing gross lesions were collected in 10% neutral buffered formalin for histopathological examination.Pooled tissue samples of bursa of Fabricius, spleen and liver from birds were collected for molecular analysis.

Results: On detailed postmortem examination ninety percent of birds showed enlarged,swollen bursa of Fabricius and thigh and breast muscle haemorrhages, some of the birds showed haemorrhages in theproventriculus-gizzard junction. Microscopically bursa revealed shrinkage of follicles, lymphocytic depletion in follicles, interfollicular connective tissue proliferation.Pooled tissue samples of bursa, spleen and liver from the dead birds were screened by PCR for 480 bp of VP2 gene of infectious bursal disease virus. Samples were positive for predicted amplicon size of 480 bp in 1.5 per cent agarose gel of virus.

Conclusion: Based on the lesions and molecular confirmation,vaccination failure and subsequent disease occurrence attributed to the huge mortality of the birds.Vaccination failure might be due to single or combination of factors like improper administration of vaccine virus, antigenic differences among the different strains,insufficient potency of the live attenuated vaccine virus, interference between the residual maternally derived antibodies and the vaccine virus etc. The economic impact of the disease in poultry farming is due to immunosuppression leading to vaccination failure and death due to secondary infections.

Keywords: Infectious Bursal Disease, vaccination failure, immunosuppression.

07-26

A MORPHOMETRIC STUDY OF SPECIES OF *AMBLYPHARYNGODON* BLEEKER, 1860 (TELEOSTEI: CYPRINIFORMES: CYPRINIDAE) FROM THE RIVERS OF WESTERN GHATS, KERALA.

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Background: A perusal of literature on genus *Amblypharyngodon* clearly shows that the distinguishing characters of the different species are rather confusing because of their close resemblance and over lapping morphometric characteristics. The present work, therefore, is aimed at providing some basic information about the taxonomy of the genus, based on landmark based morphometrics involving three population of *Amblypharyngodon* from Pathanamthitta, Kottayam (Vaikom) and Thrissur considered as *Amblypharyngodon* species1, species2 and species3 respectively.

Method: Altogether 48 morphological characters, 33 body characters and 15 head characters were taken from each specimen of fish. Principal Component Analysis was performed involving the data on body and head characters of the three species of *Amblypharyngodon*. All the analysis were carried out using the statistical package PAST (version 2.17C).

Results: A closer examination of the analysed data as well as the study of the scatter plot, clearly indicate the discrimination of the three species based on some specific morphometric characters.
A comparison of morphological data taken from the specimens of *Amblypharyngodon* from Pathanamthitta and Thrissur, revealed close resemblance in many characters with those of *A.chakaiensis* (=*A.melettinus*), whereas the specimens from Vaikom shared some characters with *A.microlepis*.
Conclusion: The present observations based purely on traditional and truss morphometric characters reveals that the specimens of *Amblypharyngodon* from Pathanamthitta and Thrissur represent 2 populations of *A.melettinus* and those from Vaikom could be treated as a distinct population of *A.microlepis*.
Keywords: *A.melettinus, A.microlepis*, *A.chakaiensis,* Morphometrics and PCA

07-27

BIOFILM DEVELOPMENT ON MUNDACKAL BEACH, KOLLAM, KERALA

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Background: Marine Biofouling is an undesirable accumulation of microorganisms, plants and animals on submerged substrates. Biofilms play an important role in the settlement of macro algal spores and larval forms results in Biofouling. Understanding the biofilm communities are very useful in the development of marine antifouling techniques.
Method: For the analysis of microfoulers on the hull of vessel HANSITA, five randomly placed quadrates (20x 20cm) were taken from the hull of the dredging vessel during monsoon, post monsoon and pre monsoon period.. The microfoulers were collected from the selected sites of hull and removed with the help of nylon brush. Water samples were collected from the study area and analyzed the physico-chemical parameters like temperature , pH , dissolved oxygen , salinity as per the methods of Grasshoff et al, 1983.To study the community structure diversity indices like species richness, evenness, Simpson dominance, Margalef's richness, Shannon diversity index were calculated by using PAST 3.09 Software.
Result: A total of 16 taxa of microfoulers were collected from the hull comprising, Ochrophyta, Dinoflagellata and larval forms. *Conscinodiscus sp.* constitutes the highest and lowest by *Thalassionema sp*. number throughout the year .Larval forms were observed only in monsoon season. Temperature (29.5), pH (8.2), Salinity ($35^0/_{00}$) showed highest value during pre monsoon. Dissolved oxygen values varied from 3.81ml to 4.9 ml. Shannon Weiner diversity was maximum value (2.66) during pre monsoon.
Conclusion: The faunal elements exhibited distinct seasonal trends in abundance with fluctuating temperature, dissolved oxygen and salinity. Simpson's Dominance index showed a few organisms were dominant. Species richness, Simpson dominance, evenness, Margalef's index and Shannon- Wiener index was higher during pre monsoon and lower on monsoon period. The species abundance was higher during post monsoon period. Micro fouling also initiates the settlement of larvae of invertebrates and spores of macro algae.
Keywords: Bio film, micro fouling, diversity indices

07-28

LEPTOSPIROSIS IN CATTLE IN FLOOD AFFECTED AREA IN THRISSUR DISTRICT – A CASE REPORT

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The present study deals with the isolation of *Leptospira interrogans* serovar Icterohaemorrhagiae from a case of mastitis in a cow from a flood affected area in Thrissur. A milk sample was brought to the Department of Veterinary Microbiology, College of Veterinary and Animal Sciences, Mannuthy from a veterinary hospital in Varakkara, Thrissur for culture and sensitivity testing. The sample was blood mixed and rose in colour. This can occur in case of leptospirosis and hence, subjected to isolation trial. It was inoculated into EMJH semi solid medium and liquid medium at 37°C. Serum and urine sample was also collected. The serum sample was subjected to Microscopic Agglutination

Test (Faine *et al.,* 1999). From the urine sample, DNA was extracted and Polymerase Chain Reaction using *lipl32* gene specific primers were done. The sample was found to be positive for antibodies against *Leptospira interrogans* serovar Icterohaemorrhagiae in MAT and from urine, isolation of could be made which was evident by the formation of dinger's ring. An amplicon of 756 bp indicating the lipl32 gene could be observed in the urine sample. The study indicates the significance of prompt diagnosis of the dreadful zoonosis in milch animals which can be excreted through milk and urine from which human beings may get infection.

07-29

EFFECTS OF SALINITY AND WATER QUALITY PARAMETERS ON THE BREEDING AND LARVA REARING OF BLACK MOLLY *POECILIA SPHENOPS*

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Background: The objective of this study was to investigate the effect of salinities and water quality parameters on (i) the breeding and fry production of black molly (ii) the body weight, total length increment and percentage of survival of black molly in laboratory condition.
Method: Black mollies were left for two weeks to spawn at different salinity regimes (0, 3 and 6 ppt). Newly hatched fry from the breeding experiment were placed in 10 L experimental aquaria with three different salinity regimes (0, 3 and 6 ppt) at stocking density rate of 2 fry per litre.Ten fry were sampled randomly at every two weeks interval for their growth performance and also for the percentage of survival on daily basis. Water quality parameters were measured once a week.
Results: There were no significant differences ($p > 0.05$) in the number of fry production at water salinity of 0, 3 and 6 ppt. The highest number of fry production was at 6 ppt followed by 0 and 3 ppt. Body weight increment for black molly fry at water salinity of 6 ppt was the highest (0.205 g) followed by 3 (0.203 g) and 0 (0.200 g) ppt.Fry reared in 6 ppt recorded the highest (2.77 cm) total length increment as compared to 3 (2.70 cm) and 0 (2.57 cm) ppt.Percentages of survival for black molly fry ranged between 84 to 100%.
Conclusion: Black molly can breed successfully in salinity 6 ppt. However, salinity has no significant influences on the number of fry production. The growth performance and percentage of survival of black molly fry are much better when cultured at 3 and 6 ppt. The information obtained from the present study would be useful for better management and commercial production of this fish species in captivity.
Keywords: Black molly, Breeding performance, Growth, Survival, Fry

07-30

CANINE MAMMARY TUMOUR: HISTOPATHOLOGICAL VARIANTS

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Back ground: Histopathology is considered as the gold standard for diagnosis of canine mammary tumours. Like human breast cancer, mammary tumour is a common occurrence in dogs. Surgical removal is the most commonly adopted approach for the treatment of canine mammary tumour. Nevertheless, histopathological diagnosis of the the tumour is inevitable to assess the malignancy of the tumour and to adopt further course of treatment.
Method: Samples from dogs having tumour growths, presented at Kerala Veterinary and Animal Science University Veterinary hospitals at Mannuthy and Kokkalai were collected in 10% neutral buffered formalin (10% NBF). After fixing in 10% NBF for 24 hours, the tissues were cut into pieces of 2mm thickness and were processed and embedded in paraffin. Sections of 4-5µ thickness were cut from the paraffin blocks and were stained with haematoxylin and eosin and observed under the light microscope for histopathological changes.
Results: Histopathological examination of the stained tissue sections revealed that out of the thirteen tumour tissues, two were benign and 11 were malignant. Majority of the tumours were malignant which had higher mitotic figures and significant nuclear and cellular pleomorphism. Benign tumours were diagnosed as fibroadenoma and the malignant variants included ductal carcinoma, solid carcinoma and mixed mammary tumour. In the present study, three cases of comedocarcinoma, characterized by the presence of necrotic area in the centre of neoplastic aggregates, are also

reported which has poor prognosis.
Conclusion: The work establishes the importance of histopathology for early diagnosis and classification of canine mammary tumours which is a key to the success of clinical therapy as modalities of treatment may vary with the type and stage or grade of the tumour.
Keywords: histopathology, mammary tumour, malignant, comedocarcinoma

08 - HEALTH SCIENCE

08- 01

DECIPHERING THE MOLECULAR EVENTS REGULATED BY TRYPTANTHRIN IN MELANOMA

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Background: Traditional Indian medicine formulations against various skin ailments such as psoriasis, eczema and dermatitis use different parts of the plant *Wrightia tinctoria* as a main ingredient. Studies conducted in our lab have shown that DW-F5, an active fraction of dichloromethane extract of the leaves of *Wrightia tinctoria* exhibits exceptional cytotoxicity towards malignant melanoma both *in vitro* and *in vivo.* Further characterization has led to the identification of tryptanthrin as one of the active components of DW-F5.
Methods: MTT assay, Western blotting, Transfection, *In vivo* models
Results: Tryptanthrin, induces apoptosis in melanoma cell lines while being non-toxic towards normal immortalized melanocytes. The cytotoxicity of tryptanthrin in different melanoma cell lines were in concordance with the expression levels of MITF-M protein, where MITF-M protein is the master regulator in melanoma progression. Tryptanthrin successfully inhibited the activation of MITF-M by inhibiting the phosphorylation at serine 73 residue. *In vivo* studies carried out in NOD-SCID mice showed that tryptanthrin causes significant tumor reduction and invasion.
Conclusion: Our *in vitro* and *in vivo* results indicate that tryptanthrin is a potential chemotherapeutic agent against malignant melanoma which mediates its anti-melanoma activity by inhibiting the activation of MITF-M, the master regulator of melanomagenesis and progression.
Keywords: Melanoma, Tryptanthrin, MITF-M

08- 02

ALGINATE DIALDEHYDE - GELATIN HYDROGEL SUBSTITUTE FOR MENISCAL REPAIR – A BOON TO ATHLETES AND LABOURERS

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Background: Meniscal tears are the most common knee injuries found among athletes and people in labor-intensive occupations. Medial meniscal tear occurs more frequently than the lateral meniscal tear and meniscectomy is an optional therapy but ultimately results in cartilage degradation. Hence alternate approaches are becoming imperative for this unmet clinical need. In this work alginate dialdehyde (ADA) - gelatin (G) - (ADA-G) hydrogel scaffoldhas been proposed as a substitute to assist the repair of torn meniscus under trauma conditions in perspective of clinicalorthopedic applications.
Methods: Alginate dialdehyde was prepared by periodate oxidation of sodium alginate. An injectable formulation of ADA-G hydrogel with a working time of 4 minutes was prepared by reacting 15% aqueous solution of ADA and 20%

aqueous solution of G (15ADA20G) in the presence of borax as a catalyst. This hydrogel was characterized by Fourier Transform Infrared (FTIR) spectroscopy, Scanning Electron Microscopy (SEM), andMicro-Computed Tomography (Micro-CT). Cytocompatibility of fibrochondrocytes-seededon ADA-G hydrogel was evaluated by live dead assay and actin staining. Tissue integration *ex vivo*with ADA-G in the pig meniscus tear explant was observed by SEM and simultaneously with paraffin sections stainedwith safranin O/fast green staining.

Results: FTIR depicted the characteristic aldehyde peak at 2925 cm^{-1} and hydrogel with peaks at 1604 & 1544 cm^{-1} suggesting the formation of Schi□'s base. Swelling at 37^0C in PBS showed that 15ADA20G possessed handling and swelling properties. The developed injectable ADA-G hydrogelexhibited comparable characteristics of swelling (85%), porosity(36-60µ) with an average pore size of 48µmand mechanical properties (270KPa). Phase contrast images, SEM micrographs and actin staining depicted adhesion, profuse proliferation,and distribution of fibrochondrocytes onthe 3D hydrogel supporting its cytocompatibility.Application of hydrogel at the pig meniscal tear*ex vivo*showed good integration with the host meniscal tissue by SEM.Further, it is evident fromhistologythat the hydrogel remained in the vicinity of the meniscus tissue in close proximity to the teareven after 3 days in culture.

Conclusion: The developed self-healing, degradable and injectable 15ADA20G hydrogel favored the growth of fibrochondrocytes on the non-cytotoxic hydrogel niche.The *ex vivo*application of 15ADA20G at the pig meniscus tear explantindicated structural support and stability tothe delicatemeniscal tear. The making of the hydrogel is simple, economical (MADE IN INDIA CONCEPT) and easily applicable in the health care system. This may serve as a suitable biomaterial to support, enable and mend sutured menisci tears in Orthopaedic reconstructive surgeries toprevent further tears and hasten rehabilitation. Future studies may involve the proof of concept of the 15ADA20G hydrogel at the rabbit meniscal tear defect model inreal situation – its safety and efficacy.

Clinical Relevance: To develop a surgeon-friendly meniscal substitute to repair meniscal tears - an unmet clinical need of the hour.

Keywords: meniscal substitute, hydrogel, fibrochondrocytes, cytocompatibleand meniscalrepair

08- 03

DEVELOPMENT OF A NOVEL HUMAN TISSUE DERIVED SKIN SUBSTITUTE AND PRE CLINICAL EVALUATION IN ANIMAL WOUND MODELS

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Background: Large sized acute and chronic wound regeneration is a major concern worldwide. The present study describes the development and preclinical evaluation of an absorbable skin substitute/graft. The components chosen are completely human tissue derived and comprises of decellularised amniotic membrane (AM), pharmacopoeia grade fibrin (FIB) and umbilical cord derived hyaluronic acid (HA) having specific roles for wound healing and skin regeneration (AMFIBHA). The developed graft is non-immunogenic, hemostatic, biomimetic with growth factors, cytokines and adhesive proteins and is completely absorbable upon skin regeneration.

Method: The developed substitute (AMFIBHA) was characterized using different physiochemical evaluations in terms of porosity, surface wettability, swelling and water vapour transmission rate for skin tissue engineering. The dermal fibroblast proliferation and extra cellular matrix (ECM) regulation on AMFIBHA was analysed using long term *in vitro* culture for 20 and 40 days (d). The *in vivo* wound healing efficiency was evaluated for 28 d in rabbit burn model and porcine diabetic model.

Results: Physicochemical properties of the artificial substitute (AMFIBHA) match native skin characteristics. Significantly higher fibroblast growth and ECM deposition as compared to bare FIBHA and AM indicated ability to regenerate dermal tissue. The kinetics of ECM production in 20 to 40 d suggests regulated ECM deposition. The animal experiments demonstrated hemostatic, suture-less adhesion of the substitute to the wound bed without any immediate physical deformation of the scaffold. Upon histopathological examination, epidermal regeneration was complete with basal cell layers and hyalokeratin layers. Excellent dermal regeneration with collagen organization, angiogenesis and skin appendage was observed.

Conclusions: The developed combination product is an excellent skin substitute for suture-less application as established in *in-vitro* long termstudies and *in-vivo* wound models, which may be recommended for limited clinical trial.

Keywords: Amnion, Fibrin, Hyaluronic acid, Skin substitute.

08- 04

MYOCARDIAL CALCIUM- CALMODULIN-DEPENDENT PROTEIN KINASE II- DELTA (CaMKII-δ) SIGNALING REGULATION THROUGH Nrf2/HO-1 SIGNALING PATHWAY BY CLOVE OIL, EUGENOL

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Background: CaMKII is a major mediator of cellular calcium signaling. CaMKII- δ splice variant in the heart severing as a research tool associated with cardiovascular physiology and pathophysiology. Chemotherapeutic stress related myocardial impairment is a recognized adverse event of chemotherapy. Arsenic trioxide (As_2O_3) is a well- known chemotherapeutic drug for acute promyelocytic leukaemia, but it induces cardiotoxicity in many patients. As_2O_3 induced changes in cellular redox status have a profound impact on cell signaling and alters gene expression systems. The aim of the current study was to investigate the possibility of CaMKII- δ signaling modulation by redox machinery to prevent myocardial alterations under chemotherapeutic stress.
Method: Male Wistar rats were orally co-treated with eugenol for thirty days. After experimental period blood and the heart tissue was collected for various analyses. Serum cardiac markers Troponin-I, inflammatory indicator C-reactive protein and electrolytes (Calcium, potassium, and sodium) concentrations were measured. The heart tissue was excised for histopathological examination, and plasma were prepared to detection catalase, glutathione peroxidase, and superoxide dismutase. Reverse transcriptase analyses of Nrf2, HO-1 and CaMKII-δ were conducted.
Results: Membrane peroxidation product malondialdehyde (MDA) level in the plasma of experimental rats induced by arsenic trioxide was significantly ($p<0.05$) increased. Arsenic trioxide (4 mg/kg body weight) treatment significantly markedly reduced blood antioxidant status. But co-treatment with eugenol (5 mg/kg body weight) maintained all the parameters near to normalcy. CaMKII-δ expression level was up-regulated while Nrf2 and HO-1 expressions in the cardiac tissue were significantly low during arsenic trioxide administration. Meanwhile, Nrf2/HO-1 activity was enhanced in experimental rats fed eugenol along with arsenic trioxide. Moreover, co-joint therapy with eugenol maintained normal CaMKII- δ mRNA expression pattern. In addition to this, the current study revealed a strong positive correlation between cardiac markers level with membrane peroxidation rate. In addition, we observed that the process of lipid peroxidation directly linked with altered serum cardiac markers Trop-I and CRP levels. Serum electrolytes calcium and sodium level was positively correlated with MDA. Our findings suggest that lipid peroxidation level in the myocardium correlate with both cardiac markers and electrolytes. These biochemical modulations through Nrf2 linked HO-1 molecular signaling pathway induction and further inhibition of CaMKII-δ expression in myocardium by eugenol.
Conclusion: We arrived at the conclusion that, eugenol preserves Nr2/HO-1 mediated redox balance and inhibits the oxidative activation of CaMKII-δ by arsenic trioxide.
Keywords: Arsenic trioxide, CaMKII-δ, Eugenol, HO-1, Nrf2

08- 05

EXPLORATION OF NEW PHYTOCHEMICAL ENTITIES FROM *HYDNOCARPUS WIGHTIANA* BLUME: EVOLVED AS POTENT ANTICANCER HITS INDUCING MITOCHONDRIA MEDIATED APOPTOSIS THROUGH CYT C RELEASE

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Background: Cancer prevails to be the second leading cause of mortality globally. Cancerous cells are fingerprinted with uncontrolled proliferation and often exhibit resistance towards conventional treatment approaches. Employment of cytotoxic chemotherapeutic drugs is one of the purposeful therapeutic ways in clinical practice. So there is an alarming need for the development of new phytochemical entities (NPCEs) as potent and selective anticancer agents. Co-ordinated semi-synthetic strategies for the modification of bio-active phytomolecules serve as a great platform for generating hit molecules. Hydnocarpin (Hy), a flavanoid isolated and purified from *Hydnocarpus wightiana* Blume, promotes moderate cytotoxicity in cancer cells. It was studied that guanidinium rich poly- (propylene imine) dendron

conjugated hydnocarpin exhibited enhanced cytotoxicity and anticancer properties. Therefore, strategic inclusion of heterocyclic analogues on to hydnocarpin is one of the rationale behind novel NPCEs towards drug design and engineering due to their versatility and selective nature of the platform.

Method: We have carried out the synthesis of a library of hydnocarpin-isoxazole/isoxazolone derivatives with an objective to select an ideal candidate for the bed side application. Later in-depth investigations for the lung adenocarcinoma and metastatic melanoma specific cytotoxicity and the underlying molecular mechanisms were ruled out using detailed *in vitro* and *in silico* approach. As a new insight, we have utilized surface-enhanced Raman spectroscopy (SERS) in order to evaluate the DNA fragmentation and molecular dynamics associated with the synthetic analogues on cancer cells.

Results: Successfully synthesized a library of hydnocarpin-isoxazole/isoxazolone derivatives using 3+2 cycloaddition and one pot multicomponent approach. Synthesized derivatives exhibited excellent cytotoxicity selectively towards cancer cells and impressive docking scores were obtained for some of the Bcl2 family proteins. The selected candidates showed promising anticancer properties which has been validated via various apoptotic and anti-metastatic assays. *In vitro* mitochondrial membrane potential assay and caspase assay validated the intrinsic mode of programmed cell death. Raman peaks abstracted from the cytoplasmic area of compound treated cells displayed many unique peaks attributed towards Cyt c such as 775, 1106, 1470 and 1510 cm^{-1} which corresponds to heme breathing, C-S stretching, C=N stretching and bending mode of C-N(H)-C respectively. Also, Raman spectral analysis of the isolated DNA clearly illustrated the compound induced DNA damage with typical signatures with the O-P-O backbone rupture during DNA double strand breakage and ladderring process.

Conclusions: Selected NPCEs executed excellent cytotoxicity preferentially towards lung adenocarcinoma and malignant melanoma cells through the execution of programmed cell death pathway with a favorable ADME profile. Also the synthesized compounds effectively retards the crucial steps of metastatic cascade and colonization of neoplastic cells. The selected candidates promote mitochondria mediated intrinsic apoptosis though the release of cyt c. The subtle dynamics with cyt c and unique signs for DNA fragmentation was illustrated by utilizing the excellent specificity and selectivity of SERS. The outcome of the study revealed two NPCEs as Hit / advanced Hit for lung adenocarcinoma and malignant melonama.

Keywords: Phytochemical, Hydnocarpin, Isoxazole, Isoxazolone, SERS, Cytochrome c

08- 06

WHERE DO WE LAG? : ACHIEVING ELIMINATION OF MOTHER TO CHILD TRANSMISSION (EMTCT) OF HIV IN INDIA

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Background: EMTCT is the most realistic goal achievable in the fight against HIV/AIDS. This study aims to explore where we lag in achieving EMTCT and compare various factors of countries that have achieved EMTCT with that of India, Gujarat and Kerala.

Methods: Qualitative methods included Key Informant Interviews, In Depth Interviews and data triangulation at PPTCT unit of a tertiary care hospital of South Gujarat. Quantitative study was done using interviews of 200 HIV negative pregnant women. The results were compared with published literature of different study settings to arrive at conclusions.

Results: Majority of the women tested in PPTCT were in late pregnancy. The major themes generated for delayed HIV testing were migration, negligence and ignorance among ANC, lack of communication and counseling, unregulated private sector and unmonitored public sector. Violation of rights to consent was seen in about 98% of cases. Higher education improved women's knowledge about HIV ANC services.

Conclusion: Low focus on primary prevention, unregulated public and private sectors ANC care, poor community participation, documentation and tracking systems and missed opportunities in PPTCT counseling are major pitfalls in achieving EMTCT. Kerala, being a highly literate state has overcome many of these and needs to focus now on integrating public private sectors, condom promotion activities, improving PPTCT services and safeguarding human rights.

Keywords: EMTCT, HIV, Key Informant Interviews, human rights

08- 07

PHENOLIC CHARACTERIZATION OF HOT PRESSED AND FERMENTED VIRGIN COCONUT OIL AND COMPARATIVE ASSESSMENT OF THEIR ANTI-INFLAMMATORY POTENTIAL

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Background: Virgin coconut oil (VCO) is the natural, unrefined edible oil obtained from the fresh coconut kernel (Cocos nucifera), which is rich in medium chain saturated fatty acids. Besides these fatty acids, presence of phenolic antioxidants such as ferulic acid, caffeic acid, syringic acid, catechins are also reported in VCO.However, based on the mode of preparation, different types of VCO are available, which includes hot pressed VCO (HP-VCO) and fermentation processed VCO (F-VCO). HP-VCO has been less studied but has medicinal use in Ayurvedicsystem of treatment. The present study compared the phenolic constituents of HP-VCO and F-VCO using LC-MS –Q-TOF as well as their anti-inflammatory potentialin mice models of dextran and formalin induced inflammation.

Methods: Fresh grated coconut kernel was mixed with its water and squeezed into viscous slurry. This mixture was then incubated for 48h at 45˚C to yield F-VCO. Hot pressed VCO was prepared by boiling the coconut milk in a boiler at a temperature of 80-90˚C. Polyphenol in the oils were extracted and estimated using Folin- CiocalteauMethod. Phenolic composition of the oil was determined by LCMS-Q-TOF method. Female Swiss albino mice weighing 25–30 g was used. Chronic inflammation was induced by Formalin in right hind paw of animals. The drug administration were continued once daily for 5 consecutive days.The paw thickness was measured using Vernier calipers for 5 consecutive days after intra-planar injection of formalin. Acute inflammation was induced by dextran. After administration of drug, on 5thday, acute inflammation was induced by intra-plantar injection of dextran. The paw thickness was measured using Vernier calipers and recorded every hour up to 5th hour. The percentage of inhibition was calculated using standard formula.

Results: The total polyphenol contents isolated from HP-VCO was higher than that of F-VCO. Further, LC-MS-Q-TOF analysis revealed the presence of simple phenolic acids such as syringic acid, p-coumaric acid, ferulic acid and kaempferol in F-VCO; whereas ferulic acid, hydroxytyrosol, glycosides of kaempferol, myricetin and vanillic acid were identified in HP-VCO, which are of higher molecular weight.Dextran induced acute inflammation was efficiently reduced by F-VCO and with a higher extent by HP-VCO. Similar to the edible oils, their phenolic fractions were also effective in reducing inflammation induced by Dextran. HPVCO, FVCO and their phenolic contents effectively reduced the inflammatory changes induced by formalin on the hind paw of Swiss albino mice.

Conclusion: In the present study, LC MS analysis revealed the presence of low molecular weight phenolic acids as major constituents in FP-VCO while HP-VCO contained high molecular weight phenolic glycosides. Since hot pressed method involves heating at 100˚C, polyphenols might have complexed with other molecules and released. This molecular difference in polyphenolic composition could be responsible for the comparatively higher anti-inflammatory efficacy shown by HP-VCO.

Keywords: Virgin coconut oil; anti-inflammatory activity; polyphenols

08- 08

ELECTROCHEMICAL SENSING OF METHYLMALONIC ACID: FUNCTIONAL BIOMARKER OF VITAMIN B-12 STATUS.

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Background: Deficiency of vitamin B-12 leads to the increased concentration of MMA through the non-formation of blood cells. MMA and homocysteine are valuable for early detection of mild cases of vitamin B-12 deficiency. Vitamin B-12 concentration in blood serum could be analysed by radioimmunoassay. Hence the MMA concentration can be used as a maker for the vitamin B-12 level for the effective biological process. In addition, MMA is also a good maker for monitoring the success of the treatment.

Method: In the present work, a molecularly imprinted graphene oxide/gold nano particle co polymerised with allyl

trimethoxy silane –grafted- allylamine (AA) / 2-aminoethyl methacrylate hydrochloride (AEMA) polymer (*GO/AuNP-co-ATMS-g-AEMA/AA)* which is conducting in nature by bulk imprinting method to quantify and sensing MMA from the blood samples in selective manner. The sensitivity was checked by modifying the glassy carbon electrode (GCE) surface with MIP, electro chemical studies conducted with cyclic voltammetry (CV) and differential pulse voltammetry (DPV)

Results: The direct electron transfer between the electrode and cholesterol to form cholesterol oxidase leads to an increase in current from the modified GCE. On comparing with other cholesterol sensor it showed several advantages with wide linear range, low detection limit, good reproducibility and stability. This modified GCE was successfully applied to cholesterol detection in real samples, as this is having satisfactory correlation with well-established analytical method. The optimum pH was 7.4 and the response time with in the 8 minutes is found to the optimum which also confirms the suitability of the biosensor in the analysis of blood samples. .

Conclusions: Fabricated sensor profits the inherent properties of GO, AuNP, AEMA and AA constitute a matrix suitable for the arrest of MMA though the H- bonding stabilization with the molecularly imprinted site. When MMA captured by the membrane, it develops a closer proximity between the MMA and the sensor could results faster and accurate response. Concentration of MMA obtained from the present method was paired with15 clinical samples using HP GC/MSD method both the values gave good linear correlation with regression coefficient value 0.967.

Keywords: Graphene oxide; Gold nano particles, molecular imprinting polymers; methyl malonic acid; cyclic voltammetry; differential pulse voltammetry.

08- 09

A HIGH THROUGHPUT SCREENING METHOD TO DETECT T CELL IMMUNE RESPONSE

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Background: Kerala has the 2nd highest rate of mortality due to cancer in India. The first line of cancer treatment is surgery combined with chemotherapy and radiotherapy. Although there are continuous technological advancements in early detection and treatment, cancer is still a big threat to our society as the survival and prognosis is gloomy. Immunotherapy is a new class of cancer treatment which exploits the body's own immune system to recognize and kill cancer cells.

Methods: PBMCs were isolated and cryopreserved from 100 healthy donors. HLA was typed by long range PCR using gDNA. Cryopreserved PBMCs functionality was assessedfor surface markers viz CD3 PE, CD8 PerCp, CD14, CD16, CD45RO, CD56, CD57 and CD19 FITC by flow cytometry. T cell functional assay with INFγread out was done with peptides derived from flu antigens and tumor associated antigens.

Results: The viability was between 50-60 %. Theretrieved PBMCs immune cell repertoire from the 20 donors were found to be functionally effective. All the 20 PBMCs showed a response to CEF pool indicating the earlier exposure to flu antigens. The immune response produced by CEF pool was robust compared to MELA and WT 1.

Conclusion: We have optimized a protocol to successfully isolate, freeze, cryopreserve, characterize, HLA typed and created a PBMC repository. And we have validated a PBMC assay which can be used as a high throughput screening assay to validate the immunogenicity of different cancer derived antigens and thereby aid in potential cancer vaccine development.

Keywords: Immunotherapy ,cancer vaccine, PBMC assay, T cell activation ,CEF Pool, MELA, WT1,

08- 10

HIBISCUS ROSA SINENSIS L. ANTHOCYANINS MODULATES DIABETIC DYSLIPIDEMIA IN STREPTOZOTOCIN INDUCED DIABETIC RATS

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Background: Diabetes mellitus is a heterogeneous group of metabolic disorder results in the derangement of carbohydrate, lipid and protein metabolism.The present study evaluates the effect of anthocyanins present in the *Hibiscus rosa sinensis*flower petals indiabetes-induced dyslipidemia.

Materials and methods: Male Sprague Dawley rats were fed with high energy diet for 60 days. Diabetes was induced by single intraperitoneal injection (30mg/kg) of streptozotocin. Diabetic rats were administered *Hibiscus rosa sinensis* anthocyanins (HA) extract orally (50 mg/kg body weight) for 60 days. Results were compared with diabetic rats provided with the standard drugs [metformin (100mg/kg+ Atorvastatin (10 mg/kg)]
Results: Diabetic rats administered HAshowed a significant decline in serum glucose, glycated hemoglobin, toxicity markers and significantly increased the level of plasma insulin. Altered levels of serum lipids, lipoproteins, and activities of glucose and lipid metabolizing enzymes in tissues were significantly modulated upon the administration of HA in diabetic rats. Histo pathological examination of liver revealed the protective effect of HA in diabetic rats.
Conclusion: This study clearly indicated that supplementation of HA could significantly regulate hyperglycemia and lipid metabolism in streptozotocin induced diabetic rats.
Keywords: Diabetes mellitus,*Hibiscus rosa sinensis* anthocyanins,Dyslipidemia

08- 11

PROFILE OF GUT MICROBIAL DIVERSITY FROM HUMAN SUBJECTS IN KERALA - HEALTHY VERSUS DIABETIC

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Background: An adult human can carry about 2 kg of microbes in their gut which consist of at least 1000 species of bacteria which harbors about 3 million genes. The recent studies revealed that two third of the gut microbial population is unique to each individuals. The gut microbiome plays an important role in digesting certain food that are usually resistant to digestive enzymes, ensuring better nutrition, serve as a potential source of vitamins and also in reinforcing our immune system. Several studies revealed that the gut microbial community in individuals with life style diseases likes obesity, type 2 diabetes etc., showing remarkable difference when compared to healthy ones, clearly indicating their influence on health and diseases.
Methods: The present study relies on the culture independent metagenomic approach to elucidate the diversity of gut microbiome in human subjects in Kerala. Using the pooled metagenomic DNA isolated from fecal samples of 30individuals (15 healthy and 15 diabetic), the gut microbial diversity was elucidated by targeted next generation sequencing of hyper variable regions of 16S rRNA gene.
Results: The alpha diversity analysis depicted that the bacterial diversity significantly reduced in diabetic condition compared to healthy ones.The prominent bacterial groups observed are Firmicutes, Bacteriodetes, Proteobacteria, Cyanobacteria, Actinobacteria and Gemmatimonadetes. In general the most prominent genera observed are *Prevotella, Faecalibacterium, Ruminococcus, Klebsiella, Lachanospira, Bactetroides, Balutia, Dorea, Dialister, Coprococcus, Bifidobacterium* and *Clostridium*.In healthy population the following phyla Nitrospirae, Chlorobi, Fibrobacters, Proteobacteria, Verrucomicrobia, Acidobacteria and Cyanobacteria were enriched while in diabetic condition the bacterial phyla Bacterodetes, Firmicutes, Actinobacteria, Chloroflexi and Gemmatimonadetes were enriched.
Conclusions: This pilot study provided an insight into the general characteristics of gut microbiome in the Kerala population. Considering gut microbiome as a marker for health and disease, the study will definitely aid in initiating further studies to decipher the pathophysiological role of the gut microbiome in various disease conditions as well as their role as probiotics in rejuvenation and also in evolving new strategies especially in the treatment of life style diseases.
Keywords: Gut microbiome, Next generation sequencing, 16S rRNA gene, bacterial diversity, life style disease.

08- 12

AN "*EX VIVO*" ENGINEERED HUMAN TUMOR MODEL FOR RAPID AND REAL - TIME CANCER DRUG DISCOVERY

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Cancer drug discovery is a cost intensive enterprise starting from in vitro screening of compound libraries followed by testing of lead compounds in diverse model systemsincluding preclinical models followed by clinical trials. For each stage, there are well described models with varied levels of complexities. The failure rate is extremely high as the

lead compounds move from one phase to the next. Because of this, much attention has beengiven to ensureincreased specificity and sensitivity on the initial screening and preclinical modelstoreduce the failure rates. The conventional preliminary screening involves in vitro cytotoxicity assay in a panel of cancer cell lines that is followed by hollow fiber assay and preclinical testing in relevant animal models. As the cytotoxicity assay utilizes lab grown cells as monolayerculture with least relevant to the in vivo tissue architecture of the tumor, methods were developed to utilize 3D sphere models as tool for drug discovery. Eventhough they are better models of drug screening than monolayer cultures, mostly they represent with single cell clusters and the 3D architecture is not equivalent to the intact tumor tissue. Additional drawback of this model is expansion of self-renewing fractions or induction of self-renewal with acquisitions of complex drug resistance pattern. Because of this xenograft and patient derived tumor models are considered as bestdrug efficacy testing platforms in cancer drug development as they have in vivo mimicking tumor microenvironment and vasculature. A serious disadvantage of xenograft models is their low throughput and cost and labor factors so that large scale screening is impossible.

In the last decade significant advancement were made in growing most of the solid tumors as patient derived tumors immunocompromised mice that allow screening of compounds with potential personalized medicine. However, a disadvantage is the time factor, cost effectivenessand requirement of large number of animals for a massive screening. As an alternate method, we describe here a very powerful approach to grow human tumors in immunocompromised mice to be used as a screening platform. We engineered the human cancer cells as a sensor for cell death and so that large number of compounds can be screened in a rapid manner within 48 hours in moderate throughput fashion. In addition to the compound screening, the method has potential application in identifying best drugs specific to the tumor enabling best therapeutic decisions with minimum toxicity to the patients if adapted with patient derived tumors.

08- 13

STAR FRUIT AS A POTENTIAL ANTIOXIDANT

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Background: The generation of oxygen free radicals during cellular metabolism and by certain environmental factors and lifestyle, appears to play a critical role in the ageing process. High dietary intakes of antioxidant vitamins and phytochemical are helpful for better maintenance of physiologic function and a lower prevalence of many degenerative conditions in older adults. The free radical pathology is associated with many of the chronic disease that are common among older adults, e.g., cancer, heart disease, and degenerative eye disorders such as cataracts and macular degeneration. The plant derived compounds such as flavonoids, tannins, proanthocyanidins, phenols etc. having the strong antioxidant activity. so researchers are eager to find the antioxidant remedies from the natural sources and without causing any harmful effects. The present study aims to evaluate the antioxidant activity of star fruit by different methods.

Method: Antioxidant activity of star fruits were evaluated by spectrometric techniques such as DPPH and ABTS methods using Ascorbic acid standard

Result: Star fruit has got high amounts of phenols and flavonoid content and has showed highest DPPH and H_2O_2 radical scavenging activity when compared to standard Ascorbic acid.

Conclusion: The water extract of star fruit was prepared and investigation showed marked antioxidant activity by DPPH method and hydrogen peroxide scavenging method when compared to standard Ascorbic acid. On the basis of the results, it is concluded that star fruit has got high amounts of phenols and flavonoid content and has showed highest DPPH and H_2O_2 radical scavenging activity.I C 50 values confirms the results. These antioxidant rich fruits can be used as a functional nutraceuticals for preventing oxidative stress induced diseases.

Key words: Antioxidant activity, star fruit, DPPH scavenging activity, H_2O_2 method

08- 14

ENGINEERED BONE FOR LOAD BEARING APPLICATIONS

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Background: Management of Critical defects in load bearing areas are one of the intriguing challenges in orthopaedics. The donor site morbidity and lack of adequate supply still remains the drawbacks of autologous bone grafts. Thus, alternate engineered bone graft materials arerequired to address challenges in the treatment ofcritical sized bone defects. Method: A novel porous Bioceramic scaffold of dimensions (6mm × 10mm),was designed and characterised for load bearing application.Physico chemical characterisation techniques used were FTIR, XRD, and Compressive Strength. *In vitro* experiments for assessments of cell viability and osteogenic differentiation was performed using Humanmesenchymalstem cells which were seeded on the scaffolds at a density of 5×10^{4} cells.*In vivo* bone regeneration were evaluated by implanting the scaffold in a critical size defect in a load bearing ovine model for five week period Histopathology studies of explanted samples were carried out to confirm the bone regeneration
Results: The mechanical characterisation results revealed that the Bioceramic scaffold has strength comparable to cortical bone. *In vitro* results demonstrated that the Bioceramic scaffold supports cell proliferation andosteogenic differentiation. *In vivo* ovine implantation and subsequent histopathology results on explanation, confirmed the "*De novo*" bone regeneration and closure of critical sized defect.
Conclusions: The bioceramic scaffold supports mesenchymal stem cell proliferation and osteogenic differentiation*in vitro* and could enhance the bone regeneration in critical size defects, *in vivo*. The Bioceramic scaffold would hence provide a potential solution to address the challenges of critical bone defects in load bearing regions.
Keywords: Bone, Bioceramic, *in vivo* models

08- 15

HEART MURMUR FOR DEFECT IDENTIFICATION – A FFT AND WAVELET STUDY

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Background: Cardio Vascular diseases are a major cause for the increasing mortality rate in India. Recently in India 52% of the death is due to cardio vascular diseases and heart disease death rise in India by 34% over 16 years. The unhealthy life style and irregular food habits of human beings resulted in an increase in the cardiovascular diseases. The analysis of heart murmur can give information about the performance and conditions of the heart. The blood flow within the heart, blood volume, and pressure govern the functioning of heart valves. Any malfunctioning of the valves can alter the smooth blood flow which can be identified by analyzing heart murmur.
Method: The acquisition of new methods for the diagnosis of diseases is always important since they can contribute to the development of health science. Fast Fourier Transform (FFT) is a powerful mathematical technique that finds applications in the medical and biomedical field where analysis of signals is carried out in the frequency domain. In the present study, the abnormality in the heart murmur due to reversal of blood flow from left ventricle to left atrium caused by disruption in mitral valve, termed as Mitral regurgitation (MR), is analyzed by comparing with the normal heart murmur using FFT and Wavelet technique.
Result: The defective heart can be identified by wavelet and FFT analysis of heart murmur. The FFT analysis of normal heart shows two frequencies corresponding to lub and dub sounds whereas the heart murmur MR shows multiple frequency components. The wavelet analysis scalogram spectrum of normal and defective heart murmur gives

information regarding the frequency and the time when it appears. The analysis of MR heart murmur through FFT and wavelet offers a sensitive surrogate technique for earlier identification of cardiac disorder. Greater frequency spread in the wavelet analysis.

Conclusion: The study reveals that significant information can be obtained from frequency analysis of heart murmurs. The analysis of MR heart murmur through FFT and wavelet offers a sensitive surrogate technique for earlier identification of cardiac disorder. greater frequency spread in the wavelet analysis.

Keywords: Heart murmur, Mitral Regurgitation, Fast Fourier Transform, Wavelet Transform

08- 16

CHEMOTHERAPEUTIC LOADED POLYSACCHARIDE - METAL NANOFORMULATION FOR ANTI - GLIOMA THERAPY

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Glioma is the most aggressive type of brain tumor having a poor prognosis with the existing therapeutic strategies due to the selectivity of the blood-brain barrier (BBB)over conventional chemotherapeutics that restrict the therapeutic effect.Considering the costly development procedures for the novel drug formulations, the repositioning of existing chemotherapeutics with suitable modifications are recommended.Despite all efforts, not a single formulation has been approved for an efficient repositioning of conventional chemotherapeutics for anti-glioma therapy. Herein, a novel nanoformulation (PGD)has been designed using the PST001, a galactoxyloglucan extracted from the seed kernel of *Tamarindus indica*, capped over gold nanoparticles and encapsulated with doxorubicin. The PGD nanoformulation exhibit cytotoxic effects on glioma cells, faster cellular uptake, retains for longer duration in plasma than free drug and have higher distribution in the brain. The present PGD nanoformulation is well-appreciated for the repositioning of conventional broad-spectrum chemotherapeutics for anti-glioma therapy.

08- 17

EXPRESSION OF PD - L1 IN TRIPLE NEGATIVE BREAST CANCER: A POTENTIAL BIOMARKER FOR IMMUNOTHERAPY

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Background: Triple negative breast cancer (TNBC) is the most aggressive breast cancer subtype, and there is no targeted therapy. The programmed cell death protein 1 (PD-1) and its ligand PD-L1 have critical roles in tumor immune surveillance. PD-1 is an immune checkpoint protein expressed in mononuclear immune cells. PD-L1 is a trans-membrane protein expressed on a wide variety of cells including immune cells, epithelial and vascular endothelial cells. Westudied the role of PD-L1 expression in patients with triple negative breast cancer (TNBC)by immune histo chemistry and correlated with clinico-pathological parameters.

Methods: PD-L1 immunohistochemistry was performed on formalin fixed paraffin embedded tissue samples. The prevalence of PD-L1 expression was correlated with various clinico-pathological parameters. Pearson χ^2 and t-student test were used to compare the survival of patients with positive PD-L1 expression and those with negative PD-L1 expression.

Results: Of the 163 TNBC cases evaluated for PD-L1 expression, the number of cases with any tumoral cell staining was 65 (39.88%). Among them 33 (51%) showed strong PD-L1 surface expression. Some cases had PD-L1 expression in both tumoral cells and stromal cells. Although there was a range of expression of PD-L1, no significant correlation with the level of expression and overall survival or disease frees survival observed. There was also no other association with important clinico- pathological variables as well.

Conclusions: High levels of PD-L1 expression suggest the role of PD-L1 as a potential biomarker for immune checkpoint blockade therapy in TNBC patients.

Key words: Breast cancer, TNBC, PD-L1, Overall survival.

08- 18

THREE DIMENSIONAL CELL CULTURE SYSTEMS FOR *IN SITU* CYTOCOMPATIBILITY EVALUATION OF SELECT PHYTOCHEMICALS FOR NEURAL TISSUE ENGINEERING APPLICATIONS

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Background: Neuronal repair following a brain injury was considered challenging till recently due to the concept that adult neural regeneration is improbable or delayed. Three dimensional cell culture systems are better biomimetic tissue models over 2D cell culture systems by providing better simulation of *in vivo* biological environment. In this context, the main objective of our study is to construct an extracellular matrix based three dimensional annulus - core cell culture system for cytocompatibility evaluation of select phytochemicals with tissue regenerative properties.
Methods: A three-dimensional migration assay model was set up using Rat tail vein Collagen I hydrogel seeded with $1x10^5$ L929 fibroblast cells/ml in an annular tissue simulant model(1cm diameter) consisting of Collagen gel incorporated with select tissue regenerative phytochemicals. Cellular proliferation and migration into the phytochemical-laden inner core was analysed qualitatively by the Calcein AM- Ethidium homodimer staining and confocal imaging. Physico- chemical characterisation of the hydrogels was assessed by Scanning Electron Microscopy, NMR spectroscopy and rheology measurements.
Results: L929 fibroblasts proliferated and migrated chemotactically in collagen-cross linked hydrogels. The physico-chemical characteristics, gelation time, rheology parameters of the hydrogels were found to be favourable for the cell survival and proliferation within this gels.
Conclusion: This study proves that this collagen annulus -core three dimensional gel construct could be an ideal *in situ* cytocompatibility evaluation platform, which could be further developed with different type of cells and phytochemical combinations for neural tissue engineering applications.
Keywords: Three Dimensional hydrogels, neural tissue engineering, phytochemicals,

08- 19

EVALUATION OF ANTI INFLAMMATOTY ACTIVITY OF *KOKILAKSHAM KASHAYAM* ON RAW MACROPHAGE CELL LINE

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Background: Pathophysiological events involve the production of pro inflammatory cytokines, tumour necrosis factor (TNF-α) and interleukin (IL-1β) by cells like monocytes, macrophage and dendritic cells. Several biochemical components such as lipid, protein, DNA and RNA also show variation in diseased condition. *Kokilaksham kashayam*, an ayurvedic herbal decoction is being traditionally used for the treatment of chronic inflammatory condition. The aim of this study is evaluation of effect of *Kokilaksham Kashayam* on production of pro inflammatory cytokines by RAW 264.7 macrophage cell line.
Methodology: Raman spectroscopy studies and inhibition of proinflammatory cytokines were carried out in the macrophage cell line RAW 264.7. TNF-α and IL-1β were quantified using ELISA whereas Raman spectral analysis was carried out in WITec alpha300RA (WITec GmbH, Ulm, Germany) confocal microscope.
Results: Raman spectral analysis revealed that all peaks characteristic of proteins, nucleic acid, lipids and carbohydrates were observed to be intensified upon LPS stimulation and were brought down upon *Kokilaksham Kashayam* extract pretreatment. The levels of proinflammatory cytokines were also lowered in the pretreated macrophage cells.
Conclusion: This part of work establishes the anti-inflammatory potential of *Kokilaksham kashayam* extracts revealing the therapeutic potential of bioactive molecules of the herbal decoction on chronic inflammatory conditions.
Key words: *Kokilaksham kashayam*, Raman Spectroscopy, Proinflammatory cytokines, RAW 264.7

08- 20

SEX HORMONES INFLUENCE PAD4 ENZYME ACTIVITY

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Background: Peptidylarginine deiminase catalyses the reaction called citrullination. This enzyme plays a major role in human physiology. Among the different PAD isoenzymes, PAD4 is present mainly in neutrophils and it helps in mediating the defense strategy of neutrophils called NETosis. Apart from this, PAD enzymes are also shown to have relationship with the endocrine system as the enzyme activity was influenced by certain endocrine factors. Therefore, the present study was aimed to investigate the influence of sex hormones and PAD4 enzymes in neutrophils. Since this enzyme is significant in mediating the antimicrobial functions of neutrophils, the present study also look into the hormonal regulation of PAD enzyme in the presence of a bacterial stimulant (denoted as SCS).
Method: Freshly isolated human neutrophils were pretreated with either estrogen or testosterone in the presence or absence of SCS. The PAD enzyme activity was then determined at various time intervals according to Senshu *et al*. (1989) method with slight modifications.
Results: In the absence of SCS, PAD4 activity was significantly increased in the presence of estrogen and testosterone. However in the presence of SCS, the activity of the enzyme was significantly decreased in estrogen treated and testosterone treated cells. Cells treated with testosterone showed an increased PAD activity than estrogen treated cells.
Conclusion: Sex hormones have independent effect on PAD4 enzyme activity.
Key words: Neutrophils, peptidylarginine deiminase, estrogen, testosterone, bacterial stimulant

08- 21

ENHANCEMENT OF THE ANGIOGENENIC POTENTIAL OF A PORCINE CHOLECYST DERIVED SCAFFOLD BY COATING WITH CELL ADHESION MOLECULES FOR DIABETIC WOUND HEALING APPLICATION

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Background: The host laboratory has prepared a porcine cholecyst derived scaffold (CDS), by a non-detergent/enzymatic method for wound healing applications. However, the potential of CDS for diabetic wound healing application has not been explored. Preliminary *in vitro* investigations indicate that the CDS does not promote the growth of vascular endothelial cells or keratinocytes. Considering that the ability of a tissue engineering scaffold to promote angiogenesis is an essential biomaterial property which contribute to diabetic wound healing, this study attempted to modify the CDS by coating with cell adhesion molecules.
Methods: The CDS was modified with cell adhesion molecules such as gelatin, fibronectin or CCN1 through method by EDC-NHS chemistry using1-Ethyl-3-(3dimethylaminopropyl) cardodiimide and N-hydroxysuccinimide . Then, human keratinocytes and human umbilical vein endothelial cells were seeded on the modified scaffold. The viability, adhesion and proliferation were evaluated.
Results: The coating of the molecules on CDS with gelatin, fibronectin and CCN1facilitated the enhanced growth of human keratinocytes in comparison with an unmodified scaffold. The coating also promoted the adhesion, viability and proliferation of human umbilical vein endothelial cells.
Conclusion: It was concluded that the coating of CDS with cell adhesion molecules may be a useful strategy for enhancing the potential of CDS in healing of diabetic wound.
Keywords: Angiogenesis, Diabetic wound healing, Extracellular matrix, Porcine cholecyst derived scaffold, Human umbilical vein endothelial cells and Human keratinocytes

08- 22

A NEW INSIGHT ON EARLY DIAGNOSIS OF ALZHEIMER'S DISEASE BIOMARKERS BY LABEL BASED SERS IMMUNOSENSOR

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Background: Early detection and follow-up monitoring is critical for improving the physical, emotional and financial impacts of the Alzheimer's Disease (AD). Present medical providers do not routinely assess the cognitive health of their patients, leading to delayed Alzheimer's occurrence and post diagnostic care. Central nervous system (CNS) diseases represent the largest and fastest growing area of unmet medical need in low resource countries.
Methods: We have investigated on a label based, highly objective, ultrasensitive surface enhanced Raman scattering (SERS) modality in which iron-cored gold nanostar and gold nanoparticles were utilized as SERS substrates which turned out as a SERS based immunosensor to evaluate the presence of AD biomarker i.e. beta amyloid ($A\beta_{42}$ protein).
Results: An efficient SERS based nanoprobe was employed for the specific detection of beta amyloid biomarker prominent in SH-SY5Y neuroblastoma cell line. The nanoprobe was characterized and the cytotoxicity of the construct confirmed the non-toxic nature of the nanoprobe in the neuronal cells used for further assays with suitable control. The nanoprobe efficiently localized the beta amyloid inside the cells which was confirmed by the ultrasensitive, fast SERS spectral analysis and imaging technique.
Conclusion: An ultrasensitive SERS based sandwich assay has been successfully demonstrated for an efficient detection of beta amyloid proteins in Alzheimer's Disease. Iron oxide nanoparticles may facilitates giving a contrast in Magnetic resonance imaging (MRI) which can also be utilized along with SERS for a dual SERS-MRI platform. With the inspiring *in vitro* preliminary results, we have initiated the collaborative plan with Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST),Trivandrum for the next level study with our SERS-nanoprobes in clinical samples (blood plasma) in order to differentiate Normal, Mild Cognitive Impairment (MCI) and Alzheimer's Disease patient samples.
Keywords: Surface enhanced Raman spectroscopy, Alzheimer's Disease, beta amyloid, label based

08- 23

STUDIES ON EMBELIN FLUORO DERIVATIVE AS POTENT B - RAF INHIBITOR IN MELANOMA

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Background: B-RAF is a frequently mutated protein found in many cancers including melanoma. The important function of B-RAF is normal cell growth and survival. Most of known B-RAF mutations are V600E mutations. Vemurafenib is the currently used fluorine based drug used for V600E mutations but this drug has side effects, so current work focus on the semi synthetic derivative from naturally occurring hydroxyquinone, embelin.
Method: This work explains the synthesis of fluoro embelin derivative by TFA as catalyst and structure was confirmed by various spectral techniques. Molecular docking studies was conducted using Discovery studio 4.0 software and results were compared with standard drug vemurafenib. MTT assay, western blot analysis were conducted.
Results: The structure of the derivative was confirmed by Mass, and NMR. The docking studies showed the exact binding affinity of the derivatives with mutated B-RAF protein. MTT assay in melanoma cell lines showed good results. Western blot analysis showed that B-RAF expression level was reduced on the addition of the sample.
Conclusion: This work established the computational and wet lab method used for identifying a potent lead molecule for B-RAF mutated melanoma.
Keywords: B-RAF, Vemurafenib, Discovery studio 4.0, Embelin

08- 24

EFFECT OF *ROTULA AQUATICA* LOUR IN AMELIORATION OF INFLAMMATION, OXIDATIVE STRESS AND RENAL DAMAGE ASSOCIATED WITH ACUTE PYELONEPHRITIS IN WISTAR RATS

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Background: Acute pyelonephritis is a common bacterial infection of kidney which was characterized by chronic renal inflammation. Current treatment strategies mainly focused on to antibiotic therapy. The recurrent infection and drug resistance create a major problem in treatment of acute pyelonephritis. The present study evaluates the efficacy of ethyl acetate fraction of *Rotula aquatica* Lour (EFRA) in ameliorating the inflammation, oxidative stress and renal damage associated with acute pyelonephritis.

Methods: The antioxidant enzyme status, GSH content, malondialdehyde (MDA) level, nitrate level, reactive oxygen species (ROS) level and renal toxicity markers were evaluated. The mRNA level expression of kidney injury molecule-1 (KIM-1), nuclear transcription factor kappa B (NF-κB), tumor necrosis factor-alpha (TNF- α), interleukin-6 (IL-6), Neutrophile gelatinase associated lipocalin (NGAL), Tamm Horsfall protein (THP) and Toll-like receptor 4 (TLR-4) genes were analyzed using RT-PCR.

Results: The result of our study reveals that EFRA have the capability to enhance antioxidant enzyme status and reduce the elevated biochemical parameters to normal level. The mRNA level expression of KIM-1, NF-κB, TNF-α, IL-6, NAGL and TLR-4 genes were downregulated by EFRA treatment. The expression of THP was upregulated during the EFRA administration.

Conclusion: The present study proves the efficacy of EFRA in ameliorating the inflammation, oxidative stress and renal damage associated with acute pyelonephritis. The EFRA could be used as an effective drug to treat acute pyelonephritis.

Keywords: Acute pyelonephritis; *Escherichia coli;* Inflammation; Oxidative stress.

08- 25

A STUDY TO EVALUATE THE ASSOCIATION OF LIPID PEROXIDATION LEVELS AND OTHER RISK FACTORS IN THE DEVELOPMENT OF CORONARY ARTERY DISEASE (CAD)

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Coronary artery disease (CAD) is a multifactorial fatal disease with no known cure- highly predictable, preventable, and treatable. We have been identified a wide range of risk factors for coronary heart disease have been like BMI, obesity, cigarette smoking, alcohol abuse, hypertension, and diabetes mellitus. But no systematic study was available in literature to correlate the major risk factors with CAD severity. Hence we made an attempt to correlate the different risk factors of CAD with the control subjects.

Materials and methods: One hundred and fifty angiographically proved patients and hundred, age and sex matched controls were included in this study. Patients with cancer, liver, and kidney diseases are excluded. Detailed demographic and anthropometric data were recorded using proforma and clinical data from clinical records. Similar data were collected in the case of age and sex matched controls and the values are compared. **Result:** There is significant variation in the risk factors of CAD patients compared to the normal subjects. The lipid peroxidation levels of the patients was significantly higher than that of the normal controls and the levels of enzymatic antioxidant, and non enzymatic antioxidant were significantly lower than that of the normal counter parts.

Conclusion: From these findings we can conclude that the CAD patients with these risk factors have increased oxidative stress and decreased antioxidant status. So coronary artery disease is associated with greater than normal lipid peroxidation levels and with an imbalance in antioxidant's status.

Keywords: Coronary artery disease (CAD), Multifactorial disease, Risk factors, BMI

08- 26

CHOLECYST-DERIVED-GRAFT ASSISTED HEALING OF EXPERIMENTAL MYOCARDIAL INFARCTION IN A RAT MODEL

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Background: Coronary artery disease due to obstruction of end arteries leading to myocardial infarction causes death in about one-third people over 35 years of age. Cardiac tissue engineering aims to repair the infarcted myocardium using cells, scaffold and growth factors. The present study explores the potential of an epicardial-graft (EG) fabricated out of decellularised porcine cholecyst to heal induced myocardial infarction in a rat model.
Method: Sub-acute myocardial infarction (MI) was induced under general anesthesia in six Sprague Dawley rats by ligating the left anterior descending coronary artery. MI was indicated by blanching confirmed through visual examination by a veterinarian. In three animals, the EG was implanted over the site of MI within 15 minutes after the blanching and the animals were allowed to recover from the anesthesia. After 14 days of observation, the rats were euthanized by CO_2 inhalation and heart was explanted. The nature of the healing reaction in the myocardium of the EG-assisted and non-assisted reactions were compared in histology sections stained with Haematoxylin & Eosin, Masson's Trichrome and Herovici's stains.
Results: The induction of MI was successful in the rats as evidenced by gross blanching of the myocardium within two minutes after ligation. Subsequently, the histomorphology confirmed the MI. Further, the EG-assisted healing was characterised by minimal collagen deposition and increased angiogenisis.
Conclusions: This work indicates that decellularised porcine cholecyst is a potential biomaterial for fabricating epicardial-graft for assisted healing of infarcted myocardium.
Keywords: Myocardial infarction, coronary artery ligation, remodeling

08- 27

CATECHIN MODULATES AUTOPHAGY AND APOPTOSIS IN MIN6 CELLS EXPOSED TO HIGH GLUCOSE CONCENTRATION

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Background: Apoptosis(Type I cell-death)and autophagy (Type II cell-death) are the two different forms of programmed cell death,and both these cellular physiological processes plays significant role in the progression of diabetes. The present study aims to evaluate whether catechins exert any modulatory effect on autophagy and apoptosis in MIN6 cells exposed to high glucose concentration.
Materials and methods: MIN6 cells were grown in low glucose medium and the medium was replaced with high glucose(40mM) stress induced medium. After inducing glucose toxicity cells were treated with 50 µM and 100 µM concentration of catechin.Apoptosis was determined by Acridine orange (AO) and ethidium bromide (ETBR) double staining.Autophagy was analyzed using autophagy kit by *flow cytometry.*
Results: Our results suggested that catechin could attenuate oxidative stress; modulate the apoptotic signals and it can protect pancreatic β-cells from apoptotic damage under hyperglycemic condition.From our results it can also be observed that treatment of cells with nontoxic concentrations of catechin has significantly reduced the autophagy flux induced by HG. Thus catechin could protect cells against glucotoxicity induced apoptosis and can also reduce autophagic induction triggered by high glucose concentration.
Conclusion: Our observations suggests that catechin possess significant modulatory effect on autophagy and apoptosis in MIN 6 cells exposed to high glucose concentration.
Key words: autophagy, apoptosis, MIN6 cells

08- 28

AN EVALUATION OF DRINKING WATER QUALITY OF dug wells IN KOLLAM DISTRICT

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The people of Kerala, who depend on well water, face the problem of water contamination throughout the year and water scarcity during summer which results from anthropogenic activities. Assessment of water quality is very important for knowing the suitability of water for various purposes. Hence a detailed investigation was planned on the quality and the factors related to the deterioration of water quality in the present study area viz Kollam district. Samples were collected from eight stations for physio-chemical analysis. Standard methods were used for analyses. Mean values of these parameters were determined using Microsoft excel. The results were compared with BIS standards. It was revealed that many wells were positive for coliform content indicating high risk. The drinking water quality was found to start deteriorating after the onset of monsoon. People dependent on this water are often prone to health hazards due use of polluted drinking water. The results of the study help in enhancing awareness of health hazards of contaminated water among the individuals as well as in drawing attention of health regulatory authorities.

08- 29

COGNITIVE EFFECTS OF ENDEMIC FLUOROSIS-A COMPARATIVE STUDY

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Background: Fluoride has beneficial effects on teeth at low concentrations in drinking water, but excessive exposure to fluoride in drinking water can give rise to a number of adverse effects including detrimental neurological effects. This study aims at investigating if there is a link between fluorosis and the cognitive function of school going children.
Methods: This cross sectional Study was conducted in collaboration with the the Fluorosis Control Programme, Department of Health services, Alappuza district. School going children aged 8 – 10 years studying in Govt.LPS,Kalarcode,Alappuzha district with confirmed endemic fluorosis were picked up. Normal healthy age and sex matched children without fluorosis were selected from the same school.Both groups were subjected to neuropsychological assessment with Raven's Standard Progressive Matrices and MISIC digit span subtest.
Results: A total of 40 children with confirmed fluorosis were selected by simple random sampling and an equal number of age and sex matched normal children were also selected. Majority of study subjects in both groups were females(55%) and were 9 years of age (75%).The mean age of the children was 8.95.
30% of the children without fluorosis had Grade I(Intellectually superior) and Grade II(Definitely above the average in intellectuall capacity) Raven's SPM grades as compared to 15% of those with fluorosis. None of the children without fluorosis had scores in the Grade V (Intellectually impaired) category whereas 20% of the fluorosis affected children belonged to the same. The mean digit span(backward) was found to be significantly higher in the normal children than those with fluorosis. An increase in Raven's SPM grade was observed with increase in Dental fluorosis Index
Conclusion: This study establishes a significant relationship between the presence of fluorosis and impaired cognition in children. Severity of dental fluorosis is significantly associated with the grade of cognitive dysfunction. Measures to reduce fluoride intake by defluoridation of drinking water might prevent cognitive dysfunction in children.
Keywords: Children,fluorosis,cognitive function,neuropsychological test

08- 30

CYTOPROTECTIVE ACTIVITY OF *AMALAKI RASAYANA* IN UV IRRADIATED HUMAN DERMAL FIBROBLASTS

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Background: In Ayurveda, *Rasayana* therapyhas been proposed as a remedy for *Jara* (i.e., *ageing and ailments associated with it*) and rejuvenation of the body. *Amalaki rasayana* (AR) is an important *rasayana* formulation, prepared from the fruits of *amla* (obtained from the source plant *Emblia officinalis* and inserting it (fruits) into a specially created hollow cylindrical stem, taken from the plant *Butea monosperma*.
Methods: UV irradiated human dermal fibroblasts (HDF) from juvenile foreskin (Himedia, India) cells were treated with varying concentrations of Amalaki Rasayana and incubated for 24, 48, 72 and 96 hours and cytoprotective activity was evaluated by direct observation via phase contrast microscope, MTT assay and LDH assay. Results were compared with untreated control, UV alone treated HDF and UV irradiated vitamin C treated HDF.
Results: Statistical comparison of different groups with two way ANOVA showed treatment with *Amalaki Rasayana* in UV irradiated human dermal fibroblasts had significantly reduced cytotoxicity, profoundly increased the cell survival and maintained more or less intact morphology of HDF when applied in concentrations of 6.25µg/mL and 12.5µg/mL ($P<0.001$) and subsequent incubation up to 96 hours.
Conclusion: *Amalaki Rasayana* has comparable cytoprotective activity with vitamin C in UV irradiated HDF in concentration ranges 6.25µg/mL to12.5µg/mL.This could be attributed to phenolic and other bioactive compounds present in the rasayana, which might have reduced the lethal oxidative stress imparted by UV on human dermal fibroblasts.
Keywords: *Amalaki Rasayana*, cytoprotection, senescence, ageing, MTT assay, LDH assay, Human Dermal Fibroblasts

08- 31

A TRIO MODEL NANOTECHNOLOGICAL APPROACH FOR CANCER MANAGEMENT: GRAPHENE BASED PLASMONIC POLYMER ASSEMBLIES FOR MULTIMODAL IMAGING AND THERAPY

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Background: Theranostics, a unified form of diagnosis and therapy,plays a central role in personalized cancer treatment applications. Novel diagnostic formulations constructed on multifunctional hybrid nanomaterials have been developed as an efficient platform for the precise treatment and concordant visualization of disease with high sensitivity to elucidate disease from morphological variations to physiological mechanisms. Several research groups have paid considerable attention in developing such nano-theranostic agents towards the efficient management of serious diseases such as cancer.
Method: This work employs the innate properties of graphene based plasmonic polymer assemblies to perform multifunctional theranostic applications. This has been illustrated through bimodal imaging modalities (fluorescence and surface enhanced Raman scattering (SERS)) and tri-modal therapeutic regimes (chemotherapy, photothermal therapy and photodynamic therapy). The efficacy of the nanoconstruct was demonstrated through *in vitro* and *in vivo* experiments as well.
Results: Fluorescence and SERS imaging analysis of the as-designed theranostic nanoplatform showed target specific internalization to the cancer cells via receptor mediated endocytosis. The nanoconstruct achieved great therapeutic outcome via the synchronous administration of phototherapies along with chemotherapy. The promising potential of the nanoagent was further evident from the *in vivo* experiments which showed significant tumor reduction when compared to the control animals.
Conclusions: The as-designed nanostructured is played enhanced photo absorption properties which amplified light respons iveimagingand therapeutic efficacies, which could offer a promising outcome in translational research.
Keywords: Cancer, Theranostics, Multifunctional, Nanoagents

08- 32

BIMODAL FLUORESCENCE-SERS ENCODED NANOCOCKTAIL FOR THE MULTIPLEX DETECTION OF LUNG CANCER BIOMARKERS

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Background: Comprehensive profiling of multiple protein targets plays a critical role in the deeper understanding of specific disease conditions associated with high heterogeneity and complexity. Recent research has shown that no single targeting motif is sufficient to provide adequate information required to fully characterize or identify a specific disease condition.Thus, the development of highly sensitive techniques that can specifically recognize multiple biomarkers in a simultaneous fashion are greatly desired for the early diagnosis and management of diseases.

Method: The present work is based on the fabrication of programmable nanoparticles that feature an "on-off" switching transition between fluorescence and surface enhanced Raman scattering (SERS)for the multiplex detection of lung cancer biomarkers. The diagnostic efficacy of the nanoprobes was investigated under *in vitro* conditions using fluorescence and Raman microscopic analysis.

Results: Semi-quantitative evaluation of biomarkers through both the modalities (fluorescence and SERS) revealed ≈ 15, 8 and 1.2 fold increase in the respective EGFR, CK and Nap levels in the cancer cells against the normal ones.The bimodal approach achieved specific recognition of single as well as multiple biomarkers in a complex biological setting through multi-color image guided spectral tracking. Evaluation of sputum samples showed the potential of our probe in discriminating cancer patients from healthy ones.

Conclusion: We believe that this proof-of-concept will provide a blueprint for the diagnosis and differential staging of lung cancer into various histological subtypes based on the differential expression of the antigens, which may provide huge impacts in future clinical practices.

Keywords: Nanotag, Diagnosis, Lung Cancer, Bimodal, Clinical specimen

08- 33

PROGNOSTIC SIGNIFICANCEOFADDITIONAL CHROMOSOMAL ABNORMALITIES IN CML PATIENTS

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Background: Chronic Myeloid Leukemia is a hematopoietic stem cell malignancy, characterized by the presence of Philadelphia(Ph) chromosome, resulting from the translocation t(9;22)(q34;q11), leads to BCR-ABL fusion gene. Clinically CML consisted of 3 distinct phases; Chronic Phase(CP), Accelerated Phase(AP) and Blast Crisis(BC).Clonal evolution or emergence of Additional Chromosomal Abnormality during the course of CML is considered as trait of disease progression and it implies poor prognosis.

Methods: Conventional and molecular cytogenetic analysis was performed for the identification of chromosomal aberrations. Harvesting and GTG banding were performed as per the standard procedure. Karyotypes were described according to ISCN, 2016. FISH was done using the locus specific probe for BCR /ABL and AML/ETO fusion genes

Results: Among the 60 cytopathologically confirmed CML patients,the detection ofPh chromosome was observed in 52 patients. FISH showed a positive signal pattern for all the 60 cases, including the cases without division in conventional cytogenetics. A higher occurrence of ACA, 71.42%(5/7) within advanced phases were observed,while in chronic phase its incidence cameupto3.33% (2/53) merely. The highest treatment response to TKI was observed in the patients within chronic phase irrespective of occurrence of ACA. In CML-AP and BC patients with ACAs displayed adverse treatment response to IM therapy.

Conclusion: The frequency of ACA is higher in the advanced phases of CML. An adverse effect was observed in the progonosis of the advanced phase patients with ACAs. Hence the grouping of the patients according to their ACA with the treatment responsein each phase is a requisite for the effective management of CML patient.

Key words: Chronic Myeloid Leukemia, Additional Chromosomal Abnormality.

08- 34

IMPORTANCE OF COVENTIONAL CYTOGENETICS IN PEDIATRIC B LYMPHOCYTIC LEUKEMIA

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Background: Acute lymphoblastic leukemia (ALL) is a malignant proliferation of lymphoid cells blocked at early stages of differentiation. It is the most common type of cancer in children. It accounts for one-fourth of all pediatric malignancies. Numerical and structural chromosomal abnormalities are frequently found in the hematological malignancies. Some of the abnormalities have important role in prognosis prediction.
Methods: The present study included 100 pediatric patients with BLL, who had attended the Pediatric Oncology out-patient clinic of the Regional Cancer Centre, Trivandrum. Conventionalcytogenetic analysis was performed in all cases to find chromosomal aberrations in each case. Fluorescence InStiu Hybridization (FISH) technique was used to confirm the presence of BCR-ABL fusion gene in the study group.
Results : When conventional cytogenetic analysis was carried out among the 100 cases, 44 cases showed normal karyotype (46, XX or 46, XY) analysis could not be done in 20 cases because of inferior quality of metaphases. Numerical abnormalities were found in 29 cases.The numerical abnormalities observed included polyploidy (2 case),high hyperdiploidy (24 cases), hypodiploidy (1 case), trisomy 9 (1 case), 46,XY, -20,+mar (1 case).Structural abnormalities were found in 5 cases.The structural abnormalities included the presence of Philadelphia chromosome [t(9;22)(q34;q11)] in 4 cases and one case showed rare structural abnormality and the karyotype of the case was, 46,XY,8 p- . Numerical and Structural abnormalities were showed in 2 cases included presence of Philadelphia chromosome [t(9;22)(q34;q11)], high hyperdiploidy and polyploidy.FISH (Fluorescence in situ hybridisation) was done as a molecular confirmation of the translocation, t(9;22)(q34;q11) in the patient group. Presence of BCR-ABL fusion gene was observed in 6 cases.
Conclusions: Many of the chromosomal aberrations found in the study group plays a specific role in the prognosis prediction of the patients with leukemia. The use of conventional and molecular cytogenetic studies will be helpful in more effective risk stratification among children with leukemia. More specific treatment to each risk group will reduce unnecessary side effects of treatment in low risk patients and also improve the survival of high risk patients, thus will improve overall treatment outcome among the patients.
Keywords: Acute Lymphoblastic Leukemia, Fluorescence In Stiu Hybridization,Cytogenetics, Risk Stratification.

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IN SILICO PREDICTION AND THREADING BASED EPITOPE MAPPING OF LEPTOSPIRAL SURFACE ADHESION PROTEIN LSA46

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Background: Leptospirosis is one of the neglected diseases caused by the spirochete, *Leptospirainterrogans*. The common treatment available for the disease is the usage of antibiotics such as Penicillin, cephalosporin, amoxicillin etc. and also as a mode of management of the disease several peptides as vaccines has been developed. The currently available vaccines are not serovar specific so there is a need for a well conserved vaccine candidate which can show cross protection against number of serovars of pathogenic Leptospires. Lsa46 is a surface exposed outer membrane protein plays a major role in colonization in host tissues. Lsa46 acts as laminin and plasminogen binding protein which enables the protein to easily enter into host cells inducing infection. The major target for the development of vaccine in current era is focussing on surface exposed outer membrane proteins, as they can induce strong and fast immune response in hosts.
Method: In the present study, physiochemical parameters of Lsa46, subcellular localization, secondary structure analyses, antigenicity, conserved domain analyses etc. were analyzed through computational tools and online webservers. The secondary structure of the Lsa46 were predicted by threading based method in ITASSER server and validated by Ramachandran plot analyses. The B cell epitope prediction showed 4 major sequential B cell epitopes of Lsa46 and all these epitope score were found to be of a higher value. The protein peptide interaction was performed by molecular docking studies using Discovery studio.
Results: The highest scored epitope and the ligand, human IgG show a stable docking score of 20.86. The dynamic simulation studies carried out with the molecular docked complex gives a binding energy of – 147515.3Kcal/mol.

Conclusions: All results of the present study help to elucidate the structural and functional characterization of Lsa46 and a deep insight for epitope based design. Wet lab analysis is required to clarify the scientific validation of the predicted epitope as an ideal vaccine candidate. Also pre-clinical and clinical findings are required based on the bioinformatic approaches used in this study for a validating it scientifically.

Key words: Leptospirosis, Lsa46, epitope based vaccine design, Molecular docking

08- 36

PREVALENCE AND ANTIBIOTIC SUSCEPTIBILITY OF TRADITIONAL MEDICINAL PLANTS ON PATHOGENIC BACTERIA USING AGAR WELL DIFFUSION METHOD

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Interest and support for the conservation and development of medicinal plants is increasing in all parts of the world. This is due, in part, to a growing recognition given to the role of medicinal plants in the provision of culturally relevant and affordable health care in creating sustainable livelihoods and in the vital conservation of biodiversity. This has also drawn the attention of the world community towards the need for creating mechanisms to ensure sustained development of the sector and to allow sharing of information between countries, organizations and agencies.Long before mankind discovered the existence of microbes, the idea that certain plants had healing potential, indeed, that they contained what would currently characterize as antimicrobial principles, was well accepted. Since antiquity, man has used plants to treat common infectious diseases and some of these traditional medicines are still included as part of the habitual treatment of various maladies.

Materials and methods: Medicinal plants represent a rich source of antimicrobial agents. The different part used to include root, stem, flower, leaf, twig exudates and modified plant organs. The selected plants for the present study are *Curcuma aromatica, Loranthus ferruginous, Piper betle, Momordicacharantia, Simarouvaglauca and Psidiumguajava.* The study carryout to find the antibiotic activities of selected native medicinal plants. The study consists of culturing the microbes in the nutrient medium and identifies the bacterial species using standard biochemical procedures and analyzes the action of potential antibacterial properties of medicinal plants. The bacterial species identified as *E.coli, Klebsilla pneumonia, Shigella species, Salmonella species, Staphylococcus, Streptococcus and Vibrio cholerae.* Agar well diffusion method used to identify the sensitivity of bacterial species.

Result and discussion: The study shows that *E.Coli, Klebsiella pneumonia* bacteria's show highly sensitive in *Curcuma aromatica. Shigella, Staphylococcus, Salmonella* species shows resistance in *Piper betle. Vibrio cholera* shows resistance in extracts of *Momordicacharantia* plant. *Streptococcus* shows resistance in *Simarouvaglauca and Momordicacharantia.*The medicinal plants like *Loranthus ferruginous, Psidiumguajava* shows a positive resistance towards the microbes. The relevance of the study narrate that the herbal medicines are safer and less damaging to the human body than synthetic drugs. The use of modern drugs brings about side effects which are sometimes more dangerous than the disease itself.

Keywords: antibacterial properties,multiple antibiotic resistance,agar well diffusion method

08- 37

REPRODUCTIVE HALTH OF WOMEN IN COASTAL AREAS OF THIRUVANANTHAPURAM

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Background: Reproductive health is considered as one of the major problem faced in the public health sector across the globe. Health of the women is one of the key indicators in determining the quality of life of a nation. Kerala is one of the states having the highest quality life in the country. Coastal community always has a number of unattended

problems with them, especially the women population in the fishing community that form a different segment from the general population

The coastal area is an untouched population in many developmental studies the popularization of science is in its infancy in thus part of the state. Base line service in the coastal area in the Thiruvananthapuram, itself-shows alarming results bout the reproductive health level of awareness among women Population. To them, science is purely based on the customs and believes that they follow and the superstitions that they have. Awareness on reproductive is of health is significant importance of the reproductive age group, especially young mothers regarding the dangerous of unhygienic practices

Method: Surveys are used to collect the base line information of the samples this was collected by using an interview schedule comprising the personal, socio economic status, life style and activity pattern of the samples. Both primary and secondary data will be collected for research. In order to check the feasibility of the tools prepared, a pilot study will be conducted among 5 women belonging to the coastal area of Vizhinjam, Thiruvanthapuram. Collected data was statically analysed and interpretedusing appropriate statistical technics.

Results: The base line information of the samples includes data related to their age, details of family members etc. from this it was identified that 70% of the respondentbelongs to the age group of 25-35years. 65% of them have more than 3 members in their family 60% of them couldn't,completed their 10th standard. According to the economic status fisher women are very poor and marginalized.89% of them preferred government hospital for their delivery and 90% of them taken iron folic acid and vitamin supplements throughout their pregnancy periods. The abortion rates are very rare among the respondents and miscarriage was seen between the fisherwomen due to their lack of knowledge

Conclusion: The findings regarding the reproductive profile of the women in coastal Aras where quite disheartening needed urgent address miscarriage were found to be very common in fisher women at it was quiet shocking to know that they are not bothered about health issues and related complication after a miscarriage. Hence awareness about the reproductive health care is very much important which can surely bring positive attitudinal changes among the woman in coastal areas.

Keywords: Reproductive Health, Miscarriage, Menstrual Hygiene, Unattended population

08- 38

ASSESSMENT OF ANTIOXIDANT, ANTIMUTAGENIC AND ANTIHEMOLYTIC POTENTIAL OF *CYNOMETRA TRAVANCORICA*, A SUBSTITUTE OF *SARACA ASOCA* IN ASOKARISHTA

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Background: *Cynometra travancorica,* endemic to Western ghats of Kerala and Karnataka, is used as a substitute of *Saraca asoca* in an Ayurvedic formulation known as Asokarishta used in the treatment of several gynaecological disorders. The biological properties of this plant have not been reported so far.

Method: Antioxidant potential of methanolic extract of *C. travancorica* was evaluated by DPPH and hydroxyl radical scavenging assays. Total phenolic content was estimated by using Folin – Ciocalteu reagent. Efficacy of the extract to inhibit sodium azide and 4-nitro-o-phenylenediamine induced mutagenicity in *S. typhimurium* strain TA 100 was evaluated by Ames test. Potency of the extract in inhibiting AAPH induced erythrocyte hemolysis and lipid peroxidation was determined. GSH content in AAPH challenged erythrocytes was estimated. SDS-PAGE technique was performed to separate the isolated erythrocyte membrane proteins.

Result: Extract of *C. travancorica* yielded IC 50 values of 4.68 ± 0.26 and 1.75 ± 0.35 µg/mL in DPPH and hydroxyl assays. Total phenolic content was estimated to be 116.36 mg/g calculated as gallic acid equivalent. Extract (1 mg/mL) showed 48.2 and 53.3 % inhibition against NaN_3 and NPD induced mutagenicity in strain TA 100. Extract prevented the erythrocyte hemolysis and lipid peroxidation with IC 50 values of 17 and 59 µg/mL, respectively. Extract treatment restored the depleted GSH content and also protected the membrane proteins from oxidative damage caused by AAPH.

Conclusion: *C. travancorica*, rich in phenols exhibit potent antioxidant, antimutagenic and antihemolytic properties.

Keywords: *C. travancorica*, antioxidant

08- 39

CLINICO-EPIDEMIOLOGIC AND ENVIRONMENTAL FACTORS IN YOUNG ONSET PARKINSON'S DISEASE: A PROSPECTIVE STUDY

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Background: Clinical features and the response to treatment in Young Onset Parkinson's Disease(YOPD) differ from Idiopathic Parkinson's disease. It remains controversial if they are cases of Parkinson's disease starting at a younger age or a different disease. Studies on monozygotic twins and quadruplets have suggested that heredity plays little to no role in Parkinson's disease. Meanwhile, multiple environmental factors are increasingly being identified as the probable aetiological factor in YOPD
Method: Prospective case series study conducted in inpatients, in Dept of neurology of a tertiary care centre in South India. Patients admitted between September 2015 and August 2018 analysed. All clinical features are noted in study proforma. Epidemiologic factors were noted. Environmental factors were noted based on standard proforma. Chemical analysis of possible environmental factors done in Regional soil analytical laboratory, under govt. of Kerala, Trivandrum . Family members were clinically tested and family history is recorded in 3 subsequent generations
Results: 34 cases were included in the study 18 cases (52.9%) were females. Mean age was 43.12yrs (± 4.1yrs). Tremor was the most common presenting symptom – 22 in 34 cases (64.7%). Hypokinesia [34 in 34 cases (100 %)] was the most common clinical feature. Family history of movement disorder was noted in 6 Cases (17.6%). In all of the cases basal ganglia structures were normal. Akinetorigid group was 12 out of 34 cases (35.3%) . Fatty liver with deranged liver function was noted in 29.1%. Two patients had multiple lipomatosis. Dental fluorosis noted in 41.7%. Pesticide exposure was present in 23.5% and all of these cases were tremor dominant YOPD. Elevated soil manganese in 41.1% cases, elevated soil phosphorous levels in 58%.
Conclusions: Majority of our patients belonged to tremor dominant variety, in contrast to akineto-rigid syndrome in western studies[1] . Levodopa induced dyskinesia is more common in akineto-rigid variety , in contrast to western studies. There were no radiological abnormalities detected in basal ganglia, except for incidental findings, correlated with western literature. Co-morbid condition observed are (a) Fatty liver, which has a definite relation with parkin gene in experimental animals (b) Asian variety of lipomatosis associated with parkinsonism (c) Dental flurosis. Soil analysis shows increased concentration of manganese and acidity in the soil in the living area and the locality, which has direct correlation with YOPD. Other abnormalities in the soil, whether it is related or unrelated with disease is not known.
Keywords: Young onset Parkinson's disease, Lipomatosis, Flourosis, Levodopa

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EGFR MUTATION ANALYSIS IN NSCLC: EXON 20 Q787Q POLYMORPHISM

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Background: EGFR, a trans membraneglycoprotein genehas an important role in the tumor development. Mutation in exons 18, 19, 20 and 21 of the EGFR gene result in the aberration of signal transduction pathways which regulates cellular activities such as proliferation, differentiation and apoptosis, resulting in tumor formation.This study concentrates on EGFR mutation analysis in NSCLC patients.
Materials and methods: DNA isolation andmutation analysis of EGFR exon 18, 19, 20 and 21 were performed by PCR followed by direct bidirectional sequencing
Results: Forty patient samples were subjected tomutation analysiswhich identified exon 19 deletions and exon 21 L858R mutations. The missense variants EGFR exon 20 S768I and EGFR exon 20 V774M were also identified in one of the patients studied.In exon 20 a variant form CAG to CAA at codon 787 (2361G>A) was identified in 13 patients (32.5 %) which is a genomic variation of EGFR.
Conclusion: Q787Q polymorphism was found frequently in the samples studied. This needs further studies to validate the significance of this SNP as a molecular marker for NSCLC. Further larger samples are to be analyzed to correlate smoking history with the mutations of EGFR tyrosine kinase domain.
Keywords: Non-SmallCell Lung Carcinoma, Epithelial Growth Factor Receptor, Polymorphism

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HESPERIDINE NANOPARTICLE INCORPORATED ELECTROSPUN SCAFFOLDS FOR WOUND HEALING APPLICATIONS

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Background: Tissue Engineering (TE) is an important field for the development of biological substitutes that restore, maintain and improve the tissue and organ functions. Every year, millions of people are exposed to different kinds of epidermal or skin damage by hot water, flames, accidents, and boiling oil, and these accidents result in major disabilities or even sometimes death. Although various commercially available wound dressings have been produced, a low-cost, easy-to-use and biofunctionalizable biomaterial that provides a moist environment and facilitates healing is still a target of active tissue regeneration research.
Methods: Synthesis of polymer coated hesperidin nanoparticles by nanoprecipitation method. Synthesized nanoparticles were incorporated into electrospun nanofibers via electrospinning. Characterised by XRD,FTIR,SEM, UV-Visible spectroscopy and DLS
Results: Characterization studies revealed the nanoscale properties of hesperidin nanoparticle and the synthesized nanoparticles can be successfully incorporated in to the electrospun fibers via electrospinning. Cytotoxicity study of hesperidin nanoparticle incorporated electrospun scaffolds on L929 cells revealed maximum cell viability in high concentrations. In vitro cytocompatibility results showed that the cells were more viable in hesperidin nanoparticle incorporated electrospun scaffolds than PLGA electrospun scaffolds.
Conclusions: The study suggests that the hesperidin nanoparticle incorporated electrospun scaffolds show more cell adherence and cell proliferation therefore it can be a good candidate for wound healing applications.
Keywords: Hesperidine, Electrospinning, Nanoparticle, Scaffolds

09 - LIFE SCIENCES

09-01

IN VITRO CYTOTOXIC AND APOPTOTIC POTENTIAL OF PURIFIED TERPENOID OF *BRACHYTHECIUM BUCHANANII* (HOOK.)A. JAEGER IN MG63 OSTEOSARCOMA CELL LINES: A SEARCH

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Background: Osteosarcoma is the most common malignant bone tumor in children and adolescents. This aggressive cancer mostly occurs in the long bones. Therefore, novel therapeutic approaches, such as biological therapies and gene therapy, are required to efficiently treat osteosarcoma. Bryophytes are primitive non vascular species contain a pool of secondary metabolites. However, little is known regarding the therapeutic effects of bryophytes on carcinoma.
Methods: This study investigated the effects of purified terpenoids on MG63 human osteosarcoma cells, in addition to elucidating the regulatory signaling pathways underlying the effects of terpenoids, the caspase cascade and the antioxidant enzyme system. The MG63 cell line was treated with various concentrations of terpenoids. Cells were analyzed using MTT and flow cytometry. The migration and invasion potential using wound-healing was analyzed.
Results: The purity of the terpenoid fraction was checked by HPLC and FTIR analysis. Structural elucidation was completed by using NMR. Microscopic studies showed that terpenoid treated cells exhibited marked morphological features characteristic of apoptosis. The flow cytometry study substantiated terpenoid induced apoptosis in MG 63 cells. Cell cycle analysis revealed the significant increase in the number of cells arrested at the S growth phase. Terpenoid extract also resulted in DNA fragmentation in the cells. Western blot analysis was used to test for the presence of the antiapoptotic proteins Bcl2 and cleaved caspase 3 (procaspase3) and the proapoptotic protein Bax. In present study it was demonstrated that the antioxidant enzyme system was also involved in the terpenoidinduced apoptosis
Conclusions: Thus, the overall results confirmed the terpenoids induced apoptosis in MG63 cells.
Keywords: Anticancer, caspase, G2/M phase arrest, S phase arrest, DNA fragmentation, apoptosis

09-02

EFFECTIVE AMELIORATION OF LIVER FIBROSIS BY *TETRACERA AKARA*(BURM. F.) MERR., AN ETHNOMEDICINAL PLANT*VIA.*INHIBITINGNF-KBSIGNALING PATHWAY AND HSC ACTIVATION- A NOVEL THERAPEUTIC APPROACH

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Background: Liver fibrosis is a chronic degenerative disease, which when left untreated may lead to cirrhosis or hepatocellular carcinoma and are usually irreversible conditions lacking complete cure in modern allopathic treatment. Roots of *Tetracera akara*(Dilleniaceae) locally known as '*Nennelvalli*' is used by the Kani tribes of Kerala for treating liver disorders and the present investigation aims to scientifically evaluate the hepatoprotective effect of *T. akara*against CCl_4-induced liver fibrosis to reveal its mechanism of action andits bioactive phytoconstituents.
Method: *T. akara* crude extract and various fractions were subjected to antioxidant screeningand the most potent ethanolic fraction (TA ETH) was selected for further evaluation. Fibrosis was induced in Wistar rats as per the procedure of Marsillach*et al*., 2009. Comparative HPTLC, HPLC and HR LC-MS analysis of TA ETH was carried out to reveal the bioactive constituents.
Results: In chronic liver fibrotic studies, TA ETH (300 mg/kg) showed significant hepatoprotection and was comparable to the standard, Silymarin, which was evident from the reduced levels of biochemical serum parameters (AST, ALT, ALP etc.) and increased level of antioxidant enzymes like CAT & SOD. The gene expression studies carried out revealed that the levels of TNFα, TGF β, TIMP 1were down regulated, whereas the levels MMP13 and IL 10 were upregulated in the TA ETH treated group leading to the inhibition of NF κB signaling pathway and HSC activation. Detailed phytochemical analysis revealed the presence of Betulinic acid and HR LC-MS showed the presence of bioactive terpenoids and flavonoids.
Conclusions: Thus, from the study it can be inferred that the anti-fibrotic potential of *T. akara*may be due to the synergistic effect of bioactive phytoconstituents with antioxidant and anti-inflammatory potential present in TA ETH *via*. inhibitingNF κB signaling pathway and Hepatic Stellate Cell activation.
Keywords: Dilleniaceae, *Tetracera akara*, Fibrosis and Betulinic acid.

09-03

POLYPHENOLS RICH *MURRAYA KOENIGII* LEAF EXTRACT EXERTS CARDIAC PROTECTION IN STREPTOZOTOCIN INDUCED DIABETIC RATS

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Background: *Murraya koenigii* is a medicinal plant with great therapeutic potential. The leaves are used by Indians in herbal medicines to treat diabetes. The present study is aimed to determine the effect of *Murraya koenigii* in cardiac tissues under diabetic conditions.
Methods: Diabetic rats were treated orally with hydro alcoholic extract of *Murraya koenigii* leaves at a dose of 200 mg/Kg body weight for 60 days. The effect of extract on serum glucose, glycated hemoglobin, plasma insulin, and the levels of thiobarbituric acid reactive substances (TBARS), hydroperoxides (HP), conjugated dienes (D), activities of superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx), glutathione-reductase (GRD) and reduced glutathione content (GSH) were estimated. Metformin and atrovastatin were used as standard drugs. Phytochemical characterization of hydro alcoholic extract of *Murraya koenigii* was done using HPLC analysis.
Results: A significant increase in plasma insulin, activities of superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx), glutathione-reductase (GRD) and reduced glutathione content (GSH) and a significant decrease in serum glucose, glycated hemoglobin, thiobarbituric acid reactive substances (TBARS), hydroperoxides (HP) and conjugated dienes (CD) were observed in the treated groups. HPLC analysis revealed the presence of biologically active phytochemicals such as gallic acid and morin in the hydro alcoholic extract of *Murraya koenigii* leaves.
Conclusion: This study evaluated the antioxidant potential of hydro alcoholic extract of *Murraya koenigii* leaves.

These findings suggest the protective role of *Murraya koenigii* against oxidative stress in the heart of diabetic rats. Hence in addition to the anti diabetic effect, *Murraya koenigii* possess antioxidant potential can be used as a therapeutic agent to diabetic cardiomyopathy. The cardio protective effect of *Murraya koenigii* may be due to the synergistic action of photochemical present in it.

Keywords: *Murraya koenigii,* Antioxidants, Heart diseases, Diabetes.

09-04

SCREENING AND IDENTIFICATION OF CAMPTOTHECIN PRODUCING ENDOPHYTIC FUNGI FROM *OPHIORRHIZA MUNGOS*

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Background: Endophytic microorganisms have been reported to be equipped with the potential for the biosynthesis of plant specific compounds as part of their biochemical adaptation. As camptothecin is reported as the third largest anticancer drug currently available in the world market. Identification of its production by endophytic microorganisms is very important. Hence the present study focused on the identification and characterization of camptothecin producing endophytic fungal isolates for its wide range biological applications.
Methods: In the present study, endophytic fungi were isolated from the surface sterilized leaf tissues of *Ophiorrhiza mungos*, selected fungi have been screened and identified for camptothecin biosynthetic potential. This was further confirmed by HPLC and LC-MS/MS analysis.
Results: MS/MS analysis confirmed the extract of two fungal isolates *Meyerozyma* sp., and *Talaromyces* sp. isolated from *Ophiorrhiza mungos* to have the presence of compounds with *m/z* 348 same as that of the camptothecin standard. This was further confirmed due to the presence of daughter ion masses of 349, 320, 305, 277, 249 and 220 by MS/MS analysis.
Conclusion: The microbial production of camptothecin is very important as it is one among the most selling anticancer drug of high significance due to the increasing global demand. In the present study, 2 endophytes from *Ophiorrhiza mungos* have been characterised for their potential of camptothecin production which suggest the role of endophytic microorganisms for its biosynthetic potential.
Keywords: Camptothecin, *Ophiorrhiza mungos*, anticancer drug, endophytes, LC-MS/MS fragmentation

09-05

A HIGHTHROUGPUT APPRAOCH FOR CANCER DRUG SCREENING USING REDOX GFP AND FRET BASED PROBES OF CELL DEATH

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The most versatile tool known for live cell imaging of cell death is the detection of caspase 3 activation using CFP/YFP based FRET probes with single excitation, dual emission ratiometric imaging. Similarly, redox sensitive GFP probes (roGFP) targeted mitochondria has been employed for live cell imaging of mitochondrial oxidation with dual excitation ratio imaging approach. Even though these probes for caspase activation and mitochondrial oxidation were extensively used for studying the progression of these events in live cells independently, simultaneous single cell imaging of both these events remains as a challenge because of difficulty in imaging owing to their spectral overlap. In order to overcome this limitation, we have introduced the caspase sensor based CFP/YFP FRET probe at the nucleus and mitochondrial oxidation probe at the mitochondria for simultaneous visualization of both the events. We have developed few cancer cells stably expressing these probes that allowed us to visualize both caspase activation and progression of mitochondrial oxidation at single cell level with sufficient temporal and spatial resolution in diverse imaging platforms. We describe a systematic approach for real time visualization of these critical events both by wide-field microscope and confocal imaging. In addition, we also describe how these two events of cell death can be quantitatively measured in high-throughput imaging method for compound screening using a dual ratio imaging. Further, simultaneous with caspase activation and mitochondrial oxidation with potential application in understanding cell death and cell survival

pathways. The real time probe with capability for simultaneous detection of the key events of cell death and cell survival possess diverse application potential in understanding cell death and cell survival signaling and drug discovery process. Preliminary results prove that, mitochondrial oxidation is an event that precedes caspase activation. The cells beyond a threshold level of oxidative stress undergo caspase activation that can be very well identified and tracked using the method described here.

09-06

LARVICIDAL EFFICACY AND MODE OF ACTION OF 22-HYDROXYHOPANE FROM ADIANTUM *LATIFOLIUM* AGAINST *ORYCTES RHINOCEROS* (COLEOPTERA: SCARABAEIDAE)

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Background: *Oryctes rhinoceros* is one of the serious pests of coconuts and other palms. Its larvae depend on microorganisms as symbionts in the digestion of lignocellulosic food. Secretion of digestive enzymes, histomorphology of gut and ecdysteroid level in haemolymph are important for normal development of the larvae. Plants synthesize different phytochemicals to resist the attack of insect pests. The present work aimed in the study of larvicidal efficacy and mode of action of 22-hydroxyhopane isolated from leaves of *Adiantum latifolium* against *O. rhinoceros*.
Method: Larvicidal efficacy was studied in third instar larvae of *O. rhinoceros* by feeding the larvae with cow dung mixed with the compound, antibacterial activity by Agar well diffusion method. Histological studies of midgut tissue by Haematoxylin – Eosin staining. Amylase, protease and trehalase activity by following standard protocols, 20-hydroxyecdysone level in haemolymph by ELISA.
Result: 22-hydroxyhopane showed significant larvicidal activity against *O. rhinoceros* (LC_{50} value 20.81µg/g) and antibacterial activity on gram positive and gram negative gut bacteria. It also caused histolysis of midgut tissue, inhibition of secretion of digestive enzymes such as protease, amylase and trehalase, 20-hydroxyecdysone surge, prepupation and death of larvae.
Conclusion: The leaves of *A. latifolium* can be used as a source of natural pesticidal compounds against *O. rhinoceros*.
Keywords: *Oryctes rhinoceros, Adiantum latifolium,* 22-hydroxyhopane, 20-hydroxyecdysone Haematoxylin – Eosin, ELISA.

09-07

PURIFICATION AND FRACTIONATION OF ANTHOCYANINS FROM SUSPENSION CULTURES OF *OSBECKIA ASPERA* L. AND *OSBECKIA RETICULATA* BEDD.

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Anthocyanin show many biological potentialities including their application as food colourant. The present study aims to extract, purify, and fractionate anthocyanin from *in vitro* suspension cultures of *Osbeckia aspera and O. reticulata* and to evaluate its biological potentialities. *In vitro* culture including cell suspension, elucidation of anthocyanin, purification, characterization and its fractionation from *Osbeckia aspera* (L.) var. *aspera* and *Osbeckia reticulata* were done. Cell suspension cultures from friable calli was carried out using different hormonal combinations, light intensity, photoperiod, temperature, pH, sucrose concentrations and chemical elicitors like jasmonate, salicylate, $CuSO_4$, gibberellic acid and abscisic acid. High accumulation of anthocyanin was attained at 14 days on the medium fortified with 2, 4-D (0.5 mg l^{-1}) + BA (0.5 mg l^{-1}). 200 - 400 lux light intensity, 24 h light period, 20°C temperature, pH 4.25, 6% sucrose concentration, 200 µm jasmonic or salicylic acid for 72 h induced maximum anthocyanin i.e., 39.85 and 40.2 respectively. Extractability of anthocyanin from cell cultures with Methanol: HCl system yielded the best than isopropanol: HCI system. pH 1.0 and 2.0 with temperature up to 40°C was ideal in terms of extraction efficiency of anthocyanin among the species. UV-Vis absorption spectra of purified anthocyanins were also analyzed. The Amberlite XAD-7HP chromatography shows $A_{Vis\text{-}max}$ at 525 nm, 527 nm, 528 nm and 529 nm respectively for *O. aspera* and that for *O. reticulata* were 524 nm, 525nm, 526 nm and 528 nm respectively. LC-MS analysis yielded the following fractions in *O. aspera* such as malvidin-3,5–diglycoside (655.2); 7,3',5-trideoxy delphinidin-3-glycoside (417.2); cyanidin (287.1);

tricontyl-4-hydroxycinnamate (584.3). In the case of *O. reticulata* the fractions were tricontyl-4-hydroxycinnamate, bisdeoxy delphinidin-3-glycoside and bisdeoxy cyanidin.

09-08

DOCUMENTATION AND QR CODE ENABLED DIGITIZATION OF TREE AND GARDEN FLORA OF KANAKAKKUNNU PALACE, THIRUVANANTHAPURAM – INDIA'S FIRST DIGITAL GARDEN IN PUBLIC PLACE

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Background: The 21 acres of Kanakakkunnu Palace premise is a unique model of conservation of biodiversity and ecosystem management. In the present investigation both trees and garden plant species at Kanakakkunnu Palace were documented. All the documented data were digitized through website creation, QR code linking and Android App creation.
Method: After documentation of trees and garden plants in the Palace premise, each plant species were digitalized through a website with unique URL. After complete digitalization of the floristic data, unique QR code for each plant species was generated by linking the specific URL through online software QRstuff.com. Android App for accessing the tree and garden plant species of Kanakakkunnu Palace was developed by using Java as the programming language and XML as the database.
Observations: A total of 126 trees and garden plant species were documented in the Kanakakkunnu Palace premise during the study period (2016-2018). Of the 126 species documented belonging to 105 genus and distributed in 44 families. Database is created as a Blog using Google Blogger with website link - https://asvnairflora.blogspot.com/.
Conclusions: QR code for each plant was stick along with the plant label. So a person coming to Kanakakkunnu Palace can scan the QR code, using their QR code scanner through their smart phones. The QR code translate to the specific URL of website, where the person can easily access the complete data of that plant which includes the Photograph, economic importance, flowering period, geographical distribution, nativity and botanical characters. It is not possible to provide all the details in the label. In the bottom of each flora page, a download link for the Android App –'Golden Flora' is also provided. Specific QR codes were also stick in the herbarium sheet. By scanning the QR code in the herbarium sheet one can see the natural pictures and all the details of dried specimen without visiting its natural habitat.
Keywords: Digital Garden, QR code, Android App, URL, Blog.

09-09

IRRIGATION REQUIREMENT USING CROPWAT MODEL AND ASSESSING THE INFLUENCE OF NUTRIENT MANAGEMENT AND METHOD OF PLANTING ON CROP AND WATER PRODUCTIVITY OF AEROBIC RICE

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Background: Rice (Oryza sativa L.) is one of the most important cereal crops, about 55% of the rice area is irrigated and accounts for 75% of the total rice production in the world. Rice crop is a prime target for water conservation, because it is the widely grown crop under irrigation. Rapidly depleting water resources threaten the sustainability of the irrigated rice and hence the food security and livelihood of rice producers and consumers. Conventional rice production systems (puddled transplanting) require large quantities of water. Hence, use of aerobic rice is a new way of production system, which is specially adapted to well-drained, nonpuddled, and nonsaturated soils
Methods: The study quantified water requirement of aerobic rice (*Cv. Uma*) using CROPWAT model and in addition, different methods of planting and nutrient management practices were evaluated. Details are as follows: method of planting as transplanted and direct line sowing and different nutrient management regimes (viz., - T_{1-}125 % application of inorganic fertilizers T_{2-}100 % application of inorganic fertilizers and T_{3-}100 % application of organic manures in the field of Water Management (Agriculture) Division at CWRDM, Kunnamangalam, Kozhikode.
Results: The current study showed that direct line sowing performed better than the transplanted method under aerobic rice and with respect to nutrient management, 125 % of recommended dose of inorganic N fertilizers (RDIF) inorganic nutrient management produced higher yield compared to the organic manure application. Organic manure applied

treatment produced the lowest crop growth parameters. Net irrigation requirement for the aerobic rice is 380 mm for the cultivated season, whereas the same modeled using CROPWAT for anaerobic rice is 819 mm, which showed a water saving to the tune of 57 %.
Conclusions: To conclude, direct method of line sowing along with 125 % of recommended dose of inorganic fertilizers will result in higher crop and water productivity under aerobic rice cultivation.
Keywords: Aerobic rice, Productivity, CROPWAT Model.

09-10

EFFECT OF BISPHENOL A ON THE PROTEIN TURNOVER REGULATING ENZYMES AND PROTEIN PROFILE IN THE MALE *DROSOPHILA ANANASSAE* (DOLESCHALL)

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Background: Bisphenol A (BPA), major industrial chemical and an environmental estrogen, is present in various types of plastic products and has residual effect on the ecosystem. Adult males of *Drosophila ananassae* which were developed in culture with BPA at concentrations of 10, 15 and 20mg/L were tested for effects in protein profile and protein turn over regulating enzymes.
Methods: Estimation of total protein**,** SDS PAGE and assays of Cathepsin D, Leucine amino peptidase, Transaminases and Phenyl oxidase using standard protocols.
Results: Significant changes in protein profile and enzyme activities in the studied concentrations indicate stress response to BPA.
Conclusion: BPA induces stress in the males of *Drosophila ananassae* which were developed in BPA containing media. Bishenol A present in the environmental matrices is detrimental to invertebrates.
Key words: *Drosophila ananassae*, Bisphenol A, protein profile, Transaminases, Phenyloxidase, Leucine amino peptidase, Cathepsin D

09-11

ANALYSIS OF GENETIC DIVERSITY IN *ANANAS COMOSUS* (L.) MERR HYBRIDS USING ISSR MARKER

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Background: Pineapple, *Ananas comosus* (L.) Merr., is a commercially demanding important tropical fruit that belongs to the family Bromeliaceae. In pineapple sexual reproduction is rare in nature due to self-sterility.Hybridization is possible due to heterozygosity and hybrids are valuable materials in breeding programmes and a wide variety of genotypes could be generated. Genetic variations are very important in crop improvement and it forms the basis of development of new varieties.
Method: Two pineapple hybrid plants (coded as KM 1 and KM 2) from the cross between *Ananas comosus* cv. Mauritius female (coded as M) and *Ananas comosus* cv. Kew male(coded as K) and one hybrid (coded as AK) from the cross between *Ananas comosus* cv. Kew female and *Ananas comosus* var. *bracteatus* male (coded as A) were selected for the present study. DNA isolation was done using NucleoSpin® Plant II Kit (Macherey-Nagel). The quality of the DNA isolated was checked using agarose gel electrophoresis. Nine primers were used for ISSR- PCR analysis. The PCR products were checked in 1.2% agarose gels prepared in 0.5X TBE buffer containing 0.5 µg/ml Ethidium bromide. For analysing the molecular data, strong and reproducible bands were scored. The analysis was carried out in power marker software.
Results: In the present study, genetic diversity among the parents and hybrids of a combination of pineapple varieties were analyzed using 9 ISSR primers. But 7 primers only produced banding patterns. Out of the 7 primers, 6 produced polymorphic bands and one primer produced a monomorphic band. In total, primers produced 33 bands, out of which 31(94.29 %) were polymorphic and 2 (5.71%) were monomorphic. In the UPGMA tree, two principal clusters were formed. The first principal cluster consists of A, AK and KM 1. The second principle cluster contained M, K and hybrid

KM 2.
Conclusion: This study proves that ISSR marker is a powerful tool for the detection of genetic variability in different cultivars and hybrids of *Ananas comosus.* So the morphological similarities between hybrids and parents are proved by the molecular analysis.
Keywords: *Ananas comosus,* Genetic diversity, ISSR marker, UPGMA

09-12

POLYPHENOLIC COMPOUND AND ITS FREE RADICAL SCAVENGING POTENTIALITY OF WILD AND CULTIVARS OF *IMPATIENS BALSAMINA*

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Plants are valuable sources for vast array of secondary metabolites. Among them anthocyanins are naturally occurring flavonoids and are the largest group of water soluble pigments derived from the precursor phenylalanine. These are natural colourants with immense biological potentialities. Bright color of anthocyanins ensures a natural healthy alternative to synthetic dyes. Balsam is one of the species show wide variation in terms of colour and shape of flower and are widely distributed throughout the Northern hemisphere and tropics. Tribals use the coloured floral extracts of *Impatiens balsamina* against snakebite, burn, warts, rheumatism, fractures, hair growth, constipation etc. Interestingly, the ethnic usage is not validated scientifically. Anthocyanins are proven for its nutraceutical values. Initially the anthocyanin from Balsam species was screened followed by evaluation of antioxidant potential of the promising species. Significant levels of total phenols and flavonoid content was noticed in the wild and cultivar of *I.balsamina*. Subsequently, the antioxidant potential was analysed. Remarkable scavenging potentialities were showed against metal chelating, ABTS radical, DPPH and FRAP assays and the results were comparable with the synthetic antioxidant like ascorbate and catechin. The varied potentialities of the radical scavenging by the extracts may be due to the factors like stereo selectivity of the radicals or due to the varied fractions of anthocyanin in the crude extract. Further studies are warranted to isolate and fractionate the major anthocyanins from the Balsam species.
Keywords: Balsam, Anthocyanin, Ascorbate, Catechin, *I.balsamina.*

09-13

THE EFFECT OF RHEUMATOID ARTHRITIS SYNOVIAL FLUID ON THE TH17 / TREG RATIO IN A HEALTHY BLOOD SAMPLE

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Background: Rheumatoid Arthritis is a chronic autoimmune disorder that affects the joints and leads to their inflammation. The synovial fluid of Rheumatoid Arthritis patients contains many pro-inflammatory cytokines like IL-1β, IL-23, IL-15, IFN-ϒ, TNF-α etc. The peripheral blood sample of Rheumatoid Arthritis patients was found to have disturbed Th17/Treg balance, due to the expansion of Th17 cells and Th17-related proinflammatory cytokines. Decreased frequency of Treg cells have also been observed. Th17/Treg balance is very important for a healthy immunoregulation. A disruption in this pattern can lead to the development of autoimmunity.
Method: Healthy blood sample was taken and cultured with 10% cell-free Rheumatoid Arthritis synovial fluid at 37°C in 5% $CO_2$for 18 hours. Mitogen stimulation was given for 6 hours. Surface staining and intracellular staining for Th17 and Treg cells were carried out and acquired in Flow Cytometry.
Results: From the analysis of the plots obtained, there is a slight increase in the value for Th17 cells and a considerable decrease in the value of Treg cells from the control, signifying a notable increase in the Th17/Tregratio. The Th17/Treg

ratio was found to be disrupted.
Conclusions: The increase in the percentage of Th17 cells may be due to the presence of pro-inflammatory cytokines like IL-1β, IL-23, IL-15, TNF-α etc. present in the Rheumatoid Arthritis synovial fluid. These may have caused the polarization of T cells and gave rise to an increased number of Th17 cells. This has also lead to the decrease in the production of Treg cells. This implies the possible role of Th17/Treg imbalance in diseased conditions.
Keywords: Rheumatoid Arthritis, Synovial fluid, Th17, Treg

09-14

THE HISTOPATHOLOGICAL CHANGES IN THE GILL AND LIVER TISSUES OF FRESHWATER FISH, *LABEOROHITA* EXPOSED TO MALATHION: PROTECTIVE ROLE OF CURCUMIN

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Malathion is used excessively to protect crops which eventually affects the aquatic ecosystem including fishes. Malathion (O, O-dimethyl-S-1, 2-bis ethoxycarbonyl ethyl phosphorodithioate) is a non-systemic, wide-spectrum pesticide in the organophosphate chemical family and is widely used throughout the world. Curcumin, the phytochemical, has proven to be a promising dietary supplement in aquaculture. Therefore, the aim of the present study was to assess the protective role of dietary Curcuminagainst the histopathological effect on gill and liver of edible fish, *Labeorohita*exposed to long term (10 days) Malathion toxicity. In this study, twenty- four fish were divided into four groups of six each and placed in separate glass aquaria. The fish of group I were freshwater control, group II and III were treated with 0.4 PPM and 0.8 PPM malathion for 10 days respectively and supplemented with commercial fish feed. The group IV fish were treated with 0.8 PPM malathion and dietary curcumin (1g per gm body wt.) were simultaneously administered for 10 days. All the histopathological observation indicated that exposure to sublethal concentrations of Malathioncaused destructive effect in the gill and liver tissues of *L.rohita*. However, this toxic effect was neutralised by the administration of dietary curcumin. The administration of curcumin was considered as an effective way to counter the toxicity of malathion in fish. Curcumin supplemented feed can improve the growth of fish in aquaculture
Keywords: Curcumin, *Labeorohita*, Malathion

09-15

ISOLATION AND CHARACTERIZATION OF AMENTOFLAVONE FROM TWO SPECIES OF *BIOPHYTUM* DC. (OXALIDACEAE)

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Background: The biflavonoid, amentoflavone is reportedly a potent bio-active compound and its presence identified earlier in the medicinally important species, *Biophytum sensitivum*. In the present study,extraction protocols were standardized for the isolation of amentoflavone from two other species of *Biophytumviz*. *B. reinwardtii*(Zucc.) Klotzschand*B. veldkampii*Shanavas *et al.,*followed by its chemical characterization.
Methods: The shade-dried plant parts of the two species of*Biophytum*were Soxhlet extracted with ethyl alcohol (70%) as the solvent. Subsequently, this crude extract was used as the raw material for the isolation of amentoflavone. Column chromatography, with a gradient solvent system of chloroform, methanol and water, followed by the thin layer chromatography of the pooled fractions with a solvent combination of chloroform, acetone and methanol was adopted. High Performance Liquid Chromatography was used to confirm the isolated compound as amentoflavone. Yield, physical (solubility and melting point) and chemical properties of amentoflavone were also noted for both species.The spectroscopic techniques adopted for chemical characterization included Ultraviolet-Visible spectroscopy (UV-Vis), High Resolution Mass Spectroscopy (HRMS) and 1D Nuclear Magnetic Resonance Spectroscopy (NMR).
Results: The yield of amentoflavone was higher in *B .reinwardtii* (86.66mg /100g dried plant powder) than in *B. veldkampii*,(77.50 mg/100g).The crude ethyl extract was subjected to two rounds of coloumn chromatography. Similar fractions (of *B. reinwardtii* -19 fractions and of *B. veldkampii* -17 fractions) from the first step were pooled together (five fractions each for both the species)according to the TLC profile. The 4th fraction in both, showed a clear prominent

band in TLC, which could be seen as a distinct fluorescent yellowband on the chromatogram upon a spray of 8% KOH reagent under short UV (100nm) and blackish brown colour under long UV (320nm). This zone was scrapped off and eluted with pure ethanol which on standing deposited an yellow powdery substance. Co-TLC was used to confirm the isolated compound as amentoflavone (R*f* value- 0.6). In HPLC also the isolated samples showed the peak corresponding to the standard amentoflavone at the retention time (5.3 minutes). The data generated from the different spectral techniques (UV-Vis, HRMS and NMR- ^{1}H NMR, ^{13}C NMR, DEPT) corresponded well with the chemical configuration of amentoflavone in the database. Therefore it could be confirmed that the isolated pure compound from both species of *Biophytum* was amentoflavone (**$C_{30}H_{18}O_{10}$**).

Conclusion: The present study is the first report on the isolation of amentoflavone from *Biophytum reinwardtii* and *B. veldkampii.*Since the amentoflavone content in the two species of *Biophytum* is high, it can be extracted in sufficient amounts and both speciescan beconsidered potential source of the compound.

Keywords: *Biophytum,* Amentoflavone, Column chromatography, TLC, HPLC, UV-Vis, HRMS, NMR

09-16

GUT CONTENT ANALYSIS OF *PILA GLOBOSA* WITH DIGESTIVE ENZYMES - A COMPARATIVE STUDY

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Background: *Pila globosa*, the Apple snail forms one of the vital components in maintaining biodiversity of aquatic ecosystems. Many gastropods are capable of aestivation by maintaining low metabolic activities in anaerobic condition. The aim of the present work is to identify the major metabolic changes two periods of activities of *P. globosa*- dormant and active periods with special reference to gut physiology.

Method: The physical (Ash, Moisture, pH, Temperature) and biochemical (Protein, Lipid, Carbohydrate and Cellulose) parameters of gut contents (oesophagus, stomach, intestine and rectum) were investigated by using standard protocol and changes in dormancy and active periods were compared. Assays were performed to determine enzymes (amylase, cellulase and protease) produced by the gut regions.

Results: All studied enzymes (amylase, cellulase and protease) were detected on the gut regions in varying quantities in both dormant and active periods.These enzyme activities were found to enhance the process of digestion thereby causing a decrease in the gut contents from oesophagus to rectum. Aestivated snails had negligible amount of enzymes in all the gut regions than the active snails. Furthermore, the intestine showed highest quantities of enzymes than other regions of gut.

Conclusions: The study clearly evinced that the digestion efficiency in *P. globosa*is not only aided by the presence of rich amount of digestive enzymes but also by the various physico-chemical parameters (moisture, Ash, pH and temperature) with respect to the allied environmental conditions (dormancy and active). Moreover, the above adaptations thriving for its better performance and thereby ensure their survival under extreme environmental conditions.

Keywords: *Pilaglobosa***,** gut contents, enzymes, physical and biochemical indices, environmental conditions, aestivation, dormancy.

09-17

METAGENOMIC PROFILING OF MICROBIAL COMMUNITIES IN FLOOD-AFFECTED AREAS OF KUTTANAD

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Background: Devastated monsoon flood in Kerala during August 2018 was declared as the calamity of severe nature according to the national disaster management plan. Almost one-sixth of the total population of Kerala had been directly affected by this flood. It can affect the biogeochemical cycles, biological diversity of microorganism and their resistant gene distribution. Kuttanad is one of the worst affected areas in this flood because it lies below the sea level

and the stagnant flood water cancause serious health issues to the public health sector.Here, we initiated a meta genomics approach to analyze the taxonomic profiling and exploring the microbial diversity of sediment samples from flood-affected areas of Kuttanad. We are also interested in identifying then ovel antibiotic resistant genes and their effect on public health surveillance.

Methods: Three sediment samples were collected per site from five flood-affected areas of Kuttanad, Keraladuring August 2018. Metagenomic DNA was extracted using Power soil DNA extraction kit (MoBioLaboratories) and whole-genome metagenome sequencing by HiseqXIllumina system.

Results: High-quality met agenomic DNA wasextracted from sediment samples of five flood-affected areas of Kuttanad, Kerala. An equal amount of DNA from triplicates samples was pooled and taken for whole genome metagenome sequencing. We are expecting highly diverse microbial profiles and novel antibiotic-resistant genes from flood-affected areas.

Conclusion: Our study provides a better understanding to track the changes in microbial communities during the flood and the distribution of resistance genes in this ecosystem. This can uncover detailed information about pathogenic microbes and their epidemiological information that can benefit the public health sector.

Keywords: Metagenomics, Whole genome shotgun sequencing and Taxonomy.

09-18

A STUDY ON THE INECTICIDAL POTENTIAL OF *ASPARAGUS RACEMOSUS* AGAINST RED PALM WEEVIL

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Background: In insect immunity, circulating haemocytes have crucial role in cellular mechanism and caused reduction in total haemocyte count and much variation in their normal profile. Hemocyte play an important role in cellular immunity and identification of different types of haemocytes is important for understanding the cellular immune system in insects.

Methodology:The larvae were reared on sugar cane stems for three generations and select the fourth instar larvae were treated with ethanol extract of *Asparagus*, moderate mortality rate was observed and to analyze estimation of protein according to the protocol. **(Lowry** *et al* 1951). The hemocytes were identified by their distinguishing characters as described by Saheli (2008) and analyse the photographs. Total haemocyte Count was obtained by using Neubauer hemocytometer.

Results: Treated with Asparagus ethanol extracts at concentration 8000ppm and **LD $_{50}$ 1104.08** ppm on fourth instar larvae they showed drastic reduction in Total Haemocyte Count in the fourth instar larvae. The differential hemocyte count of Rhynchophorus larvae showed a sharp increase in the count of granulocytes.

Conclusions: The present study on Rhynchophorus larvae, ethanol extracts of *A.racemosus* can caused serious disturbance of the total hemocyte population and differential hemocyte counts of the identified hemocyte types as well as exhibited dangerous cytopathological effects and leads to decrease in the capacity of larval immune defense.

Keywords: *Asparagus racemoses, Rhynchophorous ferrugineus,* Hemocytes,Total Hemocyte Count, Differential Hemocyte Count.

09-19

PURIFICATION AND CHARACTERISATION OF AGARASE ENZYME FROM AGAROLYTIC BACTERIA ISOLATED FROM CORAL REEF ECOSYSTEMS

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Agar is a polysaccharide present in the cell walls of certain red algae.Agar-degrading bacteria may utilize agar as sole carbon and energy source and can either (i) soften the agar, forming a depression around the colonies or can (ii) cause extensive liquefaction of the agar.Agarolytic bacteria produce an enzyme *viz*., Agarase (*agarose 4-glycanohydrolase*).

Agarases are classified as either α-agarases or β-agarases.When secreted, α-agarases yield oligosaccharides whereas β-agarases result in D-galactose residues.Agarases havevarious industrial and medical application potentials like preparation of protoplasts, isolation of monoclonal hybrids, usage in functional foods, cosmetics,extraction of DNA or RNA fragments from agarose gel. It has a greater role in disposal of agar at Plant Tissue Culture Laboratories.The present study attempted purification and characterisation of agarolytic bacteria isolated from selected coral reef ecosystems along the southern coast of India.

Materials and Methods: Coral samples were screened for agarolytic activity and the isolated strains were identified by biochemical and molecular characterisation. Agarolytic indices were calculated and qualitative test for agarase was performed. Enzymes were purified by dialysis and SDS-PAGE was carried out. Enzyme assay was performed to analyse the specific activity of the enzymes. Protein quantification was done. The purified enzymes were characterised to get pH - temperature optimum and the time course of reaction. Various substrates were analysed to check substrate specificity. Enzyme kinetics was studied and K_m, V_{max} values were determined.

Results and Conclusion: A total of 21 bacterial strains were isolated from different coral reef ecosystems which either liquefies the agar, form pits or soften the agar.Among the 21 strains compared *Aliagarivorans marinus and Flammeovirga yaeyamensis* were found to be potent agarase producers. The enzyme was found to be stable atpH at 3.0 - 8.5 and optimum temperature between 20 – 35^{0}C and 30 minutes time course. Calcium ion could increase the activity of the enzyme whereas sodium ion could inhibit its activity. Enzymes showed higher specificity to agarose than agar.

All the 21 strains showed good agrolytic activity which offers a potential source for agarase enzyme production.

Key words: *Aliagarivorans marinus, Flammeovirga yaeyamensis,* SDS-PAGE

09-20

IN VITRO SHOOT MULTIPLICATION IN *BRUGUERA CYLINDRICA* W & A

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Background: *Bruguera cylindrica W & A*. (Rhizophoraceae) is an important rare mangrove plant. This plant has various medicinal properties and environmental importance. They are very important in protecting the coasts from cyclones. The mangrove plant need to be conserved so that the future generation may benefit by this plant. The main aim of the study is the mass production of the important rare mangrove plant, *Bruguiera cylindrica* through micropropagation methods because the survival rate of seedlings is naturally low.

Method: The present work suggests protocols for the large scale multiplication throughshoot multiplication. The explants were cultured on MS (Murashige and Skoog) medium fortified in different concentrations of benzyl adenine (BA) and supplemented with different combinations of hormones for shoot multiplication.Different concentrations of benzyl adenine (BA) and combination of BA and Naphthalene acetic acid (NAA),Kinetin, activatedcharcoal and NaCL .Encapsulation in the form of synthetic seeds is also done as part of the study.

Results: The seeds produced one shoot and three roots on MS medium**.** The seeds cultured on MS mdium supplemented with 1mg/l BA AND 0.5mg/l NAA produced 1shoot and 2 roots,3mg/l BA along with 0.5 mg/l NAAproduced 1 shoot and 1root. The shoot tip cultured on MS medium with 2mg/L BA along with 0.5mg/l NAA produced 1 shoot-The shoot tips on 1mg/l BA and 0.5mg/l KIN produced 1 shoot and seeds on MS medium with 2mg/l BA along with 0.5mg/l KIN produced 2 shoots.The seeds on 2mg/l BA and 500mg/l charcoal produced one shoot and seeds on 3mg/l BA with 500mg/l charcoal produced two shoots .The shoots on 2mg/l BA and 500mg/l activated charcoal produced one shoot.Seeds on MS medium with 4mg/l BA along with 500mg/l NaCL produced 2 shoots and 3 roots and shoot tips on medium with 4mg/l BA with 500mg/l NaCL produced one shoot. Shoot tip produced one shoot on MS medium supplemented with 500mg/l activated charcoal along with 500mg/l NaCL and seeds produced 3 shoots and 6 roots.

Conclusion: Tissue culture protocols were standardized for micropropagation of *Bruguiera*cylindrica W & A.Rapid clonal multiplication was achieved via nodal segment culture, shoot tip culture and seed culture.

Keywords: Micropropagation, *Bruguiera cylindrica* W & A, Murashige and Skoog (MS) medium, Encapsulation, Activated charcoal, NAA, BA, kinetin.

09-21

BACTERIAL ISOLATION, HYDROLYTIC ENZYMES PRODUCTION AND ITS RELATION TO ORGANIC MATTER OF MANGROVE SEDIMENTS FROM NORTHERN KERALA

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Background: Mangroves are specialised wetland forest found in intertidal zone of estuaries. It is considered as the most productive and economically significant ecosystem in the world.Bacteria is an integral part of mangrove ecosystem, which help to transformation and recycling of different nutrients. Most of the mangrove bacteria are able to produce the hydrolytic enzymes. The extracellular hydrolytic enzymes are widely used in industrial and biodegradation process. Researchers are seeking new bacterial strains to make different enzymes to complete the current enzyme requirements. The organic matter of sediments can influence the bacterial population and hydrolytic enzyme activities.
Method: Sediments were collected from Kadalundi, Edaat-Thuruthi, Pazhangadi, Valapattanam, and Kasaragode. For the isolation of bacteria,10g sediments diluted into 30ml distilled water and serial dilution was done. 100µl dilution spread on to the Nutrient Agar medium. Plates were incubated at 30°C for 24 hrs.Bacteria were screened for the various hydrolytic enzymes such as Protease, Amylase, Lipase, Chitinase, Cellulase, Pectinase and Ligninase. Among the Protease, Amylase, Lipase and Chitinase producing bacteria were performed on Nutrient Agar medium supplemented with casein (2%), starch (1%), tributyrin (1%) and colloidal chitin (5%) respectively. As well as, CMC agar (cmc 1%), Pectin agar (Pectin 0.5%), Crawford's agar with 0.5% tannic acid were used for the detection of Cellulase, Pectinase, and Ligninaseenzymes respectively. The pure cultures were inoculated on plates and incubate at 30°C for 24-48 hrs. Until the incubation hydrolytic zone was noted. The determination of organic matter used by Walkely-Black method.
Result: Total 57 bacterial isolateswere isolated from the mangrove sediment samples.Most of the bacterial isolates produced protease (78.57%), cellulase (71.42%), amylase (50%) and lipase (44.64%). While some of the isolates producedligninase (7.14%). Chitinase and pectinase enzymes was not observed. Organic matter of sediments founded as 2.057% to 4.063%.
Conclusion: This study revealed that mangrove bacteria is one of the potential sources for high yield of extracellular hydrolytic enzyme production.
Keywords: Mangroves, Extracellular Hydrolytic Enzymes, Organic matter, Bacteria.

09-22

EFFECT OF ANTI-ETHYLENE COMPOUNDS ON HYPERHYDRICITY REVERSION AND MULTIPLICATION IN *DIANTHUS CHINENSIS* L.

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Background: Hyperhydricity (HH) is a physiological disorder in water imbalance frequently occurs during the tissue culture based propagation especially after 3-4 subcultures. The formation of glassy shoots of HH cultures were noticed in *D.chinensis* cultures and the syndrome adversely affected*in vitro* production of this highly demanded ornamental species. Reversion of HH shoot to normal plantlets through various *in vitro* experiments will improve production of plants thus able to meet the market demand of this ornamental species.
Method: This work explores *in vitro* HH reversion experiments in Murashige and Skoog (MS) medium along with various concentrations of plant growth regulators and anti-ethylene compounds ($AgNO_3$ and $CoCl_2$). The effect of ethylene on HH induction were analyzed by using different concentration of ethyphon on MS medium. The HH reversion was conformed through estimation of relative water content, stomatal bioassay, H_2O_2 and chlorophyll content. Genetic stability of *in vitro* reverted plants wereanalyzed by using 10 RAPD primers.
Results: These findings demonstrated that the induction of HH is triggered by the excessive water accumulation of ethylene action. The hyperhydric nodal segments were cultured on MS medium containing 2.5µM BA, anti-ethylene compounds $AgNO_3$ (10µM) and $CoCl_2$ (5µM) showed complete HH reversion and produced normal microshoots (55.0) with reduced RWC (78.3%). The heavy metal ions thus regulate the ethylene biosynthesis and thereby 50% reductions

in H_2O_2 content characterized by formation of green healthy shoots with proper stomatal morphology. *In vitro* raised shoots were rooted (93.3%) *ex vitro* by 10mM IBA treatment and 92.2% plants were survived. Further, the genetic stability analyzed by using 10 RAPD primers proved plants produced through this method are clonally uniform. Therefore efficient protocol for multiplication of *D. chinensis* using combination of heavy metal salts was established.
Conclusions: Outcome of the study provide new insights in to development of hyperhydricity in the *in vitro* cultures, its avoidance and reversal procedures thus contributes improvement of *in vitro* morphogenesis to wide plant groups and in particular to *D. chinensis*.

09-23

ROS DEPENDENT ENZYMATIC AND NON-ENZYMATIC ACTIVITIES DURING FLORAL MORPHOGENESIS IN *COCCINIA GRANDIS* (L).VOIGT (CUCURBITACEAE)

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Background: The morphogenesis of flower is controlled by various internal and external factors. Formation of reproductive structures from florally determined meristem will lead to the changes in biochemistry, physiology and morphology. Reactive oxygen species (ROS) have dual role in plants, both as key regulators of growth, development, and defense pathways and as toxic by-products of aerobic metabolism. The enzymatic and non-enzymatic antioxidants have developed to detoxify ROS and prevent the formation of highly reactive and damaging radicals.
Method: The present study dealt with the formation of ROS depended antioxidant during the morphogenesis of the flower in *C.grandis*, a dioecious species belongs to the family Cucurbitaceae using biochemical methods.
Results: In the *C.grandis,* male and female plants have different developmental rates and have differed in their biochemical performance during floral morphogenesis. The protein and antioxidant enzymes (SOD, CAT, POD, APOX, GR, MDHAR, DHAR) activities were varied during the development in both the sexes.
Conclusion: The study noticed that the ROS dependent enzymatic production in *C.grandis* is specific to each developmental stage and that may be due to the changes in physiological activities such as defense mechanism, metabolism and complex signaling pathways that are involved during floral development.
Keywords: *C.grandis*, flower development, ROS, antioxidant activity.

09-24

DROUGHT STRESS INDUCED CHANGES IN METABOLITE PRODUCTION AND ANTIOXIDANT ENZYME ACTIVITY IN *MOMORDICA CHARANTIA*

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Drought is one of the major environmental factors that reduce the production of yield and growth of many crops. *Momordica charantia*, a vegetable crop belonging to the family Cucurbitaceae, is an annual monoecious with two varieties viz *M.charantia* var c*harantia* and *M.charantia* var.*muricata*. The present investigation was carried out to study the effect of drought stress on the production of metabolites (carbohydrate, protein, proline) and antioxidant activity (peroxidase (POX), catalase (CAT), ascorbic acid oxidase (AAO), and guicol peroxidase (GPX)) on the leaves of wild and cultivated varieties of *M.charantia* under controlled conditions. The experiments were conducted in the controlled and treated plants, grew in polythene bags containing garden soil, sand and cow dung (2:1:1). The experimental groups were subjected to water stress by withholding irrigation and control plants were irrigated regularly. The wild plants have more anti oxidant activity than the cultivated one. The study emphasized that wild varieties of *M.charantia have* more potential to drought tolerance than that of cultivated varieties.
Keywords: Peroxidase (POX), Catalase (CAT), Ascorbic acid oxidase (AAO), Guaicol peroxidase (POD), Ascorbate peroxidase (APX)

09-25

TWO NEW RECORDS OF BROWN ROT POLYPORES (AGARICOMYCETES, BASIDIOMYCOTA) FROM INDIA

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Background: Polypores are a specialized group of wood inhabiting fungi. They are considered as one of the major wood decomposers, and play important role in nutrient cycling. They are economically and ecologically important. As part of continuing studies on polyporoid fungi of Kerala state, many poroid species were encountered from various localities on various occasions. On detailed macroscopic and microscopic studies and identification using available literature, two brown rot polypores were found as new records to India.
Methods: Fruit bodies were collected from dead woods of forest areas in Kerala, India, during the monsoon seasons of years 2015-2017. Macroscopic and microscopic characterization was done. Systematic position is given as per the Index Fungorum (www. speciesfungorum.org).
Results: On detailed study and identification using available literature, two of the collected specimens *viz Postia floriformis* (Quél.) Jülich and *Rubellofomes cystidiatus* (B.K. Cui & M.L. Han) B.K. Cui, M.L. Han & Y.C. Dai were found as new records to India. Both these species are brown rot causing fungi, belonging to the family Fomitopsidaceae of the order Polyporales.
Conclusion: Both *Postia floriformis* and *Rubellofomes cystidiatus* are economically important since they are capable of causing brown rot disease on the trees/wood they attack. *Rubellofomes cystidiatus* was reported from South China (as *Fomitopsis cystidiata* B.K. Cui & M.L. Han) by Han *et al*. (2014). Since then, there are no reports of this species from other parts of the world. So, this is the first report of the species from a country outside China, and also a new genus record for India. The two new species records are also an addition to the floristic account of polypores of Kerala.
Keywords: Brown rot- India- Kerala- polypores - *Postia- Rubellofomes*- white rot

09-26

BIOCHEMICAL ANALYSIS AND *IN SITU* LOCALIZATION OF REACTIVE OXYGEN SPECIES IN MULBERRY GENOTYPES

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Background: Mulberry (*Morus spp.*) is a deciduous woody tree and which has great economic significance in sericulture as its leaf is used for feeding the monophagous silkworm (*Bombyx mori* L.). Leaf nutritional quality directly influences the growth and development of silkworm. Abiotic stress such as drought, temperature, salinity/alkalinity of soil etc. reduces the leaf yield in mulberry and it negatively influences the plant growth by altering the developmental, structural and physio-biochemical processes. The primary effects of abiotic stress is ion imbalance and hyper osmotic stresses, which leads to a cascade of the molecular network which in turn activates stress responsive mechanisms to re-establish homeostasis and to protect and repair damaged proteins and membranes. Under normal conditions, the production and destruction of reactive oxygen species is well regulated in plant cells. In abiotic stress conditions, balance between the production of reactive oxygen species (ROS) and the quenching activity of the antioxidant system is upset, and this leads to injury to the plants through oxidative damage. On this background, the present study is mainly focused on the biochemical analysis and in situ localization of reactive oxygen species: superoxide radicals (SOR) and hydrogen peroxide (H_2O_2) in few selected mulberry genotypes recommended for irrigated conditions (V1), rain fed areas (S13, Mysore local & K2), resource constraint conditions (RC1 & RC2), shade tolerance (Sahana) and soil moisture stress conditions (MSG2 & AGB8) under optimal input conditions. Accumulation of ROS in leaves were correlated with the activity of ROS scavenging enzymes for evaluating the antioxidant responses of these genotypes.
Method: Biochemical analysis of ROS scavenging enzymes (superoxide dismutase & peroxidase) and estimation of hydrogen peroxide were carried out in selected mulberry genotypes using standard procedures. Nitroblue tetrazolium (NBT) staining method was used to detect the in situ production of superoxide radicals in leaves and accumulation of

H_2O_2 was localized with KI/starch reagent. Photographs were captured using a camera installed with Euromex, Image Focus 4.0, version 329271.

Results: The hydrogen peroxide content varied among genotypes and it ranged from 358.84 to 916.84 µmol/g. The highest amount of H_2O_2 was found in Mysore Local (916.84 µmol/g) and RC2 (834.78 µmol/g). Quantity of H_2O_2 accumulated in leaves can be correlated with peroxidase (POX) enzyme activity and least POX activity was observed in all of these varieties. The histochemical localization of hydrogen peroxide in leaves indicated that the maximum amount of H_2O_2 was observed in Mysore Local and RC2. Almost similar amounts of H_2O_2 were localized in V1 and K2. Least accumulation of H_2O_2 was observed in MSG2, S13, and RC1 and all these varieties recorded high POX activity. Varieties with high POX activity efficiently scavenge H_2O_2 and therefore their accumulation is comparatively low in leaves. This was confirmed in the present study by the in situ localization of ROS.

The maximum amount of SOR was localized as dark blue deposits in K2; whereas minimum SOR were observed in RC1, RC2, MSG2 and AGB8. High SOD activity was recorded in RC1, RC2 and MSG2 and this can be positively correlated with the least accumulation of SOR in leaves.

Conclusions: Present study reported the least accumulation of reactive oxygen species and relatively high activity of antioxidant enzymes in stress tolerant varieties such as RC1, MSG2, S13 & RC2. In situ localization ROS in leaves also confirmed comparatively low accumulation of H_2O_2 and superoxide radicals in these varieties.

Keywords: Mulberry, reactive oxygen species, in situ localization, hydrogen peroxide, superoxide radicals

09-27

FIRST RECORD OF THE HALOPHILIC FUNGUS, *PENICILLIOPSIS CLAVARIIFORMIS* SOLMS (EUROTIOMYCETES, ASCOMYCOTA) ON *DIOSPYROS PANICULATA* DALZ. FROM INDIA

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Background: *Diospyrospaniculata*Dalz.is a gum secreting plant belonging to family Ebenaceae (DhongadeandMasram 2012), commonly called as panicle-flowered ebony.It is a moderately sized tree reaching15 meters height and 1.2 meters diameter. According to Dhongadeand Masram (2012), gum of the *D. paniculata* shows antifertility effect. Most parts of the tree have potential medicinal value and has been utilized in folk medicinesto treat several ailments like blood poisoning, rheumatism and ulcer(Sinha *et al*. 2009).At present, the population size of *Diospyrospaniculata* is decreasing due to habitat loss, habitat disintegration and uncontrolled exploitation for medicine (Ved*et al*. 2015). Ved*et al*. (2015) has listed the species as vulnerable in the IUCN Red List of Threatened species 2015.

During our studies on fungi in a sacred grove in Kerala, an interesting fungal fruit body was encountered on the fruits and seeds of *Diospyrospaniculata*. The taxonomic identity of this fungus producing the fruit body was investigated using morphological and molecular data and is being presented.

Methods: Fruit bodies were collected from the fruits and seeds of *Diospyrospaniculata*from the sacred grove, Thurayil Kavu Bhagavathy Temple, Kerala, India, during August 2018. Morphological and molecular characterizations were done. Macroscopic and microscopic anatomical features were recorded. Light microscopic observations were made on materials stained using aqueous solutions of 3% phloxine and 1% Congo red and mounted in 5% aqueous KOH. Molecular characterization was done by sequencing the nrITS gene region.

Results: The fungus was identified as *Penicilliopsisclavariiformis*Solms (Eurotiomycetes, Ascomycota)based on morphological and molecular data.

Conclusions: *Penicilliopsisclavariiformis* was first described from Indonesia by Solms-Laubach (1887) on the seeds of *Diospyrosmacrophylla*. The species reproduce sexually by forming globoseperithicia and asexually by forming conidiomata in their natural habitat (Oxford and Raistrick 1940). Douanlaand Langer(2007) reported this fungus from West Africa on the seeds of *Diospyroscrassiflora*.In India, this species was first isolated as a salt tolerant fungus from mangroves by Kashyap*et al*. (2016). As per the available reports, this fungus fruits specifically on *Diospyros* species and has not been reported from any other plant so far. The present study reveals the first record of this fungus on *Diospyrospaniculata*. The species record is an addition to the mycobiota of Kerala.

Keywords: Ascomycota, *Diospyrospaniculata*, halophilic, *Penicilliopsisclavariiformis*

09-28

PURIFICATION, FRACTIONATION OF TERPENOIDS FROM *HYPNEA MUSCIFORMIS* BY GC-MS AND ANALYSIS OF ITS ANTIOXIDANT AND ANTI-INFLAMMATORY POTENTIALITIES

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Background: Marine macroalgae produce a diverse array of secondary metabolites such as terpenes, sterols, polyphenols, acetogenins and others which were characterized by a broad spectrum of biological activities The terpenes composition from the red algae *Hypneamusciformis*was identified. The analysis of the purified fraction revealed the presence of 8 major peaks of terpenoids.The purified terpenoid fraction have exhibited significant *in vitro* antioxidant and anti-inflammatory activity.
Method: Fractionation of the crude methanolic algal extract was done by silica gel Column chromatography .The eluted fractions were then subjected to TLC and further analysed by GC-MS. The *in vitro* antioxidant activity was evaluated in terms of 1,1-diphenyl-2-picrylhydrazyl(DPPH),2,2'-azinobis 3ethylbenzthiazoline-6-sulphonic acid (ABTS), ferric reducing antioxidant power (FRAP) assays. Anti-inflammatory activity of the purified terpenoid fraction was determined by Cyclooxygenase (COX) activity and Lipoxygenase (5-LOX) activity.
Results: The methanolic extract of *Hypneamusciformis*was purified by column chromatography. Each fraction was eluted using petroleum ether and ethyl acetatae (95:5) as solvent combinations. The analysis of the purified fraction revealed the presence of 8 major peaks of terpenoids compatible with their fragmentation patterns as detected by using GC-MS spectra technique.Parallelly, the fractions were subjected to thin layer chromatography for confirming the presence of terpenoids.Purified terpenoids was subjected to evaluate the antioxidant power using various methods.The purified fraction exhibited a dose dependent inhibitionof DPPH radicals. The ABTS radical cation-scavenging assay showed that the antioxidant activity increases with an increase in the concentration of terpenoidsTheferric reducing power was found to be higher in terpenoidextract.Further, the anti-inflamatory potential of the purified terpenoid of *H. musciformis* was carried by *in vitro* cyclooxygenase and lipoxygenase inhibitory assays. Purified terpenoid extract tested inhibited LOX in a concentration dependent manner. The IC50 value was 89.87µg/mL. Similarly, the extract displayed COX-2 inhibition in a dose dependent pattern inhibiting 58.5% at 100 µg of extract.
Conclusion: The red algae *Hypneamusciformis*was known for their nutraceutical potentials. The purified fraction of terpenes isolated from this sea weed act as a potential antioxidant and anti-inflammatory agents. This study demonstrated the candidacy of red seaweeds particularly, *H. musciformis*for use as functional food supplements to scavenge free radicals and to deter inflammation.The pharmaceutical significance of terpenoids should be further analysed.
Keywords: Terpenoids, Gas Chromatography- Mass Spectrum, Column Chromatography,Antioxidant, Anti-inflammatory activity.

09-29

IN VITRO EVALUATION OF ANTI-INFLAMMATORY EFFECTS OF VARANADI KASHAYAM, A POLY HERBAL DECOCTION IN THP-1 DERIVED MACROPHAGES

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Background: Varanadi kashayam is an Ayurvedic poly herbal decoction contains 16 plants, for which the mechanisms of action involved in controlling chronic inflammatory conditions has not been evaluated. The use of traditional herbal medicines became a matter of interest in the prevention of inflammation and related disorders due to its natural origin, and fewer side effects. Inhibition of release of pro inflammatory cytokines TNF-α and IL-1β by lipopolysaccharide stimulated monocytes/macrophages are ideal *in vitro* models for identifying anti-inflammatory molecules
Aim: The present study was aimed to determine the effect of Varanadi kashayam on inflammatory responses. Human THP-1 cells were differentiated to macrophages using PMA was used as *in vitro* cell model.
Method: The efficacy of Varanadi kashayam on monocyte cell differentiation was determined by quantitative polymerase chain reaction to assess the expression of differentiation markers MMP-9, CD36, CD11b and CD14. Further Varanadi kashayam treated THP-1 macrophages were induced with Lipopolysaccharide and the production of pro

inflammatory cytokines TNF-α and IL-1β were measured and corresponding genes expressions were quantified.
Statistical analysis: Significance difference among control and sample treated groups were determined by one-way analysis of variance (ANOVA) and the Dunnett's multiple comparison test. A P value of less than 0.05 was considered to be statistically significant.
Results: The result indicates that Varanadi kashayam reduced the differentiation of THP-1 monocytes to macrophages and down regulated the expression of cell surface markers. Further, it could decrease the release of pro inflammatory cytokines from lipopolysaccharide induced THP-1 macrophages and down regulated the expression of TNF-α and IL-1β genes.
Conclusions: The results obtained from this study suggests a possible mechanism of action of the herbal decoction in inflammatory processes and opens up the possibilities of identifying bioactive lead molecules with anti-inflammatory potentials.
Keywords: Ayurveda, Differentiation, Inflammation, Interleukin-1β, THP-1, Tumour necrosis factor-α, Varanadi kashayam

09-30

MOLECULAR DETECTION OF PATHOGENIC BACTERIA *PROTEUS MIRABILIS* CONTAMINATION IN CHICKEN MEAT

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Background: *Proteus* bacteria species is one of the causes of serious infections in humans, along with *Escherichia, Klebsiella, Enterobacter* and Serratia species. These bacteria are generally known as human opportunistic pathogens, isolated from urine, wounds, and other clinical samples. *Proteus mirabilis* has been suggested as a possible causative agent of outbreaks of gastroenteritis, resulting from the consumption of contaminated food. In such a situation the study on *P. mirabilis* in chicken meat in selected districts of Kerala, India, leads to know the extent of *P. mirabilis* contamination of chicken meat in the study area.
Methods: 50 Samples of raw chicken meat were collected from slaughterhouses and meat shops in the study area by simple random sampling method. Bacteriological analysis was carried out on sample by rappaport-vassiliadis broth and hektoen enteric agar. After incubation, black colonies appeared on plates selected, drew out for further confirmation by PCR analysis. After incubation, black colonies appeared on plates selected, drew out for further confirmation by PCR analysis.
Results: 50 samples were studied and 2 samples were contaminated by *Proteus mirabilis*. It was successfully amplified using PCR and the product was sequenced using Sanger's method. Then the trimmed forward and reverse sequences were assembled by using Clustal Omega and consensus sequence was taken for analysis. The nucleotide BLAST programme analyzed for the construction of phylogenetic tree using MEGA software.
Conclusion: This study shows valuable information about the *P. mirabilis* contamination in chicken meat. The health of individuals is at risk so maintaining a proper hygienic environment is an important step to avoid *P. mirabilis* related health hazards in the consumers or spreading to other birds. Microbial control in each and every stage of chicken production can control an outbreak of food poisoning and reduce the pathogenicity of *P. mirabilis.*
Keywords: *Proteus* mirabilis, chicken meat, human pathogen, molecular analysis.

09-31

BISPHENOL A, A PLASTIC RESIDUE OF THE ECOSYSTEM INTENSIFIES MOSQUITO MENACE BY SHORTENING THE LIFE CYCLE SPAN

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Background: Bisphenol A (BPA) is a pseudo-persistent chemical, which despite its short half-life is ubiquitous in the environment because of continuous release. Typical mosquito breeding sites including that of *Culex quinquefasciatus* are polluted waters rich in organic matter and plastic wastes.
Method: GCMS analysis of mosquito breeding sites to detect ecologically relevant concentration of BPA was done.

This was followed by elucidating the action of selected doses of BPA such as 1, 2 and 4 ppm on span of life cycle, protein turnover (activity of selected enzymes as well as MALDI TOF analysis of protein bands), levels of 20- Hydroxyecdysone(20-E) and gene expression of Ecdysone receptor, EcRA and regulated gene, E75A in *Culex* larvae.
Results: BPA exposure resulted in shortening of life cycle of *C. quinquefasciatus* by 2 and half days in BPA reared larvae. Early peaking of 20-E was found in BPA reared larvae. Activity of enzymes such as cathepsin D and phenol oxidase were elevated with increased expression of a putative uncharacterized protein and phospholipase A2-associated protein in 5ppm treated larvae. Upregulation of EcRA and E75A was also observed.
Conclusions: The present investigation proved that exposure of Bisphenol A caused 24% reduction in the length of *Culex* life cycle through shift in protein turnover, novel protein synthesis and early peaking of moulting hormone levels, and upregulation of genes acted upon by Ecdysone.
Keywords: *Culex quinquefasciatus*, protein turn over, MALDI TOF, 20-Hydroxyecdysone.

09-32

COMPARISON OF THE EXPRESSION PROFILE OF mRNA FROM YOUNG AND MATURE LEAVES OF *TECTONA GRANDIS* L F. BY DDRT ANALYSIS

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Background: In plant molecular research, transcriptome analysis is one of the major ways for analyzing the differential gene expression because the gene activities are primarily regulated at its transcriptional level. DDRT-PCR is one of the tools that are used by researchers to compare and identify changes in gene expression at mRNA level between two or more cell samples.
Method: The present study includes the standardization of RNA isolation from the tender and matured leaves of teak by various methods followed by DDRT-PCR to pinpoint the differential expression profile of the transcript and their sequencing.
Results: Remarkable secondary metabolites like polyphenols in the leaves influenced the yield and quality of RNA. Modified GTC method purified the RNA and yielded good quality. DDRT-PCR amplified products were resolved on 1% agarose gel containing ethidium bromide. DNA was extracted from eight differentially expressed bands. The sequencing and BLAST search analysis indicated that 4 of the differentially expressed genes matched the previously characterized genes, while 3 of them matched the uncharacterized sequences as expressed sequence tags (ESTs).
Conclusion: The modified GTC method for RNA isolation provided effective against the interference of secondary metabolites of teak. The transcript profile of young and matured leaf showed significant variations and were further sequenced.
Keywords: *Tectona grandis*, RNA, GTC, PVP, RT-PCR, DDRT

09-33

ANATOMICAL STUDIES OF TWO *CALOTROPIS* L. (APOCYNACEAE) SPECIES

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Background: The common name '*vellerukku*' is applied to two species of *Calotropis* L. *viz.,* white-flowered *Calotropis gigantea* (L.) R. Br. and *C. procera* (Aiton) R. Br. among Siddha and Ayurveda practitioners in Tamil Nadu and Kerala. The reason is that Gamble and Fischer (1921) included these two species in the '*Flora of the Presidency of Madras'*. Hence, people in these States thought that the white-flowered *C. gigantea* is *C. procera* and thus several works related to pharmacognosy and pharmacology were carried out with white-flowered *C. gigantea* but published in the name *C. procera.* Abdul Kader and Chellakumar (2015) have studied the distribution of different *Calotropis* L. species in Tamil Nadu and Kerala, and they reported only *C. gigantea* in Tamil Nadu and Kerala. Since anatomical characters have been used as an additional data to solve the identification of several doubtful and closely related species, we have undertaken the present study at Presidency College, Chennai during 2015.

Methods: Specimens of *C. gigantea* (L.) R. Br. (both white- and purple-flowered) were collected from Chennai and *C. procera* (Aiton) Aiton f. ssp. *hamiltonii* (Wight) Ali from Ahmadabad, in Gujarat during 2013-2014. Leaf and stem anatomy were studied using Rotary Microtome as per standard procedures (Sass, 1940; Johansen, 1940; O'Brien *et al*., 1964; Esau, 1964). Toluidine blue stain was used Photographs of different magnifications were taken with Nikon labphoto 2 microscopic Unit.
Results: There were clear anatomical differences between all the three *Calotropis* L. specimens studied. *C. procera* (Aiton) Aiton f. ssp. *hamiltonii* (Wight) Ali. contains more laticifers indicating the presence of more latex in the plant body than white-flowered *C. gigantea* (L.) R. Br. Further, these two species differs in other anatomical characters such as (i) shape of midrib and vascular strand, (ii) structure of lamina epidermises, (iii) palisade thickness, (iv) and vascular anatomy of stem which are very significant in distinguishing white-flowered *C. gigantea* (L.) R. Br. from *C. procera* (Aiton) Aiton f. ssp. *hamiltonii* (Wight) Ali.
Conclusions: Since the Siddha system of medicine is originated and widely practiced in Tamil Nadu and less in some parts of Kerala, and the absence of *C. procera* (Aiton) Aiton f. ssp. *hamiltonii* (Wight) Ali in these regions, we conclude that the local name **vellerukku** used by people in Tamil Nadu and Kerala pertains to the white-flowered *C. gigantea* which is sacred to Hindus.
Keywords: *Calotropis gigantea* (purple- or lilac-flowered)*, C. gigantea* (white-flowered), *C. procera* ssp. *hamiltonii,* vellerukku, anatomy

09-34

COMPARATIVE STUDY ON ANTIOXIDANT AND ANTIMICROBIAL ACTIVITY OF ESSENTIAL OIL FROM *POGOSTEMON BENGHALENSIS* (BURM.F.) KUNTZE. AND *P. CABLIN* (BLANCO) BENTH

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Background: Western Ghats are one of the rich sources of medicinal and aromatic plants and the natural products from those plants such as essential oils (Eos) possess various biological properties. Essential oils (Eos) are proven to be the potential source of anticancer, antimicrobial and antioxidant activities.
Method: The hydrodistillation product of both plant species of *Pogostemon benghalensis* and *P. cablin* were subjected GC-FID and GC-MS analysis to identify the volatiles present. The Eos were subjected to different antioxidant analysis to prove the free radical scavenging activity. Also the microbicidal property of the Eos were analysed by standard protocol.
Result: The GC-MS analysis of Eos from *Pogostemon benghalensis* and *P. cablin* identified 41 and 36 volatiles respectively. The Eos showed significant scavenging effect on different free radical assay and were at par with artificial antioxidant BHT and ascorbic acid. Further the antimicrobial activity against selected bacterial and fungal strains were substantiated with significant MIC and MKC values. Percentage leakage of reducing sugars and potassium from the microorganism in turn supports the microbicidal activity of Eos.
Conclusion: In this study Eos from the Pogostemon species were proven to be natural antioxidants. Also the microbicidal activity of these oils provides scope to develop novel drugs.
Keywords: *Pogostemon,* Essential oil, GC-MS, BHT, MIC, Antioxidant

09-35

CONNECTOME REGULATES ODOR ADAPTATION AT DIFFERENT THRESHOLDS IN *CAENORHABDITIS ELEGANS*

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Background: Olfactory perception occurs through converting the information residing in the form of a molecular structure into a characteristic odor quality and intensity. This perception of an odorant can also differ with a change in its concentration. To understand the logic of olfactory information processing, one has to first appreciate the coding rules generated at each level, from odorant receptor present in sensory neuron up to the level of motor neurons.

Method: To analyze the mechanisms of sensory recognition and discrimination by the nervous system, we are using the model *Caenorhabditis elegans*. In *C. elegans*, sensory neurons AWC and AWA mediate attractive behavior whereas AWB, ASH and ADL are involved in repulsive behavior on odorants. The question is how the neurons alter their response for the recognition of gradient in odour concentration. Here we tested the behavior of *C.elegans* towards different volatile odorants isoamyl alcohol, butanone and benzaldehyde with their attractive and repulsive concentrations.
Results: GLR-1 is expressed in motorneurons and interneurons, including four of the five pairs of command interneurons that are required for locomotory control, found to have a role in sensing the gradient of odors. Moreover, food associated learning of *C.elegans* with a particular solvent of a low concentration showed an adaptation but the same became repulsive at higher concentration. Our results indicate that the interneuron AIY has a mediatory role in sensing changes in odorant concentrations. Especially sra-11 null mutations, an odor receptor present in AIY interneuron, result in the loss of detection of differences in odor concentration.
Conclusion: These results suggest that there is a downstream pathway involving AIY interneuron, apart from AWC, in odor gradient detection.
Key words: sra-11, Glr-1, ASH neuron, *Caenorhabditis elegans*

09-36

MOLECULAR CHARACTERIZATION OF HISTONE H2A - DERIVED ANTIMICROBIAL PEPTIDE, HIPPOSIN FROM INDIAN MAJOR CARP *CATLA CATLA*

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Background: Antimicrobial cationic peptides are prevalent throughout nature as part of the intrinsic defenses of organisms, and have been proposed as a blueprint for the design of novel antimicrobial agents.Present study was carried out to identify histone derivedantimicrobial peptide from *Catlacatla*as part of their innate immunity.
Method: Total RNA was isolated from gills using TRI® reagent (Sigma) following manufacturer's protocol. First-strand cDNA was generated. PCR amplification of the cDNA was done using Hipposin primer with 60^0C as annealing temperature. PCR products were cloned into pGEMT EasyVector, and transformed into DH5 alpha *E.coli* competentcells. Positive recombinant clones were selected for plasmid isolation. Recombinant plasmids were sequenced.
Results: Histone H2A-derived peptide, Hipposinfrom*Catlacatla* consisted of a 249bp nucleotide sequence, encoding 81 amino acids,which showed 80% similarity to the histone derived peptide of *Cyprinuscarpio.*ExPASyanalysis revealed the presence active peptide sequence of 52 amino acids. The mature peptide of histone derived peptide had a predicted molecular weight of 5.52kDa with +12 charge.
Conclusions: The present study describes the isolation and characterization of a new N-terminally acetylated AMP, which is found in *Catlacatla.*High similarity of Catla Histone H2A-derived peptide to other histone H2A derived AMPs with proven antimicrobial activity and its physicochemical properties in agreement with those of traditional antimicrobial peptides strongly endorse it to be an antimicrobial peptide.
Keywords: Innate immunity; Antimicrobial peptide;Histone H2A; Hipposin, *Catlacatla*

09-37

ANTIBACTERIAL ACTIVITY OF THE ENDOPHYTIC FUNGI FROM THE MANGROVE PLANT, *AEGICERAS CORNICULATUM*

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Background: Endophytic fungi are a group of microorganisms which inhabits in the internal tissue of all healthy plants. They do not cause any symptoms of disease in the host cell. These endophytic fungi are the rich source of unique and diverse natural compounds with various biological activities.
Method: Endophytic fungi were isolated from the mangrove, *Aegicerascorniculatum* collected from Kollam and Kannur. Healthy leaves and stems of the plants were collected, surface sterilized, cut into small segments and placed on Potato Dextrose Agar (PDA) for 2-3 weeks for the isolation of endophytic fungi. The fungal isolates obtained from the plant tissues were screened for antibacterial activity against selected pathogens by Kirby Bauer disc diffusion method.

Result: A total of 40 endophytic fungal isolates were obtained from the tissues of *A.corniculatum* and a preliminary antibacterial screening was performed. Two out of the 40 fungal isolates showed remarkable antibacterial activity against selected pathogens.The endophytic fungal isolates AC 10 and AC 19 inhibited bacterial pathogens viz.,*Vibrio cholera*, *Vibrio vulnificus*, and *Bacillus cereus*..The fungus AC 10 showedantibacterial activity against *Vibrio alginolyticus* and *Vibrio parahaemolyticus*also.
Conclusion: The study indicated that the mangrove plant*A.corniculatum*is a promising endophytic fungal reservoir with antibacterial potential.
Key words: Endophytic fungi, Antibacterial, Mangrove, *Aegicerascorniculatum*

09-38

DNA BARCODING AND PHYLOGENETIC INFERENCE OF *CAREBARA DIVERSA* (HYMENOPTERA: FORMICIDAE) USING MITOCHONDRIAL CYTOCHROME OXIDASE I GENE SEQUENCE

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Background: The ant genus *Carebara* comprises approximately 250 described taxa distributed worldwide. Though it has such a wide distribution range, only limited taxonomic and biological discussions are available on this genus. There are still countless indefinite specimens and morphospecies present in museum collections across the world, which is further expected to grow with the increasing number of species that are being added in accordance with the ongoing researches. The majority of species are very small and seem to have cryptic lifestyles. According to Hebert et al., a single gene sequence, the mitochondrial gene cytochrome oxidase I (COI) can be used as a global identification marker for animals. In the present study a DNA barcode is developed for *Carebara diversa* and a phylogenetic analysis of the same is also performed.
Method: Genomic DNA was isolated from *Carebara diversa* using DNA extraction kit. COI genes were specifically amplified by using forward and reverse primer pairs. The PCR products were purified by column purification procedure and sequenced from both ends by dideoxy chain termination method using the primers used for PCR amplification. The forward and reverse sequences were aligned and the consensus sequence was used for BLAST searches.
Results: The partial sequencing of mitochondrial COI sequence of the species was done. The phylogenetic tree, sequence divergence table and nucleotide substitution table is also constructed for assessment. The sequence was submitted to NCBI Genbank with accession number MK058407 for worldwide accession. In the present analysis *Carebara diversa* showed least divergence (16.95%) with species of genus *Cardiocondyla, Cephalotes, Pheidole* and *Wasmannia.* Among these *Cardiocondyla* belongs to the same tribe (Crematogastrini) as that of *Carebara diversa*, whereas the other three genus *Cephalotes, Pheidole and Wasmannia* belongs to a different tribe (Attini).
Conclusion: The method of using molecular methods for identification as well as taxonomic interpretation of *Carebara* species proves to be effective. The present study clearly showed that DNA Barcoding of ant species with mitochondrial Cytochrome Oxidase I will greatly facilitate and complement taxonomic studies, especially those exhibiting cryptic lifestyles. Combining DNA sequencing data with traditional morpho-taxonomy will serve as a model that can be applied in various disciplines so that the rate of species identification increases which will also help to deal with the present biodiversity crisis.
Keywords: *Carebara diversa*, Cytochrome Oxidase I gene, Formicidae, Myrmicinae, DNA barcode

09-39

MARINE ACTINOMYCETES AS ANTIVIBRIO AGENTS FOR APPLICATION IN SHRIMP CULTURE SYSTEM

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Background: Among microbial diseases*, Vibriosis*, is one of the most prevalent diseases in shrimp culture.*Vibrioharveyi, V. parahaemolyticus, V. alginolyticus, V. anguillarum,V. vulnificus,* and *V. splendidus*are usually associated with shrimp diseases. Actinobacteria,a specific group of Grampositive bacteriaare an excellent source of secondary metabo-

lites.In this study the marine actinomycetes were screened for its activity against vibrios and the potential isolates were segregated for application in aquaculture.
Five Actinomycete isolates A17, A42, A43, A60 and A76 showed remarkableantagonistic activityagainst vibrios, the opportunistic pathogens in aquaculture.
Material and Methods: Actinomycetes (75 nos) isolated from aquaculture pond and mangrove sediments were screened for antivibrio activity.Actinomycetes culture broth was prepared and centrifuged at 1000 rpm for 15 min and culture supernatant was used for testing antivibrio activity using Kirby-Bauer disc diffusion method.
Result and Discussion: Actinomycetes, A17, A42, A43, A60 and A76 showed significant inhibition against *Vibrio harveyi*.Augustine et al (2016) have reported antivibrio activity by *Streptomyces rubrolavendulae* against vibrios.
Conclusion: Marine actinomycetesare promising sources of antivibrio compoundsand therefore can be used in shrimp culture system as an alternative to the use of antibiotics.

09-40

THE EVOLUTION OF *ATROPHA NEURA ARISTOLOCHIAE* AND *TROIDES MINOS* TWO *ARISTOLOCHIA INDICA* FEEDING BUTTERFLIES AND THEIR HOST PLANT FROM THE NUCLEOTIDE SUBSTITUTION RATES OF THEIR CYTOCHROME OXIDASE SUBUNIT I (COI) GENE AND RIBULOSEBISPHOSPHATE CARBOXYLASE (RBCL) GENE.

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Background: The identification of evolution in an organism require some methods,able to identify the small changes in the past million years. In this study,we compared the nucleotide substitution rate of mitochondrial Cytochrome oxidase subunit I (COI) gene from two butterflies *Atropha neura aristolochiae* and *Troides minos* with the chloroplast Ribulosebisphosphate carboxylase (RBCL) gene from their associated host plant *Aristolochia indica* for resolving their phylogeny and co - evolution.
Methods: The genomic DNA isolated from butterflies and their host plant were amplified using PCR protocol. The amplified genes were sequenced by Sanger sequencing, the sequences obtained were analysed through nucleotide BLAST, ClastalW and MEGA. The divergence rate of both butterflies and their host plant were determined from their phylogenetic trees derived from the isolated sequences.
Results: Some correlations were observed in the divergence rates of COI gene sequences from *Atropha neura aristolochiae* and *Troides minos* and RBCL gene from *Aristolochia indica.* The sequences derived were deposited in the GenBank database, it is useful as a molecular barcode helping the species identification and determination of their genetic divergence.
Conclusion: The molecular tools used in this study has some powers to determine their evolutionary rate and co – evolution. The divergence of butterflies and their host plant were used in this study and were diverged significantly after the major vicariance events of the sub-continent such as the formation of Himalayas.
Key words: Co – evolution, Vicariance, Molecular barcode, Host plant, BLAST, ClastalW.

09-41

PROBIOTIC CHARACTERIZATION OF LACTIC ACID BACTERIA ISOLATED FROM BREAST MILK AND INFANT FECES

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Background: Probiotics are live microorganisms which when administrated in adequate amounts confer health benefits to the host. Breast milk and fecal samples are good sources of probiotics and also the main host specific sources of bacteria to establish in infant gut, mainly lactic acid bacteria which possess many functional properties. The study aims to isolate and characterize lactic acid bacteria from infant feces and breast milk with probiotic potential. **Method:** Breast milk and infant faecal samples were collected from District General hospital, Kottayam. Lactic acid bacterial strains were isolated and their probiotic potential were characterized by tolerance to low pH, simulated gastric juice and bile salt, autoaggregation, hydrophobicity and its antibacterial effect.
Results: From a total of 51 bacterial isolates 8 were selected based on their tolerance to low pH. After 6 hrs of incuba-

tion in pH 2 more than 50% of the cells of BM8, BM9, BM10 and P2F2 survived whereas in simulated gastric juice of same pH the isolates showed more survival rate. The tolerance of isolates to 0.5% bile salts was comparable with the control. The ability of isolates to autoaggregation ranges from 22- 97%. The isolate P2F4 showed maximum hydrophobicity. Culture supernatants of P2F2 and P2F4 can inhibit all the pathogens tested. **Conclusion:** probiotic characterization of the isolates showed that P2F2 and P2F4 can be good candidates since they can withstand the gastrointestinal environment and have antibacterial effects.

Keywords: Probiotics, lactic acid bacteria, simulated gastric juice, bile salt, autoaggregation, hydrophobicity, antibacterial effect.

09-42

PHARMACOLOGICAL EFFICACY OF LEAVES OF *SYZYGIUM PALGHATENSE* GAMBLE (MYRTACEAE) ENDEMIC TO PALAKKAD DISTRICT, KERALA

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Background: *Syzygium* (Myrtaceae) has received much attention since ancient times due to its multidimensional uses for mankind. The plant shows high species richness and exhibits relative homogeneity in the morphology. The identification of the new species is only based upon the morphological characters. *Syzygium palghatense* is considered as a highly promising traditional medicinal plant of this genus, which is endemic to Palakkad District of Southern Western Ghats of Kerala. So far, scientific studies for *S. palghatense* have not been explored. Due to their multipurpose usages and effective therapeutic properties, it becomes extremely important to supplement the constructive information with regards to the identification and also revealing the pharmacological properties.

Method: This study explores different aspects of pharmacology of *S. palghatense* leaf. The effective pharmacological evaluation was done through different solvent extracts of leaf (chloroform, ethyl acetate, methanol and distilled water). The methodology includes-morphological characterization, microscopic studies, nutritional profiling, physicochemical properties, powder characteristics, fluorescence analysis, phytochemical characterization, GC-MS studies and evaluation of antioxidant potential (DPPH radical scavenging assay, Superoxide radical scavenging assay, Hydroxyl radical scavenging activity and Ferric reducing antioxidant power assay).

Results: Methanolic extract of *S. palghatense* leaves was found to be most effective as compared to other solvents. Morpho-anatomical and pharmacognostic studies were found to be useful to supplement constructive information with regards to the identification and characterization. GC-MS profile indicates the presence of different phytoconstituents, which may be the reason for the medicinal properties of the study plant. The IC_{50} value of the methanolic extract in DPPH, Superoxide radical scavenging assay, Hydroxyl radical scavenging activity and Ferric reducing antioxidant power assay was estimated to be 2.75± 0.07 µg/ml, 52 ± 0.375 µg/ml, 62± 1.821 µg/ml and 2.737±0.06 µg/ml respectively. This shows significant antioxidant activity of *S. palghatense* leaves.

Conclusions: The leaf possesses various constituents, especially antioxidantly active phytochemicals which could be a lead in future drug development. This study provides an insight into the pharmacological potential of *S. palghatense*.

Keywords: *Syzygium palghatense*, Anatomy, GC-MS, Pharmacology, Antioxidant activity

09-43

INFRAGENERIC RELATIONSHIP AMONG THE INDIAN *ARISAEMA* (ARACEAE) BASED ON ITS SEQUENCES.

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Background: *Arisaema* is one of the Indian plant taxa with disjunct distribution in northeast India and Western Ghats (Puri *et al.*, 2016) rising several systematic and biogeographic questions. The genera shows greater percentage endemism and occur in either northeast India or Western Ghats. In this study molecular phylogenetic investigation was undertaken using sequence of nrITS of nuclear ribosomal DNA with a particular focus on species from India.

Method: Genomic DNA was extracted using the protocol of Doyle and Doyle (1990) with some modifications and Dneasy plant mini kit (Qiagen). DNA amplification of nrDNA ribosomal ITS region was performed using primers de-

signed by Muller and Cronk (1997). Phylogenetic analysis was done using Bayesian and Maximum likelihood method using the best-fit substitution model GTR+I+G using the Akaike information criterion (AIC). Tree generated by the two analysis were viewed and exported in FigTree v1.3.1.
Result: The ML optimal tree topology was mostly identical to the BI tree and members of each clade detected in ML corresponds to those obtained from BI. Cladogram obtained from the phylogenetic analysis initially bifurcate in to two major clades. The sect. Decipienta and sect Nepenthoidea are close together with high BS and also shows relationship as well and also shows indication of recently described species in a better resolution. Within the sect. Sinarisaema the relationship between the taxa still poses some problems inresolving.
Conclusion: From these observations the cladogram supported the infrageneric classification of the genus proposed by previous workers, but with minor deviations evidently demonstrated with molecular support.
Keywords: *Arisaema,* Phylogeny, Nuclear ribosomal DNA, Biogeographic questions

09-44

COMPARATIVE PHENOLOGY OF *TRICHOPUS ZEYLANICUS* GAERTN. SUBSP. *TRAVANCORICUS* (BEDD.) BURKILL EX K. NARAYANAN: AN ETHNOMEDICINAL PLANT

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Background: *Trichopuszeylanicus* Gaertn. subsp. *travancoricus* (Bedd.) Burkill ex K. Narayanan is an ethnomedicinal herb of southern Western Ghats, commonly known as 'Arogyapacha' or 'Sathankalanga'. As a small perennial rhizomatous herb of the family Dioscoreaceae, this sub species is mainly distributed in the Peppara, Shendurney and Neyyar Wildlife Sanctuaries, Kerala and Kalakkad – Mundanthurai Tiger Reserve, Tamil Nadu of Agasthyamala Biosphere Reserve. The Kani tribe inhabiting in the Agastyarhills of the Western Ghats, Kerala traditionally used the plant as an ant-fatigue and stamina boosting herbal drug.
Methods: The present study was conducted on the comparative phenology of the species at Peppara, Shendurney and Neyyar Wildlife Sanctuaries of Agasthyamala Biosphere Reserve, Kerala. Regular field visits were conducted to the study plots of 1x1 m to document phenological events like leaf initiation, maturation, flower bud initiation, fruit initiation, fruit maturation and seed dispersal. Fruit and seed development of the species were identified through flowers tagged on the day of anthesis and subsequent sequential growth was analyzed for the DAA (days after anthesis). Qualitative and quantitative characters of rhizome, stem, petiole, leaf (mature), flower, fruit and seed were documented. Measurements of the plant parts were taken by using Digital Vernier Caliper- Mitutoyo Absolute Digimatic, Japan. To quantify the annual production of leaf, flower, fruit and seed at respective stages were tagged and examined.
Results: The phenological events of *T. zeylanicus* ssp. *travancoricus* have solid connection with different climatic changes. The leaf flushing was started after the heavy and continuous southwest monsoon. The flower bud initiation was observed by the mid-September were in the north-east monsoon was over. The maturation period of the fruit was observed to be four to five months, so as to ensure seed dispersal coincides with next southwest monsoon.The vegetative and reproductive annual production analysis of *T. zeylanicus* subsp. *travancoricus* revealed that more elite population is present in the Shendurney Wildlife Sanctuary compared to Peppara and Neyyar Wildlife Sanctuaries.
Conclusion: The present phenological study of *Trichopus zeylanicus* Subsp. *Travancoricus*at different populationsrevealed its periodical events. It is also helps to identify the elite population among other populations.Phenological studies are inevitable for effective maintenance and restoration of endemic species, it give an ideal information for both *in-situ* and *ex-situ* conservation aspects.
Keywords: Agasthyamala Biosphere Reserve, Arogyapacha, Kani tribes

09-45

ANTICANCER EFFICACY OF PETROLEUM ETHER FRACTION OF METHANOLIC EXTRACT OF *LEUCAS ASPERA* ON HeLa CELLS

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Background: The anti-tumour effects of plant constituents have been associated with the indication of carcinogen

detoxifying enzymes, the scavenging of free radicals, cell cycle arrest, triggering of apoptosis etc. Much effort has been made in the search for cancer chemo preventive agents and in vitro short-term tests are a valuable tool in the process.
Methods: In the present study,anticancer activity of the active fraction of methanolic extract of *L.aspera* was studied *in vitro* on cancer cell lines using MTT assay. The mode of HeLa cell death was investigated by morphological analysis (fluorescent microscopy). LDH release assay was conducted to study whether the active fraction is causing lysis. Changes in the cell cycle of HeLa cells treated with the fraction was analysed by Flow Cytometry.
Results: 0ne hundred to 1000µg/ml of *L.aspera* significantly reduced the viability of HeLa cells. But when the doses were increased, the percentage of viable cells was decreased and finally at a dose of 1000µl of *L.aspera,* only 26 % cells were viable in the active fraction. Increased LDH leakage confirms increased membrane damage which is directly proportional to cytotoxicity. Microscopic examination revealed that the extract induced apoptosis in target HeLa cells after 24 hr treatment. The plant extract cause apoptosis at the concentration of 1000µg/ml. Flow cytometric analysis of HeLa cells treated with methanolic extracts showed significant inhibition of cells at Go/G_1 phase. There was 45% increase in cells arrested at G_O/G_1 phase when compared with untreated control whereas the S phase and M Phase cells decreased proportionally. Therefore the G_1 phase arrest was one of possible mechanisms of anti-proliferative activities of the extracts.
Conclusions: The MELA active fraction showed cytotoxic potential which correlated with the results of LDH Leakage assay. Morphological analysis of the mode of HeLa cell death, together with the cell cycle analysis showed that the active fraction induced apoptotic cell death. cells. The study gives an insight into a significant source of novel promising anticancer compounds in view of their pronounced cytotoxic activities against HeLa.
Key words: *Leucasaspera*, Apoptosis, antitumour effect

09-46

INTERACTION STUDIES OF PLANT FLAVANOID ISORHAMNETIN WITH CALF THYMUS DNA: *IN SILCO* AND BIOPHYSICAL EVALUATION

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The molecular interaction of phytochemical Isorhamnetin (IsoH) with calf thymus DNA (ctDNA) has not yet been addressed. We have carried out a combination of *in silco*, calorimetric and spectroscopic investigations to elucidate the mode of binding of IsoH with ctDNA. The induced fit molecular docking analysis was done against ct-DNA showed its specific minor groove binding property. In this perspective the energetics of interaction including the binding energy and binding stochiometry associated with the binding of IsoH with ctDNA was monitored by isothermal titration calorimetry (ITC). The hyperchromic effect exhibited by UV spectrum along with the significant quenching in the fluorescence intensity of ctDNA upon addition of IsoH revealed a characteristic minor groove binding devoid of significant structural alteration to the ctDNA.
Keywords: Isorhamnetin, calf thymus DNA, molecular docking, isothermal titration calorimetry**.**

09-47

ANATOMICAL STUDIES OF *HILDEGARDIA POPULIFOLIA* (ROXB. & WALL.) SCHOTT & ENDL. [= *STERCULIA POPULIFOLIA* ROXB. & WALL.] AND *THESPESIA POPULNEA* (L.) SOLAND EX CORREA (MALVACEAE) LEAVES

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Background: *Hildegardia populifolia* (Roxb. & Wall.) Schott & Endl. [= *Sterculia populifolia* Roxb. & Wall.], is a vulnerable endemic deciduous tree distributed in forests of Andhra Pradesh, Tamil Nadu and Karnataka (Rao *et al.,* 2011) while *Thespesia populnea* (L.) Soland ex Correa is an evergreen indigenous tree found both on coasts and inland. Both belong to the elaborated Malvaceae family and their leaves are used medicinally for different purposes but their isomorphic nature results difficulty in identification. As plant anatomical characters have been used as an additional aid to

identify closely related species, we have undertaken the present study.
Methods: The specimens of *Hildegardia populifolia* (Roxb. & Wall.) Schott & Endl. was collected from Advanced Institute for Wildlife Conservation, Vandalur, near Chennai and *Thespesia populnea* (L.) Soland ex Correa was collected from Presidency College Campus, Chepauk, Chennai during 2018. The anatomical studies were carried out using hand sections.
Results: In *Hildegardia populifolia* the leaves have mucilage ducts, stiff veins, and thin lamina made up of with short-columnar palisade cells; in petiole 10 vascular bundles arranged like a ring, vessels homogeneous, and axial parenchyma and one medullary bundle present; midrib abaxial side is cup-shaped, vascular strand is broadly ovate with two leaf traces. Whereas in *Thespesia populnea* leaves mucilage ducts absent, veins herbaceous and comparatively thick lamina made up of long-columnar palisade cells; in petiole 6 (4 + 2) vascular bundles arranged like a broken ring, and axial parenchyma and medullary bundle absent; midrib abaxial side broadly convex, vascular strand 'c'-shaped, and vessels dissimilar.
Conclusions: Though the leaves of *Hildegardia populifolia* and *Thespesia populnea* are morphologically similar they have distinct anatomical characters.
Key words: *Hildegardia populifolia,* critically endangered, *Thespesia populnea*

09-48

ROLE OF INSULIN PATHWAY IN MEMORY RETENTION OF *CAENORHABDITIS ELEGANS*

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Background: Since insulin has been implicated in conditions like Alzheimer's disease, a neurode generative disorder with memory dysfunctions, there is a growing interest among neuroscientists about its role in learning and memory. *Caenorhabditis elegans*, with its well-mapped nervous system, is an excellent model to address this question. The insulin pathway in C. *elegans* function through the daf-2 receptor with many insulin-like peptides acting as its ligand.
Method: We utilise the olfactory associative memory tests to analyse the learning and memory alterations in the organism. Our study involves both short-term and long-term training paradigms. We also study the neurode generative pattern of the worms following insulin administration using worms expressing GFP in a subset of neurons.
Results: Insulin affects memory in a differential manner. Worms with a developmental history of downregulated insulin pathwayperform poorly in both short and long-term associated memory tests. However, some mutants in the initial pathways of insulin, like the ligand ins-1 and the receptor daf-2, show better retention of memory. This altered memory is not through the known Akt-1 pathway. We were also able to show that excess insulin antagonises the pathway and improves memory.
Conclusion: This work establishes the role of the insulin pathway in learning and memory. Insulin pathway modifies the learning and memory of the worms. We were also able to establish that the daf-2 receptor and ins-1 are involved in enhanced memory retention pathway.
Key words: Insulin, daf-2, ins-1, learning and memory

09-49

ROLE OF SURFACE MICRO FLORA IN ENHANCING THE ANTI CANCEROUS POTENTIAL OF NONI

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Background: Noni is an ancient traditional medicinal plant scientifically called *Morinda citrifolia* belongs to the family Rubiaceae is known for its medicinal value and as dietary supplement for over 2000 years. Now it has became a researcher's plant because of its potential therapeutic effects such as antibacterial, antiviral, antifungal, anti-tumor, analgesic, anti-inflammatory and immune enhancing effects.
Method: In the present study, the surface microflora of Noni was isolated from unripen fruit, ripen fruit and tender leaves. Morphological characterization was done for the 44 isolated colonies. The selected 3 bacterial colonies from unripen fruit, ripen fruit and tender leaf were screened for its anticancerous activity by rapid plate assay. L-Asparginase

enzyme activity was confirmed by nesslerization method and was compared with the results of plant extracts. The anti bacterial potential of plant extracts and antibiotic sensitivity of isolated organisms were conducted to support the interaction between Noni and isolated microflora.

Result: By pour plate technique, it was clearly inferred that the isolated endophytic organisms were different from those of surface microflora. Rapid plate assay for selected surface microflora isolates showed positive result for unripe fruit and ripen fruit isolates while the isolate from tender leaf showed the negative result. L-Asparginase enzyme activity was confirmed by nesslerization method and potent asparaginase enzyme activity was shown by the extracellular metabolite of the organism isolated from unripe fruit

Conclusion: This work establishes the role of surface microflora in enhancing the anti cancerous potential of Noni. The anticancerous potential of Noni is may be due to the combined effect of plant extract and the extracellular metabolite from the microflora associated.

Keywords: *Morinda citrifolia*, Surface microflora , Rapid plate assay, L-Asparginase, anti cancerous

09-50

ANTI-OBESITY EFFECTS OF *GARCINIA GUMMI-GUTTA* (L.) ROBS. SEED OIL IN 3T3-L1 ADIPOCYTES

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Background: *Garcinia gummi-gutta* (L.) Robs. (Family: Clusiaceae) locally known as "Kudampuli" is an indigenous, tropical tree distributed in the evergreen forests of Western Ghats from Konkan to Kerala and Shola forests of Nilgiri hills. The dried seeds yield edible fat commonly known as 'seed butter', due to its solid state in room temperature. In the present study, the *in vitro* anti-diabetic and anti-obesity effects of *G. gummi-gutta* seed oil were studied.

Methods: The seed oil extracted from *Garcinia gummi-gutta* was evaluated for *in vitro* anti-obesity effects by determining cell viability, determination of glycerol release, measurement of intracellular cAMP level and triglyceride content in differentiated 3T3-L1 adipocytes *in vitro*

Results: The observations in statistical data of MTT assay suggested that in 3T3-L1 cells, *G. gummi-gutta* seed oil did not show any toxicity within the range of 100 µg/mL at the incubation of 48 h. The seed oil showed considerable glycerol release by increasing the concentration of the oil sample ranging from 50-250 µg/mL at the incubation of 72 h. It was found that the seed oil exhibited considerable increase in cAMP level at lower concentration (50 µg/mL). The seed oil showed considerable decrease in the expression of triglyceride level against 3T3-L1 at lower concentrations 50 µg/mL.

Conclusion: The present study indicated that *Garcinia gummi-gutta* seed oil exhibited *in vitro* anti-obesity effects. The seed oil increased intracellular cAMP levels and glycerol release and reduced triglyceride content *in vitro*. Thus the results suggest that *Garcinia gummi-gutta* seed oil can be considered as a potential anti-obesity agent.

Keywords: Anti-obesity, MTT assay, glycerol release, cAMP, triglyceride level

09-51

ETHNOBIOLOGICAL SURVEY IN THE COASTAL AREAS OF THRISSUR DISTRICT, KERALA

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Background: Traditional Knowledge (TK) is considered as the mother term which is directly linked with the tradition and culture and also is the basis for food, health and economic security of millions of people.TK has evolved, developed and has been transpired down through generations in the form of healing arts, agricultural practices, cultural practices, local languages, customs and customary practices for the wellbeing of the local communities. As a result of change in the lifestyle and livelihood practices of people, TK is rapidly getting eroded from the communities. Therefore, it is important to document such knowledgesystematically to conserveat least the existing TK. The ethnobiological studies of the coastal areas of Kerala have not yet been extensively studied, and hence the relevance of this work is justified.

Method: Systematic documentation of TK is carried out scientifically. Initial step is to create contact with the selected coastal Gramapanchayaths of Thrissur district. Contact and awareness programmes were conducted with the President, elected local body members and other local TK holders and the action plan for field survey was carried out. Interaction with the TK holders/providers were done through question and answer sessions (with voice recorder, photographsand short video clippings**),**after Prior Informed Consent is signed. The recorded information was later decoded, inventorized and documented systematically using specially designed data sheets. Data pooling and analysis of the information were carried out. The information were uploaded in the electronic data base for further reference and research.
Results: Ethnobiological survey of 7Gramapanchayaths (Eriyad, Edavilangu, Perinjanam, Kaipamangalam,Nattika, Thalikkualam and Kadappuram) of Thrissur district was carried out. Awareness on TK and its importance was provided to 151 people including Presidents, Local body members and knowledge holders. A total of 127 knowledge holders were interviewed. 425 information on single drugs, 465 information on combination drugs, 206 information on food plants and 126 information on tools/artefacts were documented.
Conclusions: Ethnobiologicaldocumentation and awareness campaign is important for making local people aware of the importance of the orally transmitted knowledge. A well designed mechanism is to be brought out to codify the remaining TK at the earliest; otherwise this valuable knowledge will be lost forever. Therefore, systematic documentation of TK among the remaining communities is highly essential to save the existing TK in the oral tradition.
Keywords: Traditional knowledge, Systematic documentation, Prior Informed Consent

09-52

STUDY OF THE EPIPHYTIC ALGAL BIOMASS FROM PNEUMATOPHORES OF *AVICENNIA OFFICINALIS* L.

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Background: Kerala supports wetlands of International or National importance. *Avicennia officinalis* has a wide geographical distribution with wide numbers found in inter tidal estuaries along many of the world's tropical and warm temperate coasts. Members of *Avicennia* have pneumatophores, that project above the mud to facilitate gas exchange for the submerged primary root. The exposed part contains large number of small openings, exposed in air. The water inundated portion and freely exposed portion support rich amount of algae.
Method: The present study was carried out in the Kunjimangalam and Valapattanam wetlands of Kannur districts of Kerala during the period of November to March 2018. Quadrant of size 25x25cm^2 where sampled at different locations of the selected two sites mentioned above randomly. Length and breadth of each pneumatophore were measured and by that surface area of pneumatophores is calculated.
Results: The pneumatophores of *Avicennia* have been found to support a rich flora of algae and other micro organisms. 15 species of algae belongs to various classes isolated The biomass of algae on pneumatophores were entirely different in the two sites.
Conclusions:The comparison of pneumatophore density at the two sites indicate that, Kunchimangalam region have favourable condition for the abundant growth of pneumatophore, supports high density of algae while compared to the most polluted Valapatanam site. 15 species of algae belongs to various classes were isolated
Keywords: Pneumatophores, *Avicennia*

09-53

ASSESSMENT OF ANTI-INSECT PROPERTIES OF *ANAMRITA COCCULUS, STRYCHNOS NUX-VOMICA* AND *CARDIOSPERMUM HALICACABUM* AGAINST *OLEPA RICINI* (LEPIDOPTERA: NOCTUIDAE)

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Background: Currently used chemical pesticides have far reaching adverse environmental and ecological impacts. Hence developing alternative eco-friendly pest management methods are in high demand. Biopesticides derived from

plants or animal origin was considered to be eco-friendly viable alternative to chemical pesticides.
Method: This work explores anti-insect activities of bark and leaf extracts of *Anamrita cocculus*, *Strychnos nux-vomica* and *Cardiospermum halicacabum.* The antifeedant activity, repellent activity and contact toxicity of these plants were evaluated against *Olepa ricini*. Basic phytochemical compositions of these plants were also analyzed along with TLC profiling.
Results: In the present study, the leaf and bark extracts of *S. nux-vomica* (75 mg/ml) showing maximum antifeedant activity with 99.73 % and 99.84 % feeding deterrence resepectively. Higher repellent index was shown by the leaf extract of *S. nux-vomica* (100 mg/ml) with 75 ± 1.76, and leaf and bark extracts of *C. halicacabum* (100 mg/ml) with 86.6 ± ٥,٤٤ and 75 ± ١,٧٦ respectively. The bark extracts of *C. halicacabum* and *A. cocculus* (10 mg/ml) have shown to be lethal in contact toxicity assay at the dose of 43.75 ± 1.32 µg/µl and 92.5 ± 0.88 µg/µl respectively.
Conclusions: *A. cocculus*, *S. nux-vomica* and *C. halicacabum* has shown promising degree of anti-insect properties that could be explored for the formulation of novel biopesticides.
Keywords: Biopesticides, Antifeedant, Repellent, Contact toxicity, *Olepa ricini*

09-54

DIVERSITY OF BUTTERFLY WING SCALES AND THEIR ROLE IN COLOUR PATTERN AND OTHER ACCESSORY FUNCTIONS

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Background: Scales of butterflies are submicroscopicparticle, they have an overlapping pattern of arrangement. They give alternate shades of colour and study conducted showed more than 20 different types of scales from a single species.
Method: Butterflies were collected from the fields as well as from the museum collections of the department and they were identified using standard key. Scales were separated from the wings by using pin head and observed by Labomed microscope(400x) and images are recorded by computer attachment.
Results: Nine different types of scales were identified from the wings of *Troides minos* (Family-Papilionoidea). The scales varied on the number of spines, shape and colour. *Pachilopta hector* (Fam; Papilionoidea) showed ten different types of scales, and they have transparent, black and yellow colour. *Jamide sceleno* represents Lycaenidae showed 23 different types of scales. All the scales obtained from the upper surface are transparent. *Eurema andersonii*(Pieridae) the common yellows showed 25 different types of scales.
Conclusion: Wing scales exhibited extreme diversity on shape, number of spines and nature of pigmentation. From the four species of butterflies under three families we could observe 67 different types of scales. Reflection and diffraction of light by scales result different shades of colour.
Keywords: Lycaenidae, Papilionoidea, Pieridae, *Troides minos, Pachilopta hector*, *Jamides celeno***,** *Eurema andersonii*.

09-55

ON GERMPLASM CONSERVATION OF SOME ENDEMIC WILD ORNAMENTAL PLANTS IN JNTBGRI FIELD GENE BANK

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Background: Western Ghats is the sanctuary of several lesser known and promising wild plant species from the economic point of view. Very little attention has been given certain plant groups like wild ornamentals which have remarkable potential in the field of horticulture. Multiplication and domestication of wild endangered endemic ornamentals is regarded as the best way for its conservation and sustainable utilization. Hence the present study is highly envisaged to conserve this group of plants under *ex-situ* conditions in the Field Gene Bank of JNTBGRI.
Methods: Regular field trips and collections of live samples, seeds and herbarium specimens have been made and well documented with photographs along with passport data of all accessions and field notes for herbarium specimens. Live accessions have been introduced at the field gene bank conservatory of the JNTBGRI.

Results: The present study revealed that the several endemic wild ornamentals found to occur among the slopes of the Southern Western Ghats region in Kerala are bursting with potential ornamental value and could be domesticated in home gardens, parks, botanic gardens. Many ornamental species are fast disappearing from wild habitats due to over exploitation, catastrophic events and man-made alterations in their micro habitats. This highlights the need of ex-situ germplasm conservation and popularization of these plants prior to their elimination from the natural habitat. *Acrotrema arnottianum, Barleria courtallica*, *Begonia floccifera, Begonia albo-coccinea, Henckelia repens*, *Jerdonia indica, Ophiorrhiza shendurunii, Paphiopedilum druryi*, *Sonerila sahyadrica*, *Sonerila tinnevelliensis*, *Strobilanthes gamblei, Strobilanthes gracilis, Strobilanthes lupulinus, Thunbergia mysorensis* etc. are a few examples of wild ornamentals found to occur in Southern Western Ghats. Wild ornamentals of the Southern Western Ghats are mostly comprises with small gene pools in isolated pockets with reduced out breeding which makes them more vulnerable to the way of extinction. The study highlighted on the *ex-situ* conservation of 14 endemic potential wild ornamental plants in JNTBGRI field gene bank.
Conclusions:. The present study highlighted with 14 wild endemic ornamentals demarcated in isolated pockets in natural habitats require to have special measures for *ex-situ* conservation other than in-situ protocols.
Keywords: Western Ghats, Wild ornamentals, *Ex-situ* conservation, Field Gene Bank

09-56

MICROPROPAGATION AND SYNTHETIC SEED PRODUCTION OF *EUPATORIUM TRIPLINERVE* VAHL.

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Background: *Eupatorium triplinerve* (*Ayapana triplinerve*) commonly called Ayapan, is an evergreen perennial medicinal plant that has its origin from South America. It belongs to Asteraceae family. It also grows in Brazil, Peru, Ecuador, Hawai and India. Apart from the fancy value that it holds, it has many medicinal benefits also. It is a tropical American herb that is commonly known as water hemp. In view of the medicinal and commercial importance of the species, the present investigation is undertaken to standardize the protocols for rapid clonal propagation through shoot multiplication, indirect organogenesis and synthetic seed.
Method: Rapid clonal multiplication of this plant was achieved by shoot multiplication and indirect organogenesis. Nodes and inter nodal segments were cultured on MS medium containing different concentrations and combinations of KIN, IBA, BA, NAA.
Results: Nodal segments cultured on MS medium containing 2.5mg/l KIN produced increased rate of shoot production. Nodal segments cultured on MS medium containing 1.5mg/l BA produced 2 shoots. But the concentration of NAA along with BA in MS medium, rate of germination is very low. Callus was induced from internodal explants cultured on MS medium supplemented with IBA (0.5mg/l and KIN (1.5 mg/l).
Conclusion: Tissue culture protocols were standardized for the micropropagation of *Eupatorium triplinerve*. Rapid clonal multiplication was achieved via nodal segment culture and shoot tip culture
Keywords: Micropropagation, *Eupatorium triplinerve*., Murashige and Skoog (MS) medium, encapsulation, Indirect organogenesis, Indole 3- acetic acid, Benzyl adenine, Kinetin

09-57

A SYSTEMATIC ACCOUNT OF FRESH WATER DIATOMS - POTENTIAL SOURCE AS LIVE FEEDS IN AQUACULTURE AND BIODIESEL PRODUCTION

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Background: Diatoms are unicellular algae that form the base of the aquatic food chain. They have ecological importance too as they are dominant primary producers and have important role in biogeochemical cycles. They are highly abundant and diverse and adaptable to different ecological conditions. Different features of diatoms such as their size, shape, digestibility and nutritional composition make them valuable as live feeds in the field of aquaculture. The high

proportion of saturated and monounsaturated fatty acids in diatoms is considered optimal from a fuel quality standpoint and suggested to be a potential group of microalgae for biodiesel production.
Method: Diatom samples were collected from distributor channels of the river Periyar located at Perumbavoor (10.1319° N latitude and 76.4822° E longitude) in Ernakulam district of Kerala. The investigation was done between January 2017 and June 2018. Diatoms were isolated using methods such as serial dilution, agar plating and single cell isolation. The stock cultures of isolated species of diatoms were maintained in f/2 medium. For analyzing the structure and morphology of diatom cells the sample was subjected to acid treatment and identification was done with the help of light microscope. Scanning electron microscope images were used for confirmation at species level.
Results: Thirty four species of diatoms belonging to fifteen genera have been identified. The identified diatoms include *Nitzschia* sp., *Navicula* sp., *Diadesmis* sp., *Achnanthidium* sp., *Synedra* sp., *Encyonema* sp., *Sellaphora* sp., *Lemnicola* sp., *Eunotia* sp., *Pinnularia* sp., *Aulacoseira* sp., *Surirella* sp., *Stauroneis* sp., *Gomphonema* sp. and *Cymbella* sp..
Conclusion: The study was aimed at screening, isolation and identification of the diatoms collected from fresh water ecosystem and to find out the potential diatoms which can be used as live feeds and as a source of biofuel.
Key words: Diatoms; isolation; identification; live feed; aquaculture; biodiesel

09-58

EFFECT OF DROUGHT STRESS IN GROWTH AND QUALITY OF *CENTELLA ASIATICA* (L.) URB.

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The present study aims to analyze the effect of water stress in the growth and development of *Centella asiatica*. The species is getting cultivated in various parts of the world due to its high therapeutic and cosmeceutic applications. In this study the plants were grown water stress conditions with four different treatments. All the external conditions are maintained uniformly except water availability to the four treatments. Morphological, anatomical and some phyto-chemical characters were observed for assessing the effect of water stress.

Under stress condition, morphological traits showed significant variation between the treatments. The bio-mass yield decreased with increasing water stress. The anatomical characteristics in stem and petiole varied significantly. Among the four treatments, plants which got sufficient amount of water showed high content of chlorophyll and plants under treatment of least supply of water had very low amount of chlorophyll. The plants with highest water stress showed high glucose content and lowest starch content. Starch content was highest in well watered plant.
Keywords: *Centella asiatica*, drought stress

09-59

STUDY ON PESTS AND PREDATORS OF *APIS CERANA INDICA* F. IN SELECTED APIARIES OF THRISSUR DISTRICT

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The indian honeybees *Apis cerana indica* are widely used in beekeeping in Kerala.Due to inbreeding and manipulation of beehive they are susceptible to pest and predator attack.Mostly insects groups are causing high degree of disturbance to the colony.They constitute the Hymenopterans,Lepidopterans and Coleopteran insects.The social wasp *Vespa tropica* are fatal to the entire colony.The wax moth *Galleria mellonella* and wax beetle *Platybolium alvearium* are observed continously in hives.The occurrence were surveyed during the period of May 2018 to November 2018.Total six apiaries in Thrissur district were selected as study area.The colony is more susceptble for pest and predator attack during the period of growth and colony division. *A.cerana indica* are suitable for beekeeping because they are shade lovers.

09-60

CHEMOPROSPECTING OF *PSILANTHUS TRAVANCORENSIS* (WT. & ARN.) LEROY – A MEDICINAL SPECIES OF RUBIACEAE.

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Background: *Psilanthus travancorensis* (Wt. & Arn.) Leroy belonging to the Rubiaceae family is a medicinal plant used for the treatment of a wide range of diseases.. Little seems to be known about the chemical components of this plant. The evaluation of this plant for biological activity is necessary; to scientifically substantiate the use of this plant by traditional healers to develop the new drugs. Preliminary phytochemical studies revealed the presence of various major secondary components.
Methods: This study focuses on flavonoids because the quantitative estimation showed that the root of the plant is rich in flavonoids. The root was extracted with 85% ethyl alcohol and concentrated.
Results: Only the ethyl acetate extract gave positive Shinoda test for flavonoids and was used for further phytochemical analysis. Characterization of compound was carried out using various spectroscopic techniques. Determination of *invitro* hepatoprotective effect of isolated compound on CCl4 induced hepatotoxicity on cultured Hep G2 cells and its effects on various antioxidant marker enzymes were also studied.
Conclusion: The compound identified was quercetin-3-O-β-D-glucoside. *In vitro* treatment with quercetin-3-O-β-D-glucoside decreases the CCl_4-induced liver damage resulted in elevation in biochemical parameters. The results of this study demonstrated that quercetin-3-O-β-D-glucoside has a potent hepatoprotective function against CCl_4- induced hepatic injuries. This is a first time report on the isolation and hepatoprotective effect of a flavonoid from *P. travancorensis.*
Keywords: Column chromatography, quercetin-3-O-β-D-glucoside, hepatoprotectivity

09-61

LARVICIDAL EFFICACIES OF TWO PLANT EXTRACTS AGAINST *AEDES ALBOPICTUS*

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Background: Asian tiger mosquito, *Aedes albopictus* (Diptera: Culicidae) is becoming a competent vector for dengue, chikungunya and other viruses. Current research trends use plant extracts as alternative larvicides because they contain various phytochemicals that are specific in killing mosquito larvae without harming other organisms and the environment.
Method: This study is an attempt to investigate the efficacy of aqueous leaf extract of *Clerodendrum infortunatum* and *Ailanthus triphysa* on larval mortality of *Aedes albopictus.* Also the total protein, amino acid, glycogen and lipid profile were estimated in treated larvae against control ones. The qualitative analyses of phytochemicals were also done in the most effective plant extract.
Results: Aqueous leaf extracts of *C. infortunatum showed a higher mortality rate than Ailanthus triphysa* against *the larvae of Asian* tiger mosquito. The plant's high larvicidal activity is supported by the presence of phytochemicals also.
Conclusions: From the results, it is evident that *C. infortunatum* can be attributed to the susceptibility of plant extracts as killing agent against mosquito larvae.
Keywords: Asian tiger mosquito, *Aedes albopictus, Clerodendrum infortunatum, Ailanthus triphysa,* Larvicidal efficacy.

09-62

MICROBIAL DIVERSITY AND RESISTOME STRUCTURE OF POLLUTED AND NON-POLLUTED ENVIRONMENTS IN SOUTH INDIA

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Background: The environment is increasingly recognized as an important reservoir of resistance genes and plays an important role in their transmission cycles. Recent studies suggest that industrially polluted environments could assist in the rapid spread of antibiotic resistance in a local to global scale (Gothwal *et al.,* 2017). A metagenomic study by Bengtsson-Palme *et al*. on a lake (Kazipally lake, Hyderabad, India) which is severely polluted by pharmaceutical industries showed that resistance genes present in these polluted settings are 7,000 times more abundant than a control taken from Nydalasjon lake, Sweden.
Method: Here, we have analysed the metagenomic datasets of Kazipally lake (Bengtsson-Palme *et al*) and compared their taxonomic structure and resistance genes distribution with mangrove samples collected from Kerala. The taxonomic distribution studies were performed using MEGAN5 and resistome analysis using an updated resistane database (CARD).
Results: High bacterial diversity was found in Kazipally and mangrove (Shannon's diversity index > 5) datasets where Proteobacteria as the abundant phylum. We have identified an additional 40 resistance genes in Kazipally lake that were not reported in the previous study. In addition, 6 unique resistance genes in the mangrove ecosystem which is comparable to that of Swedish lake sediment samples used in the study of Bengtsson-Palme *et al*. It is found that most of the pathogenic bacterial species identified in Kazipally lake are multidrug resistant and comes under hazardous categories (CDC report, 2013) whereas pathogenic microbes are comparatively less in the mangrove ecosystem.
Conclusions: Our results indicate that resistance elements significantly differs depending on the environment as well as the amount of selection pressure acting upon the bacteria. We found a vast pool of resistance genes in Kazipally lake that are problematic to the public health sector which requires an immediate action plan to prevent its further spread.
Keywords: Antibiotic resistance, Metagenomics, Pollution, Microbial diversity

09-63

EFFECTIVE AND SUSTAINABLE ALTERNATIVE FOR USING CITRUS PEEL WASTE

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Background: Citrus fruit is immensely popular worldwide for their flavour and nutrition and it is the most important fruit crops grown throughout the world.Orange juice industry is growing day by day. Orange peel remaining after juice extraction is a major waste.So utilization of these waste cost effectively can reduce the waste and resulted in many valuable products.Several strategies are being used by local farmers and researchers to improve the fertility of degraded soil and increased crop productivity.Mulching are cheap and easily accessible for maintaining soil fertility and productivity. Organic mulches also increase water- holding capacity, nutrient availability and aeration of soil. So mulching with orange peel waste is one of the alternatives for improving soil fertility and there by productivity.Keeping the above facts in mind, we examined the effect of citrus peel mulch(fresh,dry,peel residue) on germination and growth of cow pea seeds.
Method: Growth study was done using 3 different type of orange peel (fresh,dry,and peel residue) on the cow pea under the field condition. Morphological characters were observed at regular intervals during vegetative as well as reproductive phase. Estimation of physiological parameters like photosynthetic pigment, proline,lipid peroxidation,phenol,flavanoid was done to analyse physiological changes occurred in cow pea plants under experimental condition. Soil analysis was done to find out decomposing process and soil nutrition.
Results: From the present study it was observed that different type of peel treatments in soil not exhibited any negative impact on the growth of cow pea. Both vegetative and reproductive growth was enhanced in M-60 and M-80 treatment when compared to the control. M-100 treatment showed less growth and yield suggest that growth enhancement is dose dependent and high concentration may reduce the growth. While comparing 3 type of peel treatment fresh peel treatment and peel residue showed better growth and yield.Result obtained from the physiological study of treated plants strongly suggests that plants were not subjected to any sort of stress in the field condition. Result of soil analysis to find

the decomposition process of peel and its impact on soil nutrition, revealed that soil pH is maintained between6.4-7.2. However orange peel of any type greatly increased soil K and P concentrations,but none affected soil N and organic carbon concentrations.

Conclusion: The present study thus suggested the potential use of orange peel for increasing growth and yield of cow pea. Moderate quantity of fresh or dry orange peel can be used safely in cowpea field to improve soil conditions thus for crop productivity.

Keywords: Citrus peel waste, Mulch, Soil analysis, Cowpea.

09-64

DIVERSITY OF PLANKTONIC ROTIFERS IN AYIRAMTHENGU MANGROVE KOLLAM

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Rotifers are a group of aquatic micro-invertebrates comprising around 2000 species of un segmented, bilaterally symmetrical organisms. Present study was undertaken in the mangrove region habitat of Ayiramthengu, which is a portion of kayamkulam estuary. Present study is aimed to analyse rotifer diversity in this mangrove region. Plankton were collected monthly using plankton net(60µ).During the whole study period 27 species of rotifers are identified.. In station I diversity of rotifer is high which is the station were the fresh water influx is also high. The rotifer assume a great ecological significance in mangrove ecosystem because it is the feeding ,breeding and nursery ground of many fin and shell fishes larvae and they are also used recently as bio indicator for monitoring aquatic ecosystems and integrity of water.

09-65

STUDIES ON THE VARIATIONS IN SECONDARY METABOLITES AND ANTIOXIDANT ACTIVITY OF *ZINGIBER ZERUMBET* (L.) SM. RHIZOME

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Background: *Zingiber zerumbet* (L) Smith belongs to the family Zingiberaceae is widely used by the traditional people. Medicinal plants based traditional systems of medicines are playing important role in providing health care to large section of population, especially in developing countries. This species is traditionally known as Asian ginger or Shampoo ginger or bitter ginger. The volatile oil, Limonene occurs exclusively in *Zingiber zerumbet*.

Method: Quantitative analysis of phytochemicals, antioxidant activity of *zingiber zerumbet.*

Result: Aqueous extract of shampoo ginger showed the presence of alkaloids, flavanoids, saponins, phenols, tannins, phlobatannins, terpenoids, proteins, glycosides, carbohydrates, syringyl group, triterpenes and steroids are present in the analysis. Anthraquinones contents not present in the extract. The ethanol extracts of shampoo ginger showed the presence of alkaloids, flavanoids phenols, tannins, terpenoids saponins, proteins, glycosides, carbohydrates, syringyl group triterpenes and steroids. Ethanol, butanol, acetone, chloroformand aqueous extract of ginger show absence of anthraquinones content. In the different extracts of shampoo ginger showed that high amount of alkaloids. In the chloroform extract of shampoo ginger showed the presence of alkaloids, flavanoids, phenols, tannins, terpenoids, saponins, proteins, glycosides, carbohydrates, syringyl group, triterpenes and . The result shows the variation in the presence of phytochemicals present in the shampoo ginger (*Zingiber zerumbet)* in different extract.

Conclusion: The present investigation aimed to evaluate the phytochemical screening and antioxidant activity of rhizome extract of *Zingiber zerumbet* which belongs to the family Zingiberaceae. The rhizome is mainly used to cure digestive problems.

Keywords: Antooxidants, Zingiber zerumbet

09-66

NUTRITIONAL AND ANTI NUTRITIONAL ANALYSIS IN *ARTOCARPUS HIRSUTUS* LAM.

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Background: *Artocarpushirsutus*Lam. is an endemic tree species of the family Moraceae, belongs to Southern Western Ghats of peninsular India.It is an evergreen tree with approximately 20 to 40 m height, and 3 mgirth.Nutritional facts of fruits and seeds of *A.hirsutus*are yet to be validated but several potential phytochemicals have been identified from the fruit pulp. The aim of this work was to evaluate the nutritional and antinutritional compositions of fruit pulp, seedand seed coat with hope the information would be of use to those concerned with plant food for human nutrition.
Method: The matured fruits of*A. hirsutus* were collected from Kariavattom Campus, University of Kerala, Thiruvananthapuram. Standard procedures were used for nutritional analysis. Available carbohydrate, protein and total lipid were estimated according to the standard protocol. Calorific value (in kcal/100g) was estimated by multiplying the percentages of crude protein, crude lipid and available carbohydrate by recommended factors. Reducing sugar were determined accordingly.Vitamins like thiamine, riboflavin, niacin, carotenoid and vitamin C were determined according to the respective protocols. The recommended methods were used for the determinations of oxalate and saponin. Standard protocols were used for the determination of total phenols and flavonoids. Statistical analysis was also carried out.
Results: On analysing the nutritional content, it was found that, carbohydratecontent was high for seed. On the other hand, protein content was high for seed coat. Seeds had comparatively twice the amount of lipid than seed coat and fruit pulp.Values of reducing sugar was found to be ranging from 1.926 g (seed) to 3.046 g (fruit). Vitamin analysis of all the three samples showed that seed coat contained higher amount of riboflavin (4.115 mg), niacin (1.722) and vitamin C (18.823 mg) respectively in fruit pulp and seed. On the other hand, carotene (0.06392 mg) and thiamine (0.100035 mg) were found to be highest in seed. The fruit pulp had low levels of all the vitamins analyzed. On analysis of anti-nutrient factors, it was found out that, the levels of all the anti-nutrient fraction in the fruits of *A. hirsuts*were lower than the value that can cause malabsorption of other nutrients.
Conclusion: Fruits are important sources of minerals, fibre and vitamins, which provide essential nutrients to the human body in day to life. But it is known that some fruits have so called anti nutritional factors (e.g. phytic acid and tannins) that diminish nutrient bioavailability, especially if they are present at high levels**.** The nutritional analysis revealed that the fruit of *Artocarpushirsutus* are edible and all the nutritional analysis will be helpful for the utilization and consumption of underutilized plant.
Keywords: *Artocarpushirsutus*, Nutritional Analysis, Vitamins, Anti-nutritional Analysis

09-67

SCREENING OF BIOACTIVE COMPOUNDS IN *PREMNA WIGHTIANA* SCHAUER (LAMIACEAE)

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The members of the family Lamiaceae are medicinally important and known for the characteristic aroma. *Premna* is one among the medicinally important genus in the family. The species such as *P. serratifolia, P. tomentosa* and *P. mollisima, P.herbacea* are recognized for their pharmacological properties and are the constituents of different traditional and ayurvedic medicinal formulations. The present study was carried out to characterize the bioactive constituents present in the leaves of *P. wightiana* collected from Pooppara, Idukki District, Kerala State by qualitative methods. Preliminary phytochemical analysis of methanolic leaf extract of *P.wightiana* revealed the presence of alkaloids, flavonoids, terpenoids, steroids, and phenolic compounds. GC-MS analysis was used to detect the composition of the volatile constituents present in the leaves. The mass spectrum of the unknown component was compared and interpreted with the spectrum of the known components stored in the National Institute Standard and Technology (NIST) library. A total of twenty compounds were identified by GC-MS analysis. The major bioactive compounds viz; β-caryophyllene, phytol, γ-sitosterol, squalene, α and β amyrins were identified by GC-MS analysis. Among the identified compounds a major percentage was of pharmacological importance. The present study provides a foundation for the chemotaxonomic and pharmacological studies.
Keywords: Bioactive constituents, GC-MS, *Premna,*

10 - MATHEMATICAL & STATISTICAL SCIENCES

10-01

CHARACTERIZATION OF DISTANCE HEREDITARY GRAPHS USING DISTANCE SPECTRUM

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Background: Distance hereditary graphs are connected graphs in which all induced paths are isometric. In this paper, we study the distance spectral properties of distance hereditary graphs. It is well-known that the distance hereditary graphs admit a forbidden subgraph characterization. We obtain the necessary condition of this characterization using distance spectrum. Also, we obtain a new characterization of distance hereditary graphs using distance spectrum.
Keywords: Distance hereditary Graphs, Distance Matrix, Distance Spectral Radius, Induced Sub graph.
2010 Mathematics Subject Classification: 05C50, 05C75

10-02

ANALYSIS OF A QUEUE WITH JOINING STRATEGY AND INTERRUPTION REPEAT OR RESUMPTION OF SERVICE

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Background: An M/M/1 queuing system with service interruption. If the server is busy at the arrival epoch, the arriving customer decides to join the queue with probability q and balk with probability 1-q. The service is assumed to get interrupted according to a Poisson process. The interrupted service is either resumed or restarted according to the realization of two competing independent, non-identically distributed random variables, the realization times of which follow exponential distributions. An arriving customer, finding the server under interruption does not join the system. This work has wide application in browsing internet for some purpose like money transactions through Net banking.
Method: Analyze the Nash equilibrium of customers' joining strategies using difference differential equations of the system.
Results: Compute expected number of interruptions during a single service, expected service time, Also analyze the Nash equilibrium joining strategy under a given reward cost structure because customers have the right to decide whether to enter the system or not.
Conclusions: When the joining probability q adopted by other customers is smaller than (equilibrium probability) q_e, the expected net benefit of an arriving customer is positive if he chooses to join the system, thus the unique best response is 1. Conversely, the unique best response is 0 if $q > q_e$ because that the expected net benefit is negative. If $q = q_e$, every strategy is the best response since the expected net benefit is always 0. Therefore, we have to avoid the crowd situation.
Keyword: Joining strategy, Interruption, Repeat or resumption of service, Nash equilibrium

10-03

ESTIMATION OF STRESS-STRENGTH RELIABILITY USING A GENERALIZATION OF POWER TRANSFORMED HALF-LOGISTIC DISTRIBUTION

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Background: In the present world the problem of increasing reliability of any system has become significant in many fields of industry, transport, communications technology, etc. There are appliances which survive due to their strength; they also receive a certain level of stress. But if a higher level of stress is applied than the strength then the appliances tend to break down. Suppose the random stress applied on a certain appliance be represented by Y and the random strength to sustain the stress be represented as X. Then the system fails if and only if at any time the applied stress is greater than its strength. Thus a measure of reliability of a system is given by R = Pr {X>Y\}.
Method: A new probability model obtained by generalizing the power transformed half logistic distribution is introduced by transforming the type II beta distribution. The basic properties of the distribution are studied. Then using the new distribution, the measure of reliability of a system is given by R = Pr {X>Y\} is computed.
Results: A generalization of the power transformed half logistic distribution is introduced by using the transformation of random variables. The stress strength reliability of a single component system with strength following the proposed model and different cases for stress are obtained. The usefulness of the model is also studied by applying it for a real life data.
Conclusions: The following article co-authored with Dr. Joby K Jose deals with developing a new probability model obtained by generalizing the power transformed half logistic distribution is introduced by transforming the type II beta distribution. The usefulness of the model is also studied by applying it to a real life data set. The data set used for the illustration purpose was reported by Smith and Naylor (1987). The data set represents two samples of fiber strength data. The data sets are experimental data of the strength of glass fibers of two lengths, 1.5 cm, and 15 cm, from the National Physical Laboratory in England. It can be observed that the developed density fits both the data sets.
Keywords: Half-Logistic Distribution, Transformation Of Random Variables, Drichlet Eta Function, Generalized Hyper geometric Function, Stress-Strength Reliability.

10-04

AN APPLICATION OF INTERIOR EXTERIOR AND BOUNDARY OF FUZZY SOFT MULTI TOPOLOGY IN FLOOD

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Background: Vagueness is a matter of discussion in almost fields of knowledge. To represent uncertain values fuzzy set was introduced [1]. Soft sets [2] cleared the inadequacy of parameterization. Multi-set allows multiple occurrence of an element. In the paper [3] Naisal and Raji Kumar explains an application of fuzzy soft topology in Ayurveda. This paper takes steps to take the measures to take on flood related issues.
Methods: Each area affected by flood in the aerial photo is viewed as a fuzzy set/point in the soft fuzzy space. The fuzzy value of each area affected by flood is defined as

$$\left(\frac{\log(\text{Area 6 certain affected area})}{\log(\text{Total area 6 affected area})}\right.$$

, which is a well-defined mapping from the interval $[1, \infty]$ to the interval [0, 1]. From many studies it was found that some area have chance to be affected by flood quickly, some has less chance. So we wish to put these as parameters.
Results: Here we discussed on soft multi exterior, soft multi interior, soft multi closure. At last we produced a model of decision making which is an application of fuzzy soft multi sets. We found the maximum affected area by the flood using interior, boundary, and row maximum, row minimum using the numerical value of resultant fuzzy soft set. In such areas that are affected by the flood area will be helpful to find the chance of most areas and to give remedial measures.
Conclusion: From GIS perspective it is really mandatory to know the regions which may be affected. This may help them to identify the correct places to be live.

10-05

MINIMAL IMMERSIONS OF STATISTICAL MANIFOLDS

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Background: In this paper we study certain properties of statistical immersions. A necessary condition is obtained for a statistical immersion to be an immersion for statistical manifolds with α- connection in the case of co-dimensions one as well as in general co-dimensions. Then necessary condition for an immersion to be minimal for co-dimension one is given. Also obtained condition for an immersion to be minimal for statistical manifolds with α- connections.
Classification: MSC 53A15, MSC 53C42
Keywords: Statistical manifolds, Statistical immersions, Minimal immersions

10-06

SPIKING NEURAL P SYSTEMS WITH STRUCTURAL PLASTICITY AND MEMORY

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Background: Spiking neural P systems (in short SNP systems) [1] are the computing devices inspired by the spiking neurons. Spiking neural P systems with Structural Plasticity (SNPSP systems) is a variant of SNP systems in which the biological feature of structural plasticity is incorporated. From nineteenth century onwards it is noted that the repeated activation of a neuron causes the metabolic changes. Gheorghe Pun [2] arouse a problem whether the usage of synapse determine the dynamic nature of synapses. Paolo Cazzaniga et. al. proposed P systems with memory, having facility to store the input and solutions of previous computation [3]. Motivated from these concepts, we propose a transducer model benefited with memory, using biological features synaptogenesis, synaptic pruning, polarization, dynamic synaptic connectivity and diversity in spike transmission. This paper imbibes the link between the structural changes in brain and memory for the construction of transducer model with memory. This proposed model which computes, gives solution, provides the facility to store input and solutions of computations and retrieves a copy of solution from memory if necessary.
Keywords: Spiking Neural P systems, Structural plasticity, Memory

10-07

ON A QUEUEING-INVENTORY SUPPLY CHAIN SYSTEM WITH IMPATIENCE OF CUSTOMERS

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Background: Supply chain consists of all activities associated with flow of goods and services, movement and storage of raw materials, work-in-process inventory and finished goods from point of origin to point of consumption. Effective supply chain helps firms to optimize inventory levels to reduce costs and also helps enterprises to avoid production stoppages.
Method: A queueing inventory supply chain with two units is considered. A distribution centre where the stocks are kept for meeting the demand of customers and a production centre in which the items produced are kept for meeting the demand from the distribution centre. When the inventory in the distribution centre depletes to a pre fixed level(s), it orders a fixed quantity(Q) from the production centre. If the production centre has this required amount it will be send to the distribution centre. It takes an exponentially distributed amount of time for the item to reach the distribution centre. On the other hand if the production centre has only fewer items than the required amount, the customers in the distribution centre have to wait till the required items accumulate in the production centre and get transferred to the

distribution centre. Though no customers from outside is allowed to enter into the system when the inventory in the distribution centre is zero, those customers who are already in the system at this stage may leave the system due to impatience after an exponentially distributed amount of waiting time. A stochastic model is developed by identifying the Continuous Time Markov Chain. The model is constructed and analysed using matrix analytic method. Cost function is developed to numerically investigate the optimal values. The effects of various parameters on the system performance measures are also investigated.

Results: Numerical analysis shows that as the level of inventory in the distribution centre, at which the order is placed increases, the value of the expected total cost decreases. A series of numerical works are performed for the evaluation of the performance measures of the system.

Conclusion: In this paper we studied a queuing inventory supply chain model with one production centre following (rQ,kQ)-policy and a distribution centre which follows (s,S)-policy. The model developed could be applied to similar queueing inventory problems.

Keywords: Queuing inventory, production inventory systems, supply chain, customer impatience,

10-08

A NEW FAMILY OF ALPHA POWER TRANSFORMED FRÉCHET DISTRIBUTION AND ITS APPLICATIONS IN RAINFALL DATA ANALYSIS

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Introduction: The extreme value distribution of type II was named after Fréchet (1927), who devised one possible limiting distribution for a sequence of maxima, provided convenient scale normalization. Extreme Value distributions are widely used in risk management, finance, insurance, economics, hydrology, material sciences, telecommunications and many other industries dealing with extreme events. In the present paper we introduce a new distribution from the Fréchet distribution by using the Alpha-power transformation suggested by Mahdavi and Kundu (2016), called Alpha Power Transformed Fréchet (APF) distribution. This family of distribution includes the Fréchet distributions as special cases. Some of the tractable properties are investigated. We discuss maximum likelihood estimation of model parameters and maximum rain fall data is used to evaluate the performance of the proposed distribution.

Materials & Methods:

Alpha Power Transformed Fréchet Distribution

Definition 1: The random variable X is said to have a three-parameter Alpha Power transformed Fréchet distribution denoted by APF($\lambda, \beta;$), with the parameters λ, β and α, then its pdf can be defined as follows

Results and conclusions: In this section, we present real life applications of the APF distribution in analyzing rainfall data. We collected monthly precipitation data of Kozhikode for the period 2013 to 2017 from the meteorology department. The data we considered for the analysis is the maximum monthly maximum rainfall in Kozhikode during 2013 to 2017. We fitted the APF, Fréchet and Gumbel to the rainfall data (Figure 3). We used Akaike's Information Criterion (AIC) (Akaike, 1973; Burnham and Anderson, 1998) to assess the appropriateness of APF over the Fréchet and Gumbel distributions. Smaller value of AIC indicates that the estimated density of the APF distribution fits the data quite well compare to Fréchet and gumbel density. Hence APF model can be used for the estimation and prediction of rainfall.

Keywords: Fréchet distribution, alpha power transformed Fréchet, extreme value distribution

11 - PHYSICAL SCIENCES

11-01

GRAPHENE INCORPORATED TITANIUM DIOXIDECO-EXPOSED WITH HIGH ENERGY {001} AND {010/100} FACETS FOR SELF-CLEANING NANOCOATINGS

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Background: Interest in developing self-cleaning surfaces and coatings is increasing rapidly nowadays because of the growing demand for self-disinfecting, uncontaminated, unpolluted and hygienic surfaces. This Lotus leaf-inspired nanotechnology finds wide applications on glass windows, textiles, paints, and as coatings on high performance optoelectronic devices like solar panels, green houses, flat panel displays, etc. The major requirements of a super hydrophilic self-cleaning coating material are high photo catalytic activity, photo induced super hydrophilicity, good optical transparency, photo stability etc. for which anatase Titanium dioxide (TiO_2) forms a promising candidate. But, the photo activity of TiO_2 is limited due to high recombination rate and photo response in UV region, which can be rectified by graphene hybridization. Graphene can act as a good scavenger for electrons retarding the bulk and surface recombination of photo generated excitons during photo excitation of TiO_2.

Method: A hydrothermally modified sol-gel method is adopted under varying acidic pH conditions for the synthesis of TiO_2 nanocrystals with good wettability. 0.1% reduced Graphene Oxide (rGO) is incorporated to TiO_2 synthesis at pH 3 (T3/rGO) to obtain the binary hybrid adopting the same hydrothermal method. Synthesized samples are characterized by XRD, DRS UV-Vis, Raman, TEM and HRTEM, PL and TRPL measurements. Nanocoatings are fabricated on glass substrate by spin-coating techniques for analyzing its self-cleaning behavior by studying its photo degradation, contact angle measurements, and photo stablilty.

Results: TiO_2nanocrystals synthesized at pH 3 (T-3) is found to have ellipsoidal morphologies with larger percentage of exposed high energy {001} and {010}/{100} facets with better photo catalytic activity. The photo catalytic activity is enhanced from 83% ($k = 9.23 \times$ ٣-١٠ min^{-1}) for T-3 sample to 2.4×10^{-2} min^{-1} in T3/rGO binary hybrid. The binary hybrid shows a photoinduced super hydrophilic behavior with a water contact angle of ~0° within 15 min of UV irradiation at 365 nm. This is because the recombination rate is reduced by the incorporation of graphene for the hybrid as evident from photoluminescence spectra.

Conclusions: We developed a novel hydrothermal assisted synthetic pathway for the synthesis of pristine TiO_2 and TiO_2/graphene hybrid. Synergism created by graphene incorporation resulted with stronger dye adsorption ability and high electron mobility along with photogenerated charge separation which resulted in the superior self-cleaning property for TiO_2/graphene binary hybrid.

Keywords: Superhydrophilicity, Self-cleaning, TiO_2/graphene hybrid, nanocoatings, crystal facets.

11-02

DEVELOPMENT OF AN IONOGEL MEMBRANE FOR CO_2 SENSING APPLICATION

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Background: The increasing level of CO_2 in the atmosphere is presently noteworthy ecological anguish in current society. In this scenario, research upon CO_2 monitoring in atmosphere and problems associated with it is demanding one, to preserve the clean environment in an airtight chamber. To achieve this different class of materials has been explored viz absorbents, adsorbents, permeable membranes, etc. Among them, polymer-based membranes including hybrid polymer-organic membranes, polymer-inorganic membranes are considered as most efficient for CO_2 separation.

Method: This work is intended to address the development of an ionogel membrane by entrapping most conductive ionic liquid, 1-Ethyl, 3-methyl imidazolium thiocyanate ([EMIM][SCN]), in a non conducting polymer, polyvinyl alcohol (PVA). After having a deep insight into its morphological, thermal and electrical changes on varying concentration

of the ionic liquid, a low-cost chemiresistive type CO_2 sensor was fabricatedon interdigitated Ag electrodes, and the CO_2 response rate was monitored.

Results: Developed an ionogel membrane with varying weight ratios of [EMIM][SCN] in the PVA matrix. It is found that the ionogel membrane with 20% IL has superior performance, further increase in IL adversely effects due to agglomeration of ions. Fabricated interdigitated sensor play a crucial role in the CO_2 gas abduction and separation with high CO_2 response rate. Computational investigations were also employed to study the interaction between the trapped CO_2 with the ionogel membrane. The obtained results revealed that the thiocyanate anion plays an acute role in gas capture by forming carbamate, whereas the cation and PVA matrix were mediocre by forming hydrogen bonds with captured CO_2 to form the structure more complicated one and this complexity increases the resistance of the material, that is evidently observed from the experimental results too.

Conclusion: The free-standing wet crack free ionogel membrane with 20 % [EMIM][SCN] can be used for CO_2 sensor applications while ionogel membrane with a higher concentration of [EMIM][SCN] can be used for CO_2 capturing and storage.

Keywords: Ionogel membrane; Thermal properties; Electrical Properties; CO_2 Sensors;CO_2 capturing and storage application; PVA, [EMIM][SCN].

11-03

ENHANCEMENT OF MICROWAVE DIELECTRIC PROPERTIES OF $CA_3TE_2ZN_3O_{12}$ GARNET CERAMICS BY COLD SINTERING PROCESS

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Background: Microwave dielectric ceramics with suitable dielectric constants, low dielectric losses and nearly zero temperature coefficients and their low temperature fabrication have been a hot topic for the last few decades. Conventional sintering technique require hug amount of energy, here comes the importance of low temperature/ room temperature sintering (Cold sintering). This work compares the microwave dielectric properties of $Ca_3Te_2Zn_3O_{12}$garnet ceramics sintered by conventional and cold sintering process.

Method: This work envisages the improvement in dielectric properties of $Ca_3Te_2Zn_3O_{12}$ garnet ceramics densified by cold sintering method using Li_2MoO_4at 120-200^oC from conventionally sintered at 1100^oC aided by B_2O_3. Structural probing was carries outusingX-ray Diffraction and vibrational spectroscopy. Further, the microwave dielectric properties were measured with a vector network analyser using cavity method excited by $TE_{01\delta}$ mode.

Results: The XRD pattern depicts the single crystalline phase of $Ca_3Te_2Zn_3O_{12}$ ceramics and further confirmed by vibrational spectroscopic outcomes. Rietveld refinement of the XRD pattern gives the lattice parameters (Cubic structure with space group Ia-3d, a = 12.632 Å). Conventional sintering gives a densification of 90% and having of 10.9, Q_u x f of 20340 GHz and of -31.61 ppm/^oC where as Cold sintering aided by 50% of $LiMoO_4$ gives 88% densification with of 5.6, Q_u x f of 27427 GHz and of -47 ppm/^oC.

Conclusions: The microwave dielectric properties and their correlation with symmetry of $Ca_3Te_2Zn_3O_{12}$ garnet ceramics was studied for the first time and the cold sintering process aided by Li_2MoO_4 enable $Ca_3Te_2Zn_3O_{12}$ garnet ceramics as an efficient low loss (~10^{-4}) material for microwave substrate applications.

Keywords: Garnet tellurates, XRD, Vibrational spectroscopy and Cold sintering process.

11-04

SPR INDUCED Au@Ag CORE SHELL DOPED SiO_2-TiO_2-ZrO_2 FIBER OPTIC SENSOR FOR VITAMIN A DETECTION

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Au@Ag core-shell nanoparticles were embedded in SiO_2-TiO_2-ZrO_2 ternary matrix for potential Vitamin A sensing applications and are reported for the first time. Ternary SiO_2-TiO_2-ZrO_2 glasses were prepared through a non-hydrolytic sol-gel process and were incorporated with Au@Ag core-shell nanoparticles having an average size of 30 nm. The sensing capability and selectivity of the as prepared Au@Ag core-shell nanoparticles were studied using absorption spectroscopy and was established to have good selectivity over other biomolecules. The title specimen was coated

on an optical fiber to reveal the practical application of such a sensor and analyzed its specificity towards vitamin A sensing using transmittance spectra. A linear response towards vitamin A concentration ranging from 10-1000 µM was observed for the as prepared novel vitamin A sensor. An economical, low toxic and sensitive bio-sensor for vitamin A detection based on SPR mechanism is proposed in the current work.

11-05

RICE STRAW BASED COPPER OXIDE NANOCOMPOSITE AS ANTIBACTERIAL AGENT

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In the present Structural study, nanoparticles of Copper oxide (CS)and nanocomposite of Rice straw based Copper(RSCS)were synthesised through controlled co-precipitation method with citric acid as capping agent. Characterizations of all the four synthesized samples were carried out using XRD. Comparison of XRD's of metal oxides with JCPDS confirmed that the formed metal oxide was CS, Phase purity and crystallinity of these samples were confirmed from XRD. Crystallite sizes were calculated using Scherrer equation. Copper oxide – Rice straw nanocomposite showed visible range absorption in addition to UV range. From band gap calculation it was seen that all of them showed subgaps. The present study investigates the antimicrobial activity of the synthesized samples as antibacterial agents. *The* gram positive bacteria: **Staphylococcus aureus and** the gram negative bacteria: Escherichia coli are the microbes used in the present study. The study confirms that the copperoxide samples prepared in the present study can be used as antibacterial agent against Escherichia coli. The results suggest that proper tuning can make them good antimicrobial agent.
Keywords: Biopolymer, nanocomposite, Co- Precipitation, Anti-Bacterial Agents

11-06

BEAUTY MEASUREMENT: AN ATTEMPT TO DERIVE AN EQUATION OF BEAUTY

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Background: Visual attractiveness, which we call beauty, has been one of the most important things which has shaped human civilizations. Attempts were and are always made by humans through all ages to preserve their beauty, and from ancient times itself they have identified the importance of golden ratio in visual beauty. There have been leaps and bounds in this field and we have reached the era of cosmetic surgeries. Most important among them is Dr. Stephen Marquardt who studied human beauty for years in his practice of oral and maxillofacial surgery. After his analysis of the human face from ancient times to the modern day, he established the relationship between beauty and golden ratio for both genders of all races, cultures and eras through the Beauty mask which he developed. Pentagonal and decagonal structures form the foundation of this beauty mask, which include golden ratios in all their dimensions. In this work an attempt is made to form an equational analogue of the face mask.
Results: By using the curve fitting method, which is an approximation method, an equation of beauty for the face is derived. In the derivation of this equation not all the golden ratios of the face are taken in to account. Due to these reasons, the accuracy and applicability of this equation can be determined only through trials.
Conclusions: Beauty has many facets. Yet, through this study it is established that at least the physical aspect of beauty is measurable.
Keywords: Equation of beauty, Beauty mask, Curve fitting.

11-07

ENHANCED ELECTROMAGNETIC ABSORPTION OF CB AND RGO INCORPORATED SILICON RUBBER IN X AND KU BAND

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Background: While smart phones and tablets of modern times use high speed microwaves and millimeter waves for

communications, electromagnetic interference from different sources significantly debilitate their performance. In this regard, conducting polymer nano-composites represent a novel class of materials that possess unique combination of electrical, dielectric, magnetic and mechanical properties which are useful for the suppression of electromagnetic noises. Here, polymer chosen was Silicon rubber since they possess low density, good chemical resistance, weather resistance and convenient fabrication technique.In the present work, our focus is to explore the shielding behavior of an easily available and cost effective alternative, Carbon Black (CB), in accompanying with a well-known graphene without compromising the flexibility of SR.

Method: Solution mixing followed by hot pressing was adapted for the preparation of polymer nano-composites. Modified Hummer's method was used for the synthesis of reduced graphene oxide (rGO). The as-prepared rGO and CB were subjected to ultra-sonication for 30 min in n-hexane medium separately. Then the above solutions were mixed together and again sonicatedabout 1h to get a homogeneous solution. Thensilicon rubber and dicumyl peroxide were dissolved into n-hexaneand mixed well with the above solution. After mixing, dried overnight at 60°Cand then hot pressed at 200 °C/20 min under a pressure of 2 MPa using appropriate dies.

Results: In the present work the as-prepared rGO was characterized using various techniques such as X-ray diffraction, UV-Visible absorption, FTIR and FESEM. Then the incorporation and uniform distribution of fillers within the polymer were also confirmed by XRD,FESEM image and FTIR spectra of the composite.Microstructure of the composite mimic the layer like structure of rGO and the CB particles are more or less homogeneously distributed throughout the entire composite without agglomeration. A lot of interfaces and boundaries were produced by the multiple carbonaceous fillers and also form a 3D conductive network within the rubber matrix. From the electrical conductivity studies it was found that the overall conductivity of the composites increases with increase in rGO wt%.Permittivity measurements revealed that both ε′ and ε″ increases with increase in wt% rGO and CB. The dielectric loss tangent $\tan\delta_{\varepsilon}$, ε″/ε′, was also effectively improved.The composite shows absorption dominated EMI shielding and a maximum $SE_T \sim 28$ dB can be achieved at 8-18 GHz.

Conclusions: A simple and economical strategy for the fabrication of flexible shielding material for practical applications, have been demonstrated. The strategy follows the utilization of a hybrid carbonaceous filler, easily available CB and the 2D rGO, as an efficient EM radiation attenuator for the silicon rubber. The composite displays superior absorption dominated shielding property, SE~28dB due to the synergistic effect of hybrid fillers.The electric conductivity, microstructure and EMI SE results suggest that the hybrid rGO@CB filler forms a 3D conductive framework within the polymer matrixwherein the EM radiation undergo multiple reflections and subsequently dissipated as heat. Therefore, the results indicate that the proposed simple strategy can be widely applied for effective and practical EMI shielding systems.

Keywords: Polymer composites; Electromagnetic interference shielding; Microstructure Electrical properties

11-08

OPTIMIZATION OF ELECTROCHEMICAL PERFORMANCE, AND OPERATION VOLTAGE OF SUPER CAPACITOR

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Background: It is highly desirable to develop an electrochemical double layer supercapacitor (EDLC) with high energy and power densities, improved stability and other performance parameters. This goal can only be achieved by improving the structural and electrochemical properties of the electrodes, choosing an electrolyte with improved ionic conductivity and reducing contact resistance of the current collector and their correlated effects.

Methods: In this work, we have fabricated EDLC supercapacitors with carbon based electrode materials, conventional and ionic liquid electrolytes and aluminium and copper current collectors were used to investigate the effect of process variability, stability and operating voltage of the fabricated supercapacitor investigated their performance by physico-chemical properties: X-ray diffract meter (XRD), Atomic Force Microscopy (AFM), Scanning Electron Microscopy (SEM), Raman Spectroscopy and FTIR; and electrochemical performance: Cyclic Voltammetry, galvanostatic discharge measurements and impedance spectroscopy of the fabricated supercapacitors.

Results: By tuning the individual and collective effects, we could fabricate a super capacitor with high specific capacitance of 726F/g and operation voltage of 4V with activated carbon as electrode, inorganic salt crossed IL gel as electrolyte and PCB designing copper clad as current collector to propose this combination to be the best cost-effective

choice for energy storage application.
Conclusions: Individual effects governing the performance of a supercapacitor was investigated by choosing different electrodes, electrolytes and current collectors by physicochemical andelectro chemical means for optimizing their operating voltage and achieved capacitance. The electrode material used was activated carbon, while electrolytes were inorganic salt (Na2SO4), ionic liquid (Trihexyl (tetradecyl) phosphoniumbis (trifluoromethanesulfonyl) imide) in aqueous and gel forms further by crossing the inorganic salt and IL. The current collectors used were copper foil, aluminium foil and PCB designing copper clad. The results revealed that the individual components viz. electrode, electrolyte and current collector had unique contribution to the overall electrochemical performance. The electrode material with high surface area can enhance the storage capacity, while the operating voltage is decided by the ionic conductivity and mobility of ions in the electrolyte. The overall resistance of the supercapacitor cell is governed by the current collector.
Keywords: super capacitors, Physical studies, electrochemical studies

11-09

INSIGHT INTO INTERPLAY BETWEEN CRYSTAL STRUCTURE AND LUMINESCENT PROPERTIES OF GARNET PHOSPHORS

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Background: The endeavors for energy efficient lighting has now reached the era of solid state lighting in which light emitting diodes (LED) is the new alternative for lighting applications.The significant gap that exists between the present limiting performance of LEDs and the target performance should be reduced. For that, a thorough understanding regarding the role played by the host crystal in determining the emission properties is essential for tuning the optical properties.
Methods: The electronic copies of articles on garnet phosphors were collected from various publishers such as American Chemical Society, Royal Society of Chemistry, ScienceDirect, IOP etc. The correlation exist between selected quantities were plotted using Origin 9.0 software. The structural models were drawn using Crystal Maker software. The garnets under study were reported to be synthesized via solid state reaction route, sol gel method etc.
Results: Reviewing reported articles on garnets, it became obvious that with respect to the ionic radii of the cation and the site with which cation occupies in the host lattice, emission wavelength varies accordingly. More significantly, we found the strong coupling of bond distance with internal quantum efficiency as well as emission wavelength.
Conclusions: This review deciphers the interplay between the host crystal structure and luminescence properties which are essential in designing phosphors to overcome the present limitations for lighting applications.
Keywords: Garnets, Light Emitting Diodes, Optical properties,Internal quantum efficiency, Emission wavelength

11-10

ANTIOXIDANT PROPERTIES OF LANTHANUM OXIDE NANOPARTICLES SYNTHESIZED USING ORGANIC AND BIOLOGICAL CAPPING AGENTS

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Background: Lanthanum Oxide (La_2O_3) is an odorless white inorganic rare earth oxide compound which is soluble in acids but insoluble in water. Due to its hygroscopic property, it absorbs moisture from atmosphere and change to Lanthanum hydroxide. It is suitable for ceramic and optical applications due to the thermal stability. Lanthanum Oxide nanoparticle have a lot of unique properties that make them suitable for biological, industrial and technological application such as biosensors, optical fibers, automobile exhaust catalysts etc.
Method: In the present work, we have synthesized Lanthanum Oxide nanoparticles by chemical co-precipitation method using biological capping agents such as DNA and STARCH and chemical capping agent Ethylene diamene tetra acetic acid (EDTA). The carbonate thus obtained is calcinated accordingly with the thermo gravimetric analysis (TGA) to obtain the oxide nanoparticles. Then the samples are characterized by X-ray diffraction pattern (XRD), Scanning Electronic Microscopy (SEM) and Energy Dispersive X-ray Analysis (EDAX).The antioxidant activity of different

samples is determined by using 1, 1-diphenyl-2-picryl hydrazyl (DPPH) assay according to Chang et al [2001]. The decrease in the absorption of the DPPH solution after the addition of the sample is measured at 517 nm. Ascorbic acid (10mg/ml DMSO) is used as reference. Antioxidant (H-A) reacts with DPPH and reduce it to DPPH-H and as consequence the absorbance decreases.

Results: The particle size obtained from XRD analysis using biological capping agents is compared with that of chemical capping agent for different temperatures. The average particle size is obtained from XRD analysis.Using SEM analysis morphology of the nanoparticles is studied for different temperatures. The elementary configuration is obtained from EDAX.

Conclusions: The XRD result shows that biologically synthesized Lanthanum Oxide nanoparticle has small grain size than chemically synthesized Lanthanum Oxide nanoparticle. The SEM images of the Lanthanum Oxide nanoparticles for different capping agents at different temperatures shows that the morphology of the nanoparticles has a good correlation with the particle size. The antioxidant study reveals that Lanthanum Oxide nanoparticles synthesized using biological capping agents have good antioxidant activity than the nanoparticle synthesized using organic capping agent at different concentrations.

Keywords: Chemical co-precipitation method, Lanthanum Oxide nanoparticle, EDTA,
DNA, STARCH, TGA, XRD, SEM, EDAX,Antioxidant.

11-11

INVESTIGATING THE ELECTROMAGNETIC AND CHEMICAL ENHANCEMENTS IN G-SERS WITH THERMALLY EVAPORATED SILVER

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Surface enhanced Raman spectroscopy (SERS) is an analytical tool with single molecular detection capability. Graphene, the two- dimensional allotrope of carbon, can take multiple roles in SERS. It can act as probe, a uniform surface for plasmonic nanostructures, nanometer size gap and as fluorescent quencher. Silver thin films were deposited over the graphene coated copper foil by thermal evaporation to make a Ag/G/Cu graphene mediated SERS substrate. Using Raman spectra, the maximum chemical enhancement along with electromagnetic enhancement has been identified for 15 nm Ag deposited G-SERS substrate. The limit of detection for the SERS substrate was 10^{-10} M..

11-12

STRUCTURAL STUDIES OF ZINC OXIDE THIN FILM BY SOL - GEL DIP COATING METHOD

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Background: Highly transparent semiconductor based metaloxides thin films havegained wide range of applications inmodern industry, due to their extraordinaryproperties. Zinc oxide thin film is considered as the best candidate among the various semiconducting metal oxide thin films, since it is cost-effective, non-toxic and reproducible with consistent stoichiometry using chemical synthesis method.

Method: In this work, sol –gel dip coating technique is used to synthesize Zinc oxidethin filmson glass substrate, with Zinc acetateas precursor and ethanol as solvent. XRD, FTIR and UV-Visible spectroscopic techniques are used to determine its structural and optical properties. Effect of deposition parameter such as number of dipping, on the structural properties of the deposited films have been studied.

Results: XRD pattern confirms the preferential orientation which is sensitive to deposition parameters. Film deposited having 80 layers shows (101) plane and better transmission of 70% at 800 nm. Films of 40 layers depicts the transition from amorphous to polycrystalline characteristics having (002) plane and better than 92% at 800 nm. These films can be strictly used in optoelectronic devices.

Conclusions: Sol-gel dip coating technique is the best technique for the preparation of Zinc oxide thin films owing to

its simplicity, low cost and non-vacuum system of deposition. The structural and optical properties of those films can be tailored by changing various deposition parameters.

Keywords: Sol-gel, transparent conducting oxide, deposition parameter

11-13

RESPONSE OF BHINDI (*ABELMOSCHUS ESCULENTUS* L. MOENCH) TO FERTIGATION AND FOLIAR NUTRITION OF MICRONUTRIENTS ON THE GROWTH, YIELD AND QUALITY OF BHINDI

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Background: Fertigation coupled with foliar application of micronutrients is gaining popularity as tools for improving production. Has there is widespread micronutrient deficiencies in most of the soils Fertigation and foliar nutrition proved to improve growth by providing optimum nutrient availability conditions for nutrient absorption. For attaining maximum crop productivity, the right quantity of fertilizers at the right time is essential; hence the present investigation is taken up to study the influence of these practices on growth, yield and the quality of in bhindi.

Method: A field experiment was conducted during 2016-2018 to standardize the time and site specific dose of nutrient application and to evaluate the effect of fertigation of major nutrients and foliar nutrition of micronutrients in bhindi variety 'Arka Anamika', to assess the impact of nutrient on yield and quality of the crop. The field experiment was laid out in Randomized Block Design (Factorial RBD) with eight treatments and two controls and each were replicated three times.

Results: Foliar application of micronutrients was significant regarding number of fruits per plant, highest number of fruits per plant (21.92) and highest carotenoid content (2.56 mg g^{-1}) was observed with S_2 (Foliar application of micronutrients at 4 per cent concentration) and it was superior to S_1 (21.45). Application of micronutrients increases fruit number, length and diameter.

Conclusions: The findings revealed that time of fertigation at once in two days, levels of fertigation at the rate of 100 per cent NPK and foliar application of micronutrients at 4 per cent concentration had remarkable influence on growth, yield and quality of bhindi, the same treatments recorded maximum soil nutrient status and leaf nutrient content of bhindi.

Keywords: Bhindi, fertigation, foliar application of micronutrients, yield

11-14

WETTING MECHANISM OF BIMODAL POROUS TiO_2-ZrO_2 TRANSPARENT COATINGS

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Background: TiO_2 as a self cleaning coating has the advantage to make use of both solar energy as well as rainfall to clean the surface and hence it is possible to lower the cost of maintainance. For balancing both transmission and photocatalytic properties in titania, general approach is to synthesize binary composites made up of TiO_2 and a low refractive index material such as ZrO_2, SiO_2 etc. The excess surface hydroxyl groups arised by incorporating ZrO_2 into TiO_2 trap photo induced holes which increases catalytic activity by recombination of electron-hole pairs.

Method: Hierarchically porous double templated TiO_2-ZrO_2 composites as self cleaning coatings were developed on glass substrates using dip coating technique. For comparative studies, single templated TiO_2-ZrO_2 thin films were also synthesized using the same method with PMMA only.

Results: The formation of the composite and successful incorporation of the polymer into the composite was verified by means of Fourier transform infrared spectroscopy and thermogravimetric analysis. The porous nature of the film was studied using field emission scanning electron microscopy. Raman studies and elemental mapping revealed the presence of Titanium (Ti), Zirconium (Zr) and Oxygen (O) elements.

Conclusions: The double templated nanoporous TiO_2-ZrO_2-PMMA-PF127 coating is found to have better hydrophilic

property even a day after UV-irradiation. Efficient photocatalytic property was observed for porous hydrophilic film, which is more accessible to water and hence cleans out dirt quickly showing higher self cleaning nature.
Keywords: Nanoporous, Composites, Hydrophilicity, Retainability

11-15

A FLEXIBLE, POROUS, ENVIRONMENT FRIENDLY, INTEGRATED SUPERCAPACITOR USING rGO-MODIFIED FILTER PAPER

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Background: Super capacitors are gaining attention as high-performance energy storage devices and flexible super capacitors have wide range of applications especially in flexible portable electronic devices. This work reports the construction of a flexible, porous, environment friendly integrated super capacitor from modified filter paper using reduced graphene oxide (rGO) as the active material which is produced by a green reduction technique.
Method: L-ascorbic acid- reduced graphene oxide was used as the active material. The structural characterization, morphological and optical characterization of the samples were done. A filter paper was cut, folded and rGO electrodes were patterned in a particular way such that both the electrodes and the separator were integrated into a single system and the electrochemical performance was evaluated.
Result: Reduction using L-ascorbic acid is successful in synthesizing rGO. The modified filter paper-based super capacitor has higher values of specific capacitance when compared to conventional coin type super capacitor using the same active material. This is due to the porous nature of the filter paper that enabled the used of more surface area.
Conclusion: A filter paper was cut, painted with the rGO electrode material and folded in a proper pattern to act as both the electrodes and the separator thus forming an integrated flexible, porous super capacitor where the specific capacitance was much higher that of a coin type supercapacitor.
Keywords: Super capacitor, L-ascorbic acid, reduced graphite oxide, flexible supercapacitor

11-16

INFLUENCE OF EU^{3+} SUBSTITUTION ON CRYSTAL STRUCTURE AND OPTICAL PROPERTIES OF $SrBiLiTeO_6$ DOUBLE PEROVSKITE

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Background: Light Emitting Diodes (LEDs) are propitious solutions to the share of lighting in the global energy crisis. The commercially available Yttrium Aluminium Garnet (YAG) coated white LEDs lack good Correlated Color Temperature and Color RenderingIndex values. This pronounces the importance of synthesizing new chemically and thermally stable red phosphors. Host materials with Double Perovskite structure doped with red emitting Eu^{3+} activator ions provide appreciable results in the literature.
Method: This work envisages the variations developed in the structure of the previously reported compound, $SrBiLiTeO_6$ (SBLTO) when doped with various concentrations of xEu^{3+} ions (x = 0.025-0.175mol in steps of 0.025 mol) with the aid of X-ray Diffraction and FT-Raman Spectroscopy. Further, the site symmetry of Bismuth ions and the luminescent properties such as band gap, emission wavelength, concentration quenching and emissive life time is studied using Diffuse Reflectance Spectroscopy and Photoluminescence Spectroscopy.
Results: The XRD patterns confirm the effective in cooperation of Eu^{3+} ions into the host lattice. The expected shift in the Raman peaks affirm the absence of structural variations on doping and also probes the local site symmetry. The band gap of 3.67eV favors UV-Visible excitations and using an excitation wavelength of 464nm, an orange red emission of 610 nm is observed with a concentration quenching at 0.15 mol of Eu^{3+} ions. The emissive life time values suggest that the developed phosphor is suitable for white LED applications.
Conclusions: The optical properties and local site symmetry of the tellurate, SBLTO was studied for the first time and luminescent characterizations carried out conclude that the compound could be efficiently excited under UV-Visible radiations to emit orange red color, suitable for white LEDs
Keywords: Double Perovskites, Tellurates, Eu^{3+} ions, orange red phosphor.

11-17

ENHANCED LIGHT EXTRACTION FROM ORGANIC LIGHT EMITTING DIODES USING A NANOPARTICLE SCATTERING LAYER

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Background: Organic light emitting diode (OLED) based lighting technology has gained significant momentum because of fast response, high efficiency, low power consumption, self-emission, superior color quality, ultrathin profile and applicability to flexible substrates.Although the internal quantum efficiency of OLEDs can be made nearly 100% by using phosphorescent emitters, the refractive index mismatch between the layers causes total internal reflection at the layer interfaces. Thus, only about 20% of the generated photons can leave the device as useful light. Modification of the glass air interface at the emitting surface by appending a light extraction layer can enhance the amount of light out coupled several folds.

Method: We prepared an external light extraction layer for enhancing the out coupling efficiency of an OLED. Sylgard 184 from Dow Corning was used for the film preparation. The clear elastomer and the curing agent were thoroughly mixed with a weight ratio of 10:1 and vacuum de-gassing was done for removing the air bubbles in the mixture. ZnO nanoparticles (NPs) were added with different weight percentage to the mixture and were mixed thoroughly. The substrates for the PDMS-ZnO film preparation were made by coating a sacrificial layer of ARP 3510 photoresist from ALLRESIST GmbH on a plane glass. The PDMS-ZnO composites were then spin coated at different speeds over the prepared. The layers were cured by keeping at 150^0 C for 15 minutes. The cured film was then separated by keeping the substrate in acetone.

Result: A maximum enhancement factor (EF) of 102% was observed for the green device on applying the extraction film of 108 μm thickness and having a concentration of 100 mg/g at 4 V. As the voltage goes higher, more light will be emitted from the device and there is a possibility of destructive interference of the scattered light within the film.Thus, the EF decreases as the voltage goes higher. A maximum EF of 56% was observed for the red device with an extraction film of 50 mg/g concentration and a thickness of 119 μm at 4 V.

Conclusion: A polymer-NP scattering layer was fabricated by simple and low-cost solution processing technique. The layer can be attached to the emitting side of the OLEDs without interrupting the device fabrication. The electroluminescence spectra of the devices with the film did not show any variations in the chromaticity. This procedure can be easily attributed to the roll to roll process for high volume manufacturing.

Keyword: External Light extraction layer, Zinc oxide, Optical outcoupling, OLED.

11-18

ULTRAVIOLET PHOTODETECTORS BASED ON ZINC OXIDE: DEPENDENCE ON MORPHOLOGY

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Background: Ultraviolet (UV) radiation has very important role on the survival and development of human kind. Moderate skin exposure to UV radiation is useful for health but over exposure to UV radiation can cause skin cancer, premature ageing, burns etc. Thus UV photodetectors find wide range of applications in civilian and military areas. Many wide band gap semiconductors are used for developing UV photodetectors. Among them Zinc Oxide(ZnO) is a most promising material for the fabrication of fast response, high sensitivity and high selectivity UV photodetectors. Various morphologies of ZnO can be easily obtained. The electrical, optical and structural properties of ZnO vary with

the morphology, which influences the device performance.
Method: This work deals with the fabrication of UV photodetectors based on ZnO nanoparticles and ZnO nanorods in photoconductor configuration. ZnO nanoparticles were synthesized by precipitation method and ZnO nanorods were synthesized by hydrothermal method. The current-voltage characteristics and transient photoresponse of the device were studied with Keithley source meter and 6 W UV lamp with 365 nm and 254 nm wavelengths.
Results: The device based on nanoparticles exhibited an on/off ratio of 1.5 under 365 nm light illumination and 2.8 under 254 nm light illumination at 20 V. On the other hand, ZnO nanorod based device exhibited an on/off ratio of 1.73×10^2 under 365 nm light illumination and 79 under 254 nm light illumination at 1 V. The ZnO nanorods based device exhibited good performance due to high surface to volume ratio and long conduction path. The ZnO nanoparticles based device exhibited rise and fall times of 1.51s and 0.54s respectively under 365 nm light illumination at 20V. The ZnO nanorods based device exhibited rise and fall times of 8.19s and 18.97s respectively under 365 nm light illumination at 20V.
Conclusions: We fabricated UV photodetectors based on ZnO nanoparticles and ZnO nanorods and studied the effect of morphology on device performance. It is found that nanorod morphology is more effective in UV detection. Since the ZnO nanoparticles and nanorods were synthesized at low temperatures, these techniques are suitable for the fabrication of flexible UV photodetectors.
Keywords: ZnO, nanoparticles, nanorods, UV photodetector

11-19

INFLUENCE OF GATE DIELECTRIC PROCESSING ON THE PERFORMANCE OF OFETs: EFFECT OF SOLVENT POLARITY

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Background: Among various organic materials based devices Organic Field-Effect Transistors (OFETs) have gainedenormous interest due to their potential applications in memory devices, complementary circuits,radio frequency identification tags (RFID),flexible active matrix displays and various chemical and biological sensors. Performance of the OFET largely depends on their processing.
Method: This work focusses on the electrical performance parameters of the pentacene based OFETs, fabricated with poly(methyl methacrylate) (PMMA) gate dielectric layer cast from solvents of varying dipole moments. Fabrication and characterisation of the OFETs involves spin coating, physical vapour deposition, structural and morphological analysis and electrical characterisation.
Results: Dielectric constant of PMMA films cast fromsolvents of varying dipolemoments showed an increase with increasing the polarity of the solvent used. Leakage current was minimum in the case of PMMA film cast from low dipole moment solvent. Surface morphology studies of pentacene showed large grain sizes which when deposited on PMMA cast from low dipole moment solvent. OFETs electrical performance parameters were found to be decreased with increasing the polarity of the solvents used for casting PMMA gatedielectric layer.
Conclusions: This report reveals that the selection of appropriate solvent for the gatedielectric is an important factor to obtain very good electrical performance and stability of theorganic field-effect transistors. This study reports that organic field-effect transistorsfabricated with PMMA gate dielectric cast from low dipole moment solvent showed enhanced electricalperformance in comparison with those from high dipole moment solvents.
Keywords: Organic field-effect transistor, solvent polarity, gate dielectric

11-20

GREEN FLUORESCENT CARBON NANOPARTICLES FROM THE PITH OF *MANIHOT ESCULENTA* (TAPIOCA) STEM FOR Fe(III) DETECTION

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Background: The production of better functional materials for future application from naturally existing materials with the help of green chemistry is a great challenge for the scientific community to satisfy the needs of modern lifestyle and developing technology. In this situation, Carbon nanostructures capable of providing better desired property has a major role if they can be synthesized from naturally existing biomaterials by cost effective synthesis methods. Pith from tapioca stem is a better source for the production of carbon nanoparticles since they are rich in carbon containing molecules as well as it is a non-edible part of a common agricultural product in Kerala.
Method: In this work, Carbon nanoparticles were synthesized from pith of tapioca stem by simple and cost effective hydrothermal method at 210 without using any chemicals. The obtained functionalized Carbon nanoparticles were characterized by XRD, HRTEM, XPS and FTIR methods and their optical properties and applicability in Fe(III) sensing are studied by UV-Visible absorption and Photoluminescence emission spectroscopy.
Results: The XRD and HRTEM analysis indicates that the derived structures are amorphous in nature and has a spherical morphology with an average dimension of 24 nm. The FTIR and XPS results confirm that the extracted nanostructures from pith are functionalized Carbon nanoparticles. The functional groups present on the surfaces of them act as charge trapping centres and result in strong UV absorption as well as as an excitation dependent high intensity PL emission with a high quantum yield value of 19.2%. By taking the fluorescence quenching of emission in presence of different ions, it is identified that these functionalized carbon nanoparticles are efficient candidate for Fe(III) ion detection.
Conclusions: This study concludes that Hydrothermal Synthesis is a cost effective and facile synthesis method to extract Carbon nanoparticles from biomaterials. The functionalized carbon nanoparticle thus derived from pith of tapioca stem can be used as an efficient green luminescent material as well as a highly sensitive sensor for the detection of Fe(III) ions in water.
Keywords: Functionalized carbon nanoparticles, Fluorescence quenching, Fe(III) ion detection.

11-21

THERMODYNAMICS OF QUARK GLUON PLASMA USING CLUSTER XPANSION

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Background: The experimental demonstration of quark gluon plasma (QGP) in large hadron collider (LHC) provides new insights, where the experiments were carried out at extremely very high energy densities and temperature. Under this condition quantum chromodynamic (QCD) many body interactions are possible, and the quarks are interacting through the coupling of their color charges. In this paper we found the non ideal equation of state, energy density and entropy density and their variation with temperature of non ideal Quark Gluon Plasma (QGP) in the deconfined phase using the Mayer's cluster expansion.
Method: To make theoretical study and predictions of the QGP phase, different models are developed like bag model, Cornell potential model, relativistic harmonic oscillator model etc. In this paper, to find the equation of state and other properties of deconfined phase, we use the potential suggested by S. Mattiello and W. Cassing. The interaction potential in the deconfined state is given by

$$U(r) = \left(\frac{\pi}{12r} + \frac{C_2}{2N_c T}\right) e^{-m_D r} \tag{1}$$

where r is the radial distance, is the non perturbative dimension two condensate, $M_D = 1.26\,\mathrm{T}$ is the Debye mass, T is the temperature and is the number of color. The Mayer's cluster expansion method is used with the Fourier transformed potential.
Conclusions: This work establishes the use of cluster expansion to obtain the equation of state, energy density and

entropy density of QGP phase and their variation with temperature. It is proved that in the high temperature limit the equation of state and other thermodynamic properties matches with the Stefan-Boltzmann limit.

Keywords: Equation of state, Cluster expansion, Quark gluon plasma.

11-22

ENHANCEMENT OF PROPERTIES IN $BiFeO_3$ DUE TO PHASE TRANSITION BY EUROPIUM DOPING

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Background: BiFeO3 is a room temperature multiferroic system with rhombhedral structure. Rare earth doping in place of Bi^{3+} induce phase transition in $BiFeO_3$. It enhances the structural, magnetic, and dielectric properties of the system. It also improves the memory storage and gas sensing properties of this multiferroic system.
Methods: Eu^{3+} doped $BiFeO_3$ multiferroic nanopowder samples are prepared by sol-gel method and are calcined at 600^0C for 2 hours. Positron annihilation spectroscopy and X-ray Diffraction spectroscopy used for the study of structure transformation. Better studies can be carried out if the samples are prepared in thin film form by, say, Pulsed Laser Deposition (**PLD**).
Results: The phase transition of the samples from rhombohedral to an orthorhombic structure occurs at the composition *x* >0.2. and are observed by both positron annihilation spectroscopy and X-ray Diffraction. This structural transformation enhances the properties such as magneto electric coupling, magnetic properties and dielectric characteristics of the samples.
Conclusion: Nanosized Bi□□□$_x$□Eu_xFeO□ (x=0, 0.1, 0.2) system has been prepared by sol-gel method using PVA as a chelating agent. The XRD result and Positron lifetime spectroscopy confirms the structural transformation from rhombohedraly distorted pervoskite structure to orthorhombic structure Eu doping. It enhanced the dielectric and magnetic property of the sample at x = 0.2 in $Bi_{(1-x)}Eu_xFeO_3$.

Keywords: Bismuth ferrite, defects, positron annihilation, vacancies, pulsed laser deposition

11-23

SPECTROSCOPIC STUDIES OF CERIUM BASED NANOPHOSPHORS

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Background: The luminescence properties can be tuned by doping with suitable rare earth metals. Among these, Cerium is an efficient dopant, because it has only one electron in the first shell of the 4f orbital and its optically active transition (4f-5d) can occupy only in low symmetry sites. Cerium ion doping in ZnS produce efficient phosphor materials with a complete subset of colors.
Method: Nanometer sized Ce^{3+}doped ZnS were synthesized via solid state reaction method at low temperature. The structural, compositional and morphological of the samples were analyzed by XRD, FTIR, EDS and FE-SEM. The optical characteristics were analyzed using UV-Vis spectroscopy, PL spectroscopy and CIE chromaticity coordinates.
Results: The XRD results reveal that the prepared samples belong to hexagonal wurtzite structure. The crystallite size of the particles calculated by Scherrer formula shows that the size of the particles decreases with Ce^{3+} doping. The presence of Ce^{3+} ions in the synthesized samples were confirmed by energy-dispersive spectrum. FTIR spectra characterize various vibrational bonds present in the samples. The value of band gap energy has been found in the range 3.2-3.4eV using UV-Vis spectrophotometer. The photoluminescence spectrum of Ce^{3+} incorporated ZnS phosphor showed an UV emission and a defect emission and the Ce ions induced a red shift in the UV emission and a small enhancement in the

defect emission. The CIE chromaticity co-ordinates for all the concentrations were calculated.
Conclusions: The prepared sample confirms the hexagaonal phase structure. The XRD results indicated that particle size decreases with Cerium doping. The FTIR observations show the chemical bonding in the lattice structure. The Energy Dispersive X-ray analysis reveals the presence of Zn, S and Ce element in doped samples. The optical band gap energy increases with Ce^{3+} doping. The PL spectra show a green light emitting from ZnS and by doping with cerium shows blue fluorescence. The obtained ZnS:Ce nanophosphor emits blue light with CIE coordinates x=0.128 and y=0.192. In conclusion, Ce^{3+} doped ZnS nanophosphor form an efficient phosphor material with strong visible emission intensity applicable in light emitting devices.
Keywords: Luminescence, nanophosphor, solid state, doping, UV emission, CIE coordinates.

11-24

DIELECTRIC RELAXATION AND THERMAL STUDIES IN SUPER COOLED AND GLASSY STATES OF ANTI CANCEROUS ALKALOID BRUCINE

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Differential scanning calorimetry (DSC)is used to study theglass transition phenomenon and Broad Band dielectric spectroscopy (BDS) is used to study the molecular mobility through dielectric relaxation processes. Glass transition temperature (Tg) obtained from DSC experiment is very much above the room temperature and it is closer to the Tg obtained by BDS. Temperature and frequency dependence of real and imaginary part of complex dielectric constant are studied for broad frequency range of 10^{-2} Hz to 10^{7} Hz. Primary (α) and secondary relaxations (β and γ) are observed above and below the glass transition temperature respectively. The temperature at which α relaxation freezes is close to the Tg value obtained from DSC experiment. Dielectric loss spectra are fitted using Havriliak - Negami equation and temperature dependence of relaxation time and dielectric strength are studied. Temperature dependence of relaxation time is fitted by Vogel-Fulcher-Tamann equation and found the values of activation energy of the α relaxation fragility and glass transition temperature of Brucine. From the value of fragility (90.3) obtained from VFT fit, Brucine is a fragile glass former.
PACS codes: 64.70.pm,81.05.Kf, 61.43.Fs,65.60.+a,77.22.Gm,73.61.Jc,65.80.-g
Keywords: Broad band dielectricspectroscopy, Dielectric relaxation, Glass transition, Brucine

11-25

GREEN SYNTHESIS OF SILVER NANOPARTICLES AND THEIR APPLICATION AS SERS SUBSTRATES

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Background: The recent advances in the field of nanoparticle synthesis have a strong impact in many scientific areas. Out of different nanostructures synthesized so far, metallic nanostructures have been widely used as surface enhanced Raman scattering (SERS) substrates. Highly localized electromagnetic fields are produced by exciting the localized surface plasmon resonance (LSPR) of these nanostructures, which leads to remarkable enhancement of Raman scattering signals from the molecules at the surfaces of these nanostructures. Biogenic nanoparticles, compared to chemically synthesized, is still new but is developing rapidly in the last five years. Growing demand to develop environmental friendly processes for nanoparticle synthesis, avoiding toxic chemicals.
Method: Fresh latex from the plant *calotropis gigantea* is collected. The latex is centrifuged and the supernatant is collected. It is made up to 3% and reacted with silver precursor solution using chemical method. The product is purified to obtain spherical shaped silver nanoparticles.
Results: The spherical morphology of the nanoparticles obtained was analyzed using Field emission scanning electron microscope (FESEM) and High-resolution transmission electron microscopy (HRTEM). UV-visible absorption spectroscopy showed surface plasmon resonance (SPR) in the range of 430-440 nm. The X-ray diffraction pattern (XRD)

revealed the face centred cubic structure of silver nanoparticles. SERS activity of these nanoparticles as substrates were tested using two probe molecules crystal violet (CV) and nile blue chloride (NBC) which showed excellent signal to noise ratio in the spectra obtained. Linear calibration curves plotted for varying concentrations of probe molecules against signal intensity which showed excellent results.
Conclusions: Green synthesis of silver nanoparticles using *calotropis gigantea* plant is reported. Different characterization techniques were used for the analysis of these nanoparticles. SERS activity studies of the nanoparticles using crystal violet and nile blue chloride. The measure of linearity responses obtained here indicates that these silver nanostructures can find potential applications in SERS based sensors.
Keywords: Green synthesis, silver nanoparticles, surface enhanced Raman scattering, crystal violet, nile blue chloride.

11-26

UTILIZATION OF PERLITE AND VERMICULITE IN CEMENT COMPOSITES FOR GAMMA RAY SHIELDING APPLICATIONS

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Background: The shield design is the most important aspect of the reduction of radiation to an acceptable level. Concrete is one of the important matrices, which play a very important role in the radiological shielding because of its good properties like structural strength, ability to attenuate gamma rays and low cost. Attempts to improve the shielding capacity by adding new multi-efficient materials to the conventional concrete mixture are going on at various levels. Its importance is increasing as more and more radiation sources are made use of nuclear physics research, electronic industry, material modification, material science, agricultural service etc.
Method: The present work is aimed to investigate the effects of adding perlite and vermiculite aggregates to cement as a shielding material. The Mass and linear attenuation coefficient of the samples were determined by using NaI (Tl) detector and also calculated using Xcom program for the photon energies of 662 keV, 1172 keV,1275 keV, and 1330 keV. The chemical composition as weight fraction for all samples were analyzed by EDXRF. Mechanical and physical properties such as compressive strength, water absorption, and porosity have been investigated. The thermo gravimetricanalysis (TGA) and X-ray diffraction were used to examine the thermal stability and the other characteristics of the studied samples.
Results: Gamma-ray shielding capability of perlite and vermiculite composites were experimentally and theoretically examined. It can be seen that mass attenuation coefficients of both samples decrease as energy increase. The results of the experimentally determined attenuation coefficient agree with the theoretically evaluated values. Also, the mass attenuation coefficients of the selected samples were compared with values of known shielding materials (ordinary concrete and iron) for the same gamma-ray energies. The physical properties such as density, water absorption, porosity, and compressive strength were measured.
Conclusions: The obtained values of the mass attenuation coefficient, μ, HVL and MFP were compared with values of different types of studied shielding materials. Considering factors such as availability, cost, thermo-chemical stability,and energy, we can conclude that perlite-vermiculite materials can be a choice for gamma radiation shielding for both medical and nuclear applications.
Keywords: Perlite, Vermiculite, Mass attenuation coefficient, half value layer, Compressive strength.

11-27

THE STRUCTURAL AND MORPHOLOGICAL STUDY OF VERTICALLY ALIGNED ZNO NANORODS PREPARED BY CHEMICAL ROUTE

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Background: Nanorod morphology of ZnO prepared by chemical route is a versatile and low cost method for Quantum

dot sensitized solar cell as photo anode. The special nanotaper structure of ZnO rod will enhance the efficiency of the solar cell due to the increase in surface area.

Method: ZnO nanorod array were synthesized by hydrothermal method on ZnO seed layer prepared by chemical bath deposition on glass substrate. The structural, morphological and optical properties were investigated by adjusting the hydrothermal growth parameters.

Results: The study proved that single crystalline ZnO nanorods aligned along (002) direction could be grown on seed layers grown up to a growth time of 3 min. at a comparatively low growth temperature of 140°C without any post deposition treatment. The films were found to become polycrystalline with the increase in seed layer thickness higher than 3 min. The obtained ZnO thin films were transparent with a band gap of ~ 3.1 eV. Morphological investigation shows that by adjusting the hydrothermal growth parameters, ZnO nanorods with tapered ends could be obtained, which has promising application in quantum dot sensitized solar cells.

Conclusions: The study proved that the thicknesses of the seed layer influence the structural, optical and morphological properties of the prepared thin films. The seed layer prepared by chemical bath deposition was polycrystalline in nature. By varying the thickness of the seed layer, nanorods with tapered ends could be grown. ZnO thin films, which can be used as a photoanode for quantum dot sensitized solar cells, can be grown by a cost effective route at a low growth temperature.

Keywords: ZnO nanorods, ZnO nanotaper, Hydrothermal, Chemical bath deposition, Quantum dot sensitized solar cell.

11-28

SPECTROSCOPIC FT-IR, FT-RAMAN, MOLECULAR DOCKING STUDIES, THERMAL STABILITY ANALYSIS, COMPUTATIONAL INVESTIGATION AND CONFORMATIONAL ANALYSIS OF DIURON

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Background: Density Functional Theory is a computational modelling method used to investigate the electronic structure of many-body systems. Thermo Gravimetric Analysis is a method of thermal analysis in which the mass of a sample is measured over time as the temperature changes. It can be used to evaluate the thermal stability of the compound.

Method: Theoretical and experimental investigations on the molecular structure and vibrational characteristics of 3-(3,4-dichlorophenyl)-1,1-dimethylurea (Diuron) have been carried out by density functional calculations. Potential energy scan was carried out to examine the effect of the $–N(CH_3)_2$ group rotation on the overall stability of the molecule. The TGA analysis (Fig.S1-supporting information) was carried out using an SDT Q600 V20.9 Build 20, Module DSC-TGA Standard instrument.

Results: From HOMO-LUMO plot, it is clear that HOMO is delocalized over the entire molecule while LUMO is delocalized over the phenyl ring and chlorine atoms and this gives the charge transfer effect. The TG curve of diuron indicates that stability is up to 200 °C and shows two decomposition stages. The carbonyl oxygen atom and phenyl ring were found to be the electrophilic regions and the NH moiety the nucleophilic region of the title compound. The stretching mode of NH in the IR shows a downshift of from the computed value which is due to the strong interaction as evident from NBO analysis.

Conclusions: The spectroscopic properties of the title compound are examined experimentally and theoretically and the vibrational assignments are done by means of potential energy distribution. From molecular docking studies, the binding affinity value of diuron is calculated to be -6.5 kcal/mol. The Anti conformer was predicted to be more stable than the Syn conformer.

Keywords: Thermo Gravimetric Analysis, HOMO-LUMO, Density Functional Theory

11-29

EFFECT OF ELECTROLYTE TEMPERATURE ON ALUMINIUM DOPING OF TIO_2 NANOTUBES BY ELECTROCHEMICAL ANODISATION

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Background: TiO_2 nanotubes has been extensively studied as a novel material in various applications including dye-sensitized solar cells (DSSCs), photocatalysis and sensors because of its photochemical properties, biocompatibility and low-cost.Eventhough the wider bandgap of TiO_2 is desirable for certain applications, it shows poor response to visible light absorption and hence limits its photocatalytic applications. Also the low electrical conductivity of TiO_2 adversly affects its use in optoelectronic devices. To enhance the electrical and optical properties, metal ions are selected to dope into the TiO_2 structure.

Method: Here a simple two electrode system is used to fabricate Al doped TiO_2 nanotubes using 'two step anodisation' process.

Results: FESEM shows that even with Al doping, the tubular structure of the TONTs remain intact. The temperature reported here (40^0C) is the lowest temperature reported so far for the preparation of crystalline TONTS. EDAX spectra show that Al concentration increases as the electrolyte temperature increases and that it contributes to increase in electrical conductivity of the doped TONTs, an observation very useful in DSSC applications. DRS analyses shows that Al doping decreases the band gap from 3.10 eV (pure TiO_2) and it reduces from as the bath temperature of electrolyte increases form 2^0C to 28^0C thereafter an enhancement in bandgap is observed

Conclusions: Low fabrication cost, improved crystallinity, and tuned optical and electrical properties are the major advantages of this study and hence it is very much relevant in energy and environmental applications such as photocatalysis and DSSCs.

Keywords: Titanium dioxide, Nanostructures, Electrochemical anodization, Al doping, Crystallization.

11-30

BIOCOMPATIBLE LUMINESCENT EUROPIUM DOPED FLUORAPATITE FOR IMAGING APPLICATIONS

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Background: The difficulties such as poor solubility and poor biocompatibility make fluorescent quantum dots like CdS, CdSeetc less applicable in the field of bioimaging. Apatites are a group of biocompatible phosphate minerals and fluorapatite (FAp) have higher luminescence than hydroxyapatites. The luminescent FAp crystal can be effectively used for bioimaging applications.

Method: In this work biocompatible luminescent Eu^{3+} doped fluorapatite (FAp:Eu^{3+}) was successfully synthesized by both coprecipitation and hydrothermal methods as an efficient bioimaging probe which can also be used for targeted drug delivery.X ray diffraction (XRD), photoluminescence (PL), fluorescence microscopy and energy dispersive spectroscopy (EDS)were respectively used for the structural analysis, luminescence studies and compositional analysis of the sample.

Results: The doping concentration of Eu^{3+} for bioimaging applications is optimized to be 15 at%.The XRD and PL patterns showed that material is crystalline and shows luminescence corresponding to the D → F transitions in europium on UV excitation. Fluorescent microscope images of the as prepared and annealed sampleshow the luminescent nature of the material, making it suitable for bioimaging applications. The effects of doping on composition was inferred from the EDS data.

Conclusions: The fluorescent microscope images of the Eu^{3+} doped FAp implies that it can be effectively used as a biological probe, both for targeted cell imaging and targeted drug delivery, to deliver chemotherapy molecule like doxorubicin to the cancer cells.

Keywords: Bioimaging, Fluorapatites, Biocompatible, Luminescence

11-31

EFFECT OF NICKEL DOPING ON THE STRUCTURAL, MORPHOLOGICAL AND OPTICAL PROPERTIES OF PULSED LASER ABLATED $BASNO_3$ FILMS

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Background: Barium stannate is an n-type semiconductor with cubic perovskite structure having a wide band gap of 3.1eV and has high stability upto 1000 °C. It has an important applications in the field of thermally stable capacitors, solar cells and can be used as a sensor materials for gases like CO, NO and for humidity sensors etc.
Method: The nickel oxide doped $BaSnO_3$ films were prepared by pulsed laser deposition method. The deposition of the films are carried out using a Q-switched Nd:YAG laser (Quanta-Ray INDI-series, Spectra Physics) having frequency doubled 532 nm laser radiation of pulse width 7 ns. The NiO doped $BaSnO_3$ films thus prepared were used for the structural, morphological and optical studies in detail. The crystalline nature and orientations of the NiO doped $BaSnO_3$ films were characterized by different techniques such as XRD, FESEM, AFM and UV-Visible analysis.
Results: The XRD patterns shows that all the films are polycrystalline in nature corresponding to cubic phase of barium stannate and are indexed on the basis of JCPDS Ref. Code 15 -0780.
There is no peak corresponding to the nickel oxide which indicates that the incorporated nickel oxide is dissolved in the $BaSnO_3$ films and it does not alter the cubic nature of the film. The undoped film has the highest average value of transmittance of 85% and the transmittance decreases with increasing doping concentration.
Conclusions: The NiO doped $BaSnO_3$ films with 3wt% shows the highest crystallinity reveals that moderate doping enhances the crystalline quality and higher doping deteriorates the crystalline nature. The average size of the crystallites and the lattice parameter are calculated. The morphological and EDX reveals the incorporation of NiO in the $BaSnO_3$ lattice. The transmittance decreases systematically with increase in NiO doping concentration and the band gap value decreases with with increase in NiO doping concentration .
Keywords: Pulsed laser deposition, Barium stannate, XRD, UV-Visible analysis.

11-32

CADMIUM OXIDE AND STRONTIUM OXIDE - NOVEL NANOPARTICLES WITH EFFECTIVE BANDGAPS FOR TECHNOLOGICAL APPLICATIONS

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Cadmium Oxide (CdO) andStrontium Oxide (SrO) nanoparticles were synthesized by chemical co-precipitation method. The nanosamples annealed at 800ºC were used for structural and optical studies. Debye-Scherrer equation was used to calculate the particle sizes of the synthesized materials. Optical characterizations of the nanosamples were carried out by using UV/Visible analysis. From the analysis of the absorption spectra, the direct optical bandgap of the nano samples were calculated in detail.
Oxide nanomaterials synthesized through chemical methods have proved to be very effective, providing better control as well as enable different sizes, shapes and functionalization than those generated through other physical methods. Metal oxide nanoparticles can be produced by soft chemical methods such as co-precipitation, sol-gel, hydrothermal synthesis etc. Among various chemical methods, co-precipitation has chosen in this work for the synthesis of the nanoparticles of Cadmium Oxide and Strontium Oxide.
Cadmium oxide nanoparticles are highly reactive and they can be used in energy storage systems, electro chromic thin films, magneto resistive devices etc. Metal oxide nanoparticles with high specific surface area and a high fraction of surface atoms have been studied extensively due to their unique physicochemical characteristics like catalytic activity, optical properties, electronic properties, antimicrobial activity etc1. Cadmium oxide nanoparticles has not only the unique optical and optoelectrical characteristics but also has the selective catalytic properties that can be used to photo degrade some of the organic compounds, dyes, pigments and many environmental pollutants.
About 8% by weight of cathode ray tubes is strontium oxide, which has been one of the major uses of strontium oxide nanoparticles.

Materials and Methods

Synthesis of CdO and SrO nanoparticles

CdO nanoparticles weresynthesized by chemical co-precipitation method using AR grade 0.1M cadmium nitrate, 0.02M citric acid and 0.5M sodium hydroxide as the reagents. Among the reagents, citric acid was used as the stabilizer to prevent agglomeration. The precipitates thus formed by stirring were separated from the reaction combination and were washed several times with distilled water. The dried precipitates at room temperature were thoroughly grounded using an agate mortar to obtain the fine nano powder. On heating at 800ºC, nanoparticles of CdO were formed. The same procedure was used for the synthesis of SrO nanoparticles also.

Results and Discussion

Analysis of XRD Patterns of CdO and SrO nanoparticles

X-Ray Diffraction (XRD) is one of the commonly used methods for crystalline structure determination of nanomaterials2. XRD pattern divulge that the particles are nanosized and crystalline. The sharp peaks obtained from the XRD pattern indicate the crystalline nature of the nanosamples. The XRD patterns are drawn by taking angle (2Θ) along the X-axis and intensity (counts) along the Y-axis. There is a definite line broadening of the XRD peaks which indicates the synthesized materials consist of particles in nanometer scale.

XRD patterns of the nanoparticles of CdO and SrOannealed at 8000C are shown in figures 1and 2 respectively. Particle sizes are calculated using Debye-Scherrer equation3, $t = k\lambda / (\beta\cos\theta)$; where k is the Scherrer constant and its value is taken as 0.9, β is the full width at half maximum of XRD peaks, θ is the Bragg diffraction angle and λ is wavelength of X-rays used in XRD analysis. The broadening of the peaks in the XRD pattern may be due to the micro straining of the crystal structures arising from the defects like dislocations and twinning. The particle sizes are found to be 27 and 65nms for CdO and SrO nanoparticles respectively.

FIGURE 1 and 2 XRD Pattern of CdO and SrO nanoparticles

UV Spectral Studies

Ultraviolet-Visible spectroscopy studies arewidelyused to quantitatively characterize organic as well as inorganic nanomaterials[4]. UV spectra of the nanoparticles of CdO and SrO annealed at 800ºC are shown in figures 3 and 4 respectively. UV spectra provide important information about the details related with optical bandgap of thenanomaterials. The regular decrease in absorption indicates the presence of optical bandgap in the material. This corresponds to the excitation of surface plasmons in the composite nanoparticles. The energy band of the material is related to the absorption coefficient α by the Tauc's relation[5], $\alpha h\upsilon = A(h\upsilon - Eg)^n$, where A is a constant, hυ is the photon energy, Eg is the bandgap and n=1/2 for an allowed direct transition. Plot $(\alpha h\upsilon)^2$- hυ graph of the samples heated at 800ºC and extrapolation of the straight line to $(\alpha h\upsilon)^2 = 0$, gives the value of the optical bandgap. The direct optical bandgap of the nanoparticles of CdO and SrO are shown in figures 5 and 6 respectively. The direct optical bandgap values are found to be 3.78eV and 2.33eV for CdO and SrO nanoparticles respectively.

FIGURE 3 and 4UV spectra of the nanoparticles of CdO and SrO

FIGURE 5 and 6 Optical bandgap energy calculation of CdO and SrO nanoparticles using Tauc's plot.

Conclusion

Cadmium Oxide and Strontium oxide nanoparticles have been synthesized by chemical co-precipitation method. XRD patterns reveal that the nanoparticles synthesized are crystalline in nature. The broad peaks are the characteristics of the nanocrystalline nature of the samples. The particle size is found to be 27nm for CdO nanoparticles and 65nm for SrO nanoparticles. Direct optical bandgap values of the nanoparticles of CdO andSrO using Tauc's relation are found to be 3.78 and 2.33eV respectively.

11-33

HYDROTHERMAL SYNTHESIS OF MOLYBDENUM DISULPHIDE (MoS_2) NANOPARTICLES FOR ENERGY STORAGE APPLICATIONS

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Background: Molybdenum disulphide ($MoS_{2)}$ is a very promising 2D material. It's elemental constituents are abundant, nontoxic and can be easily synthesized at gram scale with cost effective techniques. Among the various 2D materials molybdenum disulphide becomes a material of significant interest due to its unique atomic and electronic structure. Moreover, Nano MoS_2 can be considered as an analogue of graphene, which is well known for its distinct electrical, electrochemical properties and so on.

Methods: In this work we prepare MoS_2 nanostructures using Ammonium Molybdate and Thiourea byhydrothermal method .Hydrothermal growth is an attractive and relatively simple method in which crystal growth occurs at mild conditions in water, producing high purity samples. XRD,SEM and PL studies were employed for the characterization of synthesized sample

Results: X-ray diffraction studies revealed the formation of randomly stacked layers of phase pure hexagonal phase MoS_2 (2H- MoS_2) were obtained at long growth durations.The FESEM images indicated the formation of porous

spherical nanostructures of MoS_2 which can be used for efficient charge storage. The layered structure was further confirmed by the PL spectra .The layered spherical structure enhances the surface area and act as efficient charge storage centres.

Conclusions: This work establishes a simple cost effective low temperature synthesis technique has been developed to synthesize$MoS_2$for energy storage application

Keyword: Ammonium Molybdate,Thiourea,Hydrothermal growth

11-34

CRYSTAL STRUCTURE, MICROSTRUCTURE AND MICROWAVE DIELECTRIC PROPERTIES OF NOVEL GLASS FREE $NaPb_2B_2V_3O_{12}$ (B=Mg, Zn) CERAMICS

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Background: The modern communication systems demands dielectric materials with temperature stability and stringent dielectric properties, such as (i) high dielectric constant (ii) low dielectric loss (iii) high quality factor (iv) Low sintering temperature. They are widely used as dielectric resonators, duplexer, dielectric waveguide and microwave substrates etc. The sintering temperature of the materials can be reduced by adding low-melting glasses, chemical processing, and using nano particles as starting materials. However, the complication in fabrication method and increase in production cost become the main disadvantages of chemical synthesis. Hence, for microwave applications glass-free materials with good dielectric properties are strongly advised. It is reported that compounds having garnet structure possess low sintering temperature as well as good microwave dielectric properties.

Method: The present work investigates structural and dielectric properties of $NaPb_2Mg_2V_3O_{12}$(NPMVO) and $NaPb_2Zn_2V_3O_{12}$(NPZVO) ceramics. The compounds were prepared through conventional solid state reaction route under the calcinations temperature of 650 and 600°C respectively for NPMVO and NPZVO ceramics. The crystal structures of these compounds were studied using XRD and Raman spectroscopy. The dielectric properties and thermal properties were studied by the $TE_{01\delta}$ mode cavity method using a vector network analyzer. The microstructures were analyzed using scanning electron microscope.

Result: XRD confirms that NMPVO and NPZVO have cubic garnet structure with a space group of Ia-3d. The deconvoluted Raman spectrum shows 14 and 15 Raman active modes out of 25 predicted by factor group analysis The NPMVO ceramics exhibits relatively high dielectric constant in the order of 20.6 and high unloaded quality factor (Q*f) around 22,800 GHz and a positive temperature coefficient of resonant frequency of 25.1 ppm/^{o}C. while NPZVO ceramic has relatively higher relative permittivity of 22.4, unloaded quality factor of 7,900 GHz and near zero temperature coefficient of resonant frequency of -6 ppm/^{o}C. The SEM analysis shows a relatively dense microstructure grain size varies about 2–10 μm for NPMVO and an average of about 7 μm for NPZVO ceramics.

Conclusions: In this work we developed a series of novel low temperature sintered ceramic compounds with good microwave dielectric properties, which can be used for future microwave dielectric applications.

Keywords: Crystal structure, Raman spectra, Garnet, Microwave dielectric properties

11-35

BIOSYNTHESIZED, MAGNETICALLY RETAINABLE BINARY TRANSITION METAL OXIDE FEO/ MNO NANOCOMPOSITES FOR ENVIRONMENTAL REMEDIATION

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Background: Recently, biosynthesis of nanoparticles became a better choice for producing environmentally decontaminating and non-toxic product. Magnetically retainable binary transition metal oxide nanocomposites have a vital role in environmental protection due to their photo catalytic and pathogen destruction properties.

Method: In the present work the sample was prepared by chemical co-precipitation method using iron (III) chloride and manganese (II) chloride as cationic precursors at their respective molarity and sodium hydroxide solution being an anionic precursor to adjust the pH of the solution. The precipitate obtained was washed with alcohol and distilled water

several times. Then dried and heated at 600 °C to obtain FeO/MnO nanocomposite. The photo catalytic activity of FeO/MnO nanocomposites were studied by monitoring the degradation of Congo Red under UV-Visible light irradiation. The antioxidant and antimicrobial activities of the composites were also studied.
Results: The nanocomposite is very effective in the degradation of azo dye like congoRed. Defense against microbial studies reveal, the synthesized nanocomposites exhibited the strongest antibacterial activity against E.Coli than S. aureus in lower and higher concentration. Nanosized FeO/MnO Nanocomposite showed maximum of 72.43% scavenging activity against DPPH.
Conclusion: In conclusion, biologically synthesized nanoparticles possess an enormous potential in environmental remediation and can be pursued as an important material for future studies.
Keywords: FeO/MnO nanocomposites, azo dye, antibacterial, DPPH.

11-36

STUDY ON YTTRIA/ALUMINA NANO COMPOSITE SYSTEM FOR THEIR APPLICATIONS AS INFRARED TRANSPARENT CERAMIC WINDOW MATERIAL

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Background: Infrared transparent ceramics found to have applications in infrared windows and domes in homing missiles and spacecraft employed for strategic defense and space missions. Yttria is a hopeful refractory material but its strength, sinterability etc are marginal. Alumina is an excellent additive to yttria matrix as it exhibits high strength, hardness and excellent corrosion resistance.
Method: In the present study we have developed a system of 80:20 mass percentage of yttria/alumina nanocomposite and studied their structural, optical, thermal and vibrational properties. The ultrafine starting powder of the nanocomposite ($Y_2O_3 – Al_2O_3$) is synthesised by a single step modified combustion method.
Results: The as-prepared samples are characterized using X-ray diffraction (XRD) for determining the crystalline structure and phase of the nanomaterials. Thephaseformation of the system is confirmed from the JCPDS data viz. Card No 89-5591 for cubic yttria and 46-1212 for α-Al_2O_3.The crystallite size calculated by Debye Scherrerequation for the high intense peak (222) plane of yttria is 17 nm and that for (122), (141), (212) plane of aluminium oxide is 12 nm, 11nm, 17nm respectively.Particulate properties of the combustion product are analyzed with the high resolution transmission electron microscopy (HRTEM) and are in good agreement with XRD results. The phase purity of the as prepared powder is further confirmed by FTIR spectroscopy. The thermal stability of the sample at elevated temperature is analyzed by TGA method. The UV–visible absorption spectrum was recorded in the range 200–800 nm. The band gap obtained for the material is 5.69 and absorbance wavelength is 227 nm. The theoretical refractive index is 1.85 and is in the range of infrared transparent materials (1.38-4). The material shows absorbance in UV region and theoretical transmittance determined from powder is about 83.6%.
Conclusions: The production of a high quality infrared transparent ceramic material is mainly focused on a high quality starting powder. The properties exhibited by starting powder of yttria/alumina sample at 80:20 mass% ratio reveals its suitability as an excellent infrared transparent ceramic material.
Keywords: Nanocomposite, Modified Combustion, Infrared Transparent, Sinterability

11-37

INVESTIGATION OF NON-MONOTONIC VARIATION OF SECOND MAGNETIZATION PEAK IN A LOW T_c SUPERCONDUCTOR, $Ca_3Rh_4Sn_{13}$

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Background: The occurrence of second magnetization peak (SMP) anomaly in the mixed phase of type-II superconductors indicates the order-disorder transition of the vortex lattice. Non monotonic variation of second magnetization peak anomaly with temperature is reported in high temperature superconductors. We elucidated the non-monotonic

behavior of the SMP in a low T_c superconductor, $Ca_3Rh_4Sn_{13}$ (T_c=8.37 K) by analyzing the critical current densities of the specimen.
Method: The dc magnetization measurements of $Ca_3Rh_4Sn_{13}$ superconducting crystals were carried out using SQUID-vibrating sample magnetometer.
Results: Isothermal dc magnetization measurements in low temperature cubic superconductors, $Ca_3Rh_4Sn_{13}$, revealed the non-monotonic variation of second magnetization peak anomaly while increasing the temperature. It is further observed that the high critical current density (J_c) of the samples may elicit the non-monotonic variation of SMP anomaly. From X-ray diffraction and electron probe micro-analyses, it is evident that the crystal which shows the non-monotonic SMP has slightly higher concentration of point disorders and this causes the increase of critical current density.
Conclusion: The slightly higher concentration of point disorders causes the increase of critical current density in type-II superconductors, $Ca_3Rh_4Sn_{13}$ and the increased critical current density causes the non-monotonic variation of the SMP anomaly.
Keywords: Second magnetization peak, vortex lattice

11-38

ANTIOXIDANT ACTIVITY OF BIO-SYNTHESISED NANOSTRUCTURED CERIA USING ONION JUICE EXTRACT

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Background: To enhance the properties of cerium oxide nano materials and thereby meet the need for different applications, it is very essential to decrease the size and thus to increase the active surface area of nanoparticles. Chemical co-precipitation method using biological capping agent is more attractive compared to others for its cost effectiveness, eco-friendliness and its simplicity.
Methods: Nanstructured cerium oxide or nanoceria with an average crystallite size of 6nm was synthesized through chemical co precipitation method using Cerium nitrate hexa hydrate and Ammonium carbonate as starting material. Onion juice extract is used as the biological capping agent. The structural characterization of the prepared nanoparticles were studied with x-ray diffraction (XRD), Transmission electron microscopy (TEM) and Raman spectroscopy. The antioxidant efficacy of nanoceria is evaluated by the free radical scavenging activity of 1, 1-diphenyl 2-picryl hydroxyl (DPPH).
Results: The average crystallite size of thecerium oxide nano particle is found to be 6 nm. The results obtained from XRD, TEM and Raman are in close agreement with each other and confirm the cubic fluorite structure and polycrystalline nature of cerium oxide nanoparticles. The mass of sample for scavenging 50% of the free radical DPPH (SC50) was calculated as 88.43 µg from the graph and the inhibition increases as the concentration increases.
Conclusion: The evaluation reveals that nanoceria can act as an excellent antioxidant in scavenging the DPPH radical even in very small cocentration.
Keywords: Nanoceria, chemical co-precipitation, capping agent, DPPH

11-39

DECIPHERING THE CRYSTAL STRUCTURE AND PHOTOLUMINESCENCE PROPERTIES OF B SITE ORDERED DOUBLE PEROVSKITES $Ba_2Ln_{2/3}TeO_6$ (Ln = Y, Gd-Lu)

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Background: Double Perovskites are a class of ceramic compounds known for its exceptional structural and compositional flexibility which in turn leads to versatility in its applications. Identifying the exact crystal symmetry is essential inorder to predict the physical as well as chemical properties of these materials. Vibrational spectroscopic techniques such as Raman and IR are the cheapest yet powerful tools to determine the crystal symmetry. Further photoluminescence of activator substituted double perovskites are an interesting area of research as potential candidates for efficient red emitting components in WLED applications.

Method: In the present work, we investigate the crystal structure and photoluminescence properties of double perovskites $Ba_2Ln_{2/3}TeO_6$ (Ln = Y, Gd –Lu). The compounds are prepared by Solid state ceramic route. The crystal symmetry is identified using Raman and IR spectroscopy. The optical properties were characterized by diffuse reflectance spectroscopy and photoluminescence spectroscopy.
Results: X-ray diffraction patterns indicate a pseudo-cubic structure with rocksalt ordering of B- site cations; however tolerance factor values indicate lowered symmetry possibly due to octahedral tilting. Unlike in cubic perovskite systems with only four Raman and four IR active modes, $Ba_2Ln_{2/3}TeO_6$ possess more than four Raman and IR modes which point out the lowered symmetry from cubic. In accordance with observed number of modes and group theoretical predictions the most likely symmetry of $Ba_2Ln_{2/3}TeO_6$ is monoclinic with the space group $P2_1/n$. The crystal symmetry is further confirmed by the Rietveld refinement of the XRD patterns. The band gap energy of all the compounds are determined. The band gap of $Ba_2Y_{2/3}TeO_6$ is estimated to be 4.8 eV which corresponds to wavelength of absorption in UV region. Thus, inorder to investigate the photoluminescence properties, Eu^{3+} is substituted in the Y^{3+} site at five different concentrations (2.5, 5, 10, 15 and 20 mol %). The luminescence spectra monitored at an excitation of 270 nm show an emission maximum centered at 592 nm that corresponds to the $^5D_0$-$^7F_1$ electric dipole transition of the Eu^{3+} ions. This confirms that Eu^{3+} ions occupies a symmetric B-site with an inversion center. Chromaticity coordinates are calculated and show emission colour in the orange –red region of visible spectrum.
Conclusions: The photoluminescence characteristics show that the phosphor can act as a red emitting component in WLED applications.
Keywords: Double perovskites, Raman modes, Crystal symmetry, Red phosphors.

11-40

IN VITRO CYTOTOXICITY ANALYSIS OF CALCIUM SULFIDE NANOPARTICLES

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Background: Semiconductor nanoparticles have gained considerable interest among researchers owing to their wide range of applications in biomedicine. Widespread use of the nanomaterials for medical and commercial applications leads to exposure of these materials into the environment, ecosystem, water, food supplies, and the human body. For the safe use of nanoparticles in biomedicine a detailed understanding of the toxicity of the nanoparticles in the human body is necessary. Our objective was to determine the biocompatibility of undoped Calcium sulfide (CaS) nanoparticles on L929 human fibroblast cell lines using MTT [3 (-4,5-Dimethylthiazol-2-yl)2,5- diphenyltetrazolium bromide] and Lactate dehydrogenase (LDH) release assay.
Methods: Undoped highly luminescent CaS nanoparticles capped with Triethanolamine were synthesized by an eco-friendly wet chemical coprecipitation method. Cytotoxicity analysis of undoped CaS nanoparticles was carried out in human fibroblast cell lines using MTT assay and LDH release assay.
Results: MTT assay analysis method revealed that viability of the cells was more than 90% in all the samples tested which is well above the 70% cut off for cytotoxicity as recommended by ISO 10993-5:2009. LDH release assay method showed that the nanoparticles were less toxic at lower concentrations (up to 25 µg/mL) and the toxicity increases at higher concentrations. The IC50 value for the CaS nanoparticles was found to be 710 µg/mL.
Conclusions: The surface modified CaS nanoparticles are biocompatible across a wide range of concentrationswhich makes them a suitable candidate for various biomedical applications. Cytotoxicity studies are preferred pilot project test as it is simple, fast and has high sensitivity**.** Multiple techniques must be adopted, carefully assessed and applied to the nanomaterial system before its widespread use in various fields.
Keywords: nanoparticles; cytotoxicity; optical density; viability; assay.

11-41

OPTICAL BAND GAP ANALYSIS OF COPPER OXIDE AND MANGANESE OXIDE NANOPARTICLES - A COMPARATIVE STUDY

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Compared with bulk copper oxide, nano copper oxide exhibits unusual physical and chemical properties such as high surface effect, superiority of the quantum size effect, volume effect and macroscopic quantum tunneling effect. It has monoclinic structure with many attractive characteristics including super thermal conductivity, photo voltaic properties etc. Copper oxide nanostructures exhibit magnetic and super hydrophobic properties. Manganese Oxide nanoparticles appear in a solid green powder form with high surface area and interesting unique properties.
Nano oxides of Copper and Manganese were synthesized by chemical co-precipitation method. The samples annealed at 800ºC were used for structural, surface morphological and optical studies. Debye Scherrer equation was used to calculate the particle size of the nano oxide samples. Optical characterizations of the nano samples were carried out using UV/Visible analysis. From the analysis of the absorption spectra, the optical bandgap of the nanocomposites were calculated. Detailed surface morphological studies were carried out using SEM analysis and the chemical composition of the nano samples were verified using EDAX.

11-42

PHOTOLUMINESCENT PROPERTIES OF TERBIUM DOPED FLUOROBORATE GLASSES FOR GREEN EMISSION APPLICATIONS

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A new and economical Tb^{3+} activated alkali fluoroborate glasses were synthesized by conventional melt quenching technique. Using photoluminescence (PL) emission, excitation and decay curve analysis luminescence properties have been studied. The radiative parameters including radiative transition probabilities, total transition probability, fluorescence branching ratio and stimulated emission cross section were determined via a reverse calculation approach. The optimum dopant ion concentration to get maximum emission intensity seems to be 1 mol%. CIE coordinates of the samples were determined to reflect the true colour of luminescence and are found to be much closer to the commercial green phosphors. The study proves the prepared glasses to be beneficial for various optoelectronic applications including green lasers and w-LEDs.
Key words: Melt quenching technique, luminescent properties, radiative parameters

11-43

VIBRATIONAL SPECTRAL INVESTIGATION OF ORGANIC NLO CRYSTAL MORPHOLINIUM HYDROGEN TARTRATE: A DFT APPROACH

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Background: The charge transfer interaction, conjugation, hyper polarizability and electron delocalization of the molecule are studied to determine the structural dependence on the NLO property of the morpholinium hydrogen tartrateand spectroscopic investigation of MHT
Method: Morpholinium hydrogen tartrate has been synthesised in slow evaporation solution technique from morpholine and L-tartaric acid with following reaction

Reaction scheme of MHT

Experimental FT-infrared, FT-Raman, absorption and photoluminescence spectra are recorded and analysised. Complete vibrational analysis and optimised molecular structure is obtained using density functional theory calculation. Computationally all the electronic structure calculations were carried out using the Gaussian '09 program package. The geometry is fully optimized at the Becke-3–Lee–Yang–Parr (B3LYP) level with a standard 6-31G* basis set. In this work, the popular B3LYP hybrid functional has been used for calculations. The vibrational contribution of each normal mode is figured out with the aid of VEDA 4(vibrational energy distribution analysis) program.

Results: The optimized molecular structure of morpholinium hydrogen tartrate calculated using DFT theory at Becke3-Lee-Yang-Parr(B3LYP) level with standard 6-31 G* set is obtained. The optimized geometrical parameters are compared with experimental values. The FT-IR spectrum of the MHTcrystal was recorded in the frequency region of 400-4000 $cm^{-1}$and comparedwith the simulated IR spectrum computed at B3LYP/6-31G* basis set.the presence of functional groups were conformed using FT-IR, FT-Raman spectra.The UV–VIS absorption spectrum of the morpholinium hydrogen tartrate was recorded in ethanol solution using VARIAN CARY 100 B10 UV–VIS spectrophotometer. The morpholinium hydrogen tartrate crystal is active in the UV-Vis region and it could be a viable alternative for optical material in the entire visible region. The observed nature of absorption in the visible region is a desirable property of NLO material. The result of HOMO (-0.08706 hartree)and LUMO (0.09557hartree)energies indicate the charge delocalization taking place within the crystal.The HOMO –LUMO energy difference is 0.18263hartree

Conclusions: The single crystals of morpholinium hydrogen tartrate were grown by slow evaporation technique. Density functional theoretical calculations and vibrational spectral studies have been performed on morpholinium hydrogen tartratein order to identify its structural and the characteristic features .The vibrational spectral analysis has been carried out based by B3LYP/6-31G* theory calculation. The HOMO-LUMO orbitals clearly explicate the charge transfer interaction involving donor and acceptor groups.

Keywords: DFT, FT-IR, FT-Raman

11-44

ANALYSIS ON CRYSTALLOGRAPHIC STRUCTURE, SIZE AND BAND GAP VARIATIONS IN ANNEALED $CuFe_2O_4$ SPINELS

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Introduction: Copper ferrite is an inverse spinel oxide with formula $CuFe_2O_4$, widely used for various purposes in electrical and communication filed. Also it is used as a catalyst in various industrial processes such as the Fischer–Tropsch process, the Haber–Bosch process.

Method: Co precipitation method is used for the synthesis of $CuFe_2O_4$ powder from $Cu(NO_3)_2.3H_2O$ and $Fe(NO_3)_3.9H_2O$ with Lactose monohydrate ($C_{12}H_{22}O_{11}.H_2O$) as the capping agent with the presence of 0.1M NaOH solution. The pH of the reaction was kept greater than 10. The obtained powder sample was annealed for a stipulated period of time at different temperatures ranging from 600 °C to 1000 °C. The formation, structure and homogeneity of the powder of confirmed with XRD (X-Ray diffraction)

Results and discussion: The obtained peak positions and d values were found to be in agreement with cubic spinel phase. The broadened peaks in the XRD patterns indicate the diminished nano crystals and with Debye – Scherer equation the average crystallite size was obtained. The contributions of crystalline sizes and lattice strain on the peak broadening of $CuFe_2O_4$ particles were studied by Hall – Williamson analysis and size – strain plot method. As the annealing temperature increases, the crystallite sizes were found to be increasing, but the crystallographic structure (cubic spinel

phase) remains conserved. The band gap of the nanocrystals is determined from the UV–Visible absorption spectrum.
Keywords: Spinel, Ferrite, Nanocrystalline, Crystallite size, Capping agent

12 - SCIENCE EDUCATION, COMMUNICATION & SOCIETY

12-01

NUTRITIONAL PROFILE AND THE EFFECT OF DIETARY INTERVENTIONS IN TYPE II DIABETES PATIENTS

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Diabetes patients suffer from poor nutritional status due to unhealthy dietary practices and over the time they develop secondary diabetes complications due to poor awareness. Patient education is the most effective way to lessen the complications of diabetes and its management. Thus the present study is an attempt to assess the nutritional profile of type II diabetes patients and to assess the effect of dietary interventions in the management of diabetes. A total of 500 type II diabetes patients who attended the outpatient department of a leading hospital in Thiruvananthapuram was selected for the study. Inorder to assess their nutritional profile, Food Habits Score, Dietary Nutrition Index and Nutritional Status Index were worked out from the patient details collected through direct interview and was statistically analysed. Inorder to assess the effect of the dietary intervention, a dietary ready reckoner was developed and the study proceeded through a pre-test post-test study design for three months. The statistical methods employed were Mean, Independent two sample t-test, One-way Anova and Chi-square test (SPSS version 21.0). Conclusively, the findings suggest that the dietary habits, nutrient intake and the overall nutritional status of diabetes patients were inferior. Also the dietary intervention with the help of developed dietary ready reckoner has appreciable effects on type II diabetes patients in general and in specific it was effective in improving their Knowledge Attitude and Practice and Post Prandial Blood Glucose. Given sufficient time and constant reinforcement of dietary guidelines to the patients until gained knowledge and the changed attitude become a part of their life, it would definitely help them attain the goals in diabetes management.
Keywords- Type II diabetes mellitus, Nutritional profile, Dietary Intervention, KAP

12-02

BIBLIOMETRIC ANALYSIS OF CYCLOTIDE RESEARCH

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Background: Cyclotides are a group of macrocyclic plant peptides with a circular backbone. They have a knotted arrangement of three disulphide bonds. In the recent years, they have been extensively studied in plants and the topic has evolved as a separate group among proteins and peptides. These peptides have been considered significant because of their extreme stability under rigorous treatments like high temperature etc. They are believed to be having a protective role within the plant system. Owing to this fact, enormous possibilities as drug candidates and scaffolds have been associated with cyclotides. The present study involves bibliometric analysis of the available cyclotide literature till date.
Method: The data was collected from Web of Science and three free software packages were used to do the analysis like contribution from authors, different countries, trends in research and future possibilities.
Results: The biggest contributing country to cyclotide research was Australia and the most significant contributor was Craik D J. Theresearch trends were towards exploring cyclotides in new plants.
Conclusions: It was observed that no significant or impact-making studies have been initiated in India. With the rich biodiversity that India harbours, it is logical to take up cyclotide based research here so as to better tap the plant resources of this country.
Keywords: Pharma, cyclotide, citation, scaffold, host defence.

12-03

ENHANCING SEED LONGEVITY IN VEGETABLE SEEDS USING FILM COAT TECHNIQUE

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Background: Success of any crop production program depends on the quality of seeds own. Seeds undergo deterioration over storage and hence, maintenance of seed vigour and vi ability from harvest until planting is vital. Seed treatment is a common practice in agriculture for effective storage and preservation of seed. Polymerfilm coating is one such seed invigoration technique which is associated with chemical seed treatment.
Method: Freshly harvested and processed seeds of okra, variety Arka Anamika and orienta lpickling melon, variety Mudicodelocal were separately treated with polymers. The treated seeds along with the control were packed in700gauge polyethylene bags and stored under ambient conditions and observations were recorded at bimonthly intervals for a period of sixteen months.
Results: Throughout the storage period there was a decline in the seed quality parameters like germination and vigour. Inokra and OPmelon Polykote(10ml) +carbendazim-mancozeb(2g)+ bifenthrin (0.1%)were found to be superior among the treatments with respect to germination(%), seeding vigourindices and other seed quality parameters.
Conclusions: The results indicated that seed treatment with polymers was highly effective for enhancing the storage life of okra and OP melon. The polymers along with plant protection chemicals help to retain viability and storability of seeds. Among the treatments, polykote (10ml) +carbendazim- mancozeb (2g) + bifenthrin (0.1%) showed best results which may be recommended for pre storage seed treatment. Seed treatment with polymers therefore provides a cheaper and safe method to enhance seed viability and seedling performance under ambient storage condition
Keywords: Polymers, Seed coating

12-04

E-LESSON TEMPLATE GENERATION IN SCIENCE BASED ON TAXONOMY OF INGENUITY AND CONNECTEDNESS

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Background: The 21st century emphasises outcome-based education, which generates sharp expectations of the learners' achievements. The classroom design needs to be restyled by adopting flexibility as the powerful idea behind. Also, the learners need to be well versed in utilizing technology and require therightful access to accessible technologies in order to thrive in the 21st century. It is high time for thestudents to be acquainted with the significance and necessity of saving our resources and safeguardingour environment. The learners have to be so moulded as to readily take initiative to resolve problems,think about and consider various alternatives in difficult situations.
Method: The investigator developed the Taxonomy of Ingenuity and Connectedness (TIC) for the 21st century learners as a part of the doctoral study.For the practical implementation of TIC, an online software platform for creating, editing and sharing lesson templates in Science was developed named 'TicEasy.com'. TicEasy.com was developed by availing the service of a reputed software development centre. Also, an interactive workshop was conducted in order to generate e-lessons in selected science topics based on TIC using the developed software platform.
Results: TicEasy.com enabled the teachers for the effortless and effective implementation of the designed taxonomy in classroom interaction. It helps to create, edit and share lesson templates in Science based on TIC through a self explanatory, step-by-step approach, and enables downloading lesson templates as pdfs. It also provides users with a number of recommended lesson templates according to their profile and search history. TicEasy.com thus eases the lesson template creation based on TIC.
Conclusions: TicEasy.com has been envisioned to be the platform for creating, editing and sharing lesson templates, with a motto of enriching teacher/learner experiences. The investigator wishes to come up with an earnest attempt for facilitating such a global platform for the entire teaching and learning fraternity as a continued service as part of the global projection / propaganda of the Taxonomy of Ingenuity and Connectedness (TIC), which strongly point towards a future digital paperless classroom.

Keywords: Taxonomy of Ingenuity and Connectedness, 21st century learners, online software Platform, TicEasy.com, Science, e-lessons.

12-05

INFORMATION BEHAVIOUR OF VETERINARIANS IN KERALA

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Information behaviour of veterinary surgeons was studied was measured using the schedule developed by Nisha (2008) in terms of four components viz., information seeking behaviour, information storing behaviour, information processing behaviour and information dissemination behaviour. It was found that the information seeking behaviour of most of the veterinarians was high while information storing and processing behaviours were medium. Nonetheless, information dissemination behaviour was low.

12-06

DETERMINANTS OF CONSUMPTION OF LIVESTOCK PRODUCTS AMONG SCHOOL GOING ADOLESCENTS IN KERALA

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Abstract: The research was conducted among the school going adolescents in Kerala to study their livestock products' consumption pattern and to understand thedeterminants of consumption. The study revealed that majority of the school going adolescents were not consuming enough livestock protein and their Body Mass Index (BMI) was in the underweight category. Only less than one-third of them had normal BMI.
Keywords: adolescents, livestock products, consumption pattern, Body Mass Index

12-07

ROLE OF HAEMOGLOBIN LEVELS IN THE COGNITIVE PERFORMANCES OF PRESCHOOL CHILDREN

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Background: Iron deficiency is the most prevalent nutritional disorder in the world. One of the most worrying consequences of iron deficiency in children is the alteration of behaviour and cognitive performance.
Aim/Objective: The present research paper aimed to study iron deficiency anaemia in preschool children and to study the association of cognitive performance and haemoglobin level.
Materials and methods: The sample for the study comprised of 50 preschool children of 48-54 months, selected randomly from the rural areas of Malappuram district, Kerala. 25children evidenced of anaemia formed the experimental group and 25 children with normal haemoglobin levels were included as the control group. Modified version of Wechslers intelligence scale for preschool children was administered to assess the cognitive performance. The statistical methods adopted were Chi-square test and Anova using SPSS version 21.0.
Results: The results of the study indicated that there was significantly different correlation between the cognitive performance score andHb level of the children in the two groups. Lower theHb level, the time taken to perform the activity was found to increase and Hb was observed to be correlated negatively with performance time.

Conclusion: The present study indicated that haemoglobin level in children have significant role in cognitive performance. The present research paper also concluded that there is significant association between Hb level and cognitive performance in preschool children.
Keywords: Cognitive performance, anaemia, Wechsler's intelligence scale, Preschool children, hemoglobin,

12-08

INTERNET ADDICTION ON CAMPUS

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Background: The internet is an exciting new medium that is evolving into an essential part of everyday life all over the world. However, students often get lured by the endless possibilities on the internet. Students appear to be most vulnerable to developing a dependence on the internet. Realizing the extreme negative impact of internet addiction on youth, the investigator decided to focus on internet addiction among college students in the current piece of research.
Method: The sample chosen for the present study consisted of 1138 college students in Phase I, out of whom, 104 were subjected to in-depth analysis (Phase II). The 'Internet Addiction Test' (I A T) developed by Young (1996) was the tool used.
Results: Out of the 1138 subjects who were using internet, 104 subjects i.e. 9% of the total sample were spending more than 3 hours/day on the internet, and hence were labeled as those who were addicted to internet. Among those who were labeled as addicted (N-104), 69% were seen to be moderately addicted to the internet. One fifth were (20%) were severely addicted to the internet. Boys are more addicted than girls. More than half of the students (55%) were always staying longer than intended on the internet. Majority of the respondents (64%) sometimes neglected their studies to spend more time on-line. Majority of the internet users affect their emotions and interpersonal relationship.

Conclusion: The following conclusions can be made based on the present study: -

1. Internet addiction on campus is a reality, with 9% of the students being addicted to the internet.
2. Most of the addicted students were in the moderately addicted category.
3. Boys are more addicted than girls.
4. Majority of the addicted students are spending excessive time in using internet.
5. Internet addicted adolescents neglected their studies in order to spend more time on-line.
6. Internet usage of the addicted individuals does have an effect on their interpersonal relationships.
7. Excessive internet usage has a negative impact on emotional aspects.

Keywords: Excessive internet use, Study habits, emotional aspects, interpersonal relationships

12-09

MARKETING DYNAMICS OF VALUE ADDED COCONUT PRODUCTS IN KERALA - A CASE STUDY ON VIRGIN COCONUT OIL

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Background: A study on the awareness and the consumption pattern of Virgin coconut oil (VCO) in Kerala was conducted confining to the three districts of Kerala viz., Trivandrum, Ernakulam and Kozhikode which are placed almost equidistantly along the length of Kerala and representing southern, central and northern zones.
Methods: The districts and the respondents selected were from elite class in the urban centres using purposive sam-

pling. Percentage analysis is used for the study.
Results: Out of 376 consumers interacted 82 and 78 per cent of them were found to be aware, and purchasing and using VCO, respectively. Out of those who were aware 90 per cent were purchasing/using it. The monthly expenditure for VCO was found to be Rs. 325 corresponding to 5.1 and 2.1 percentage to food and food plus non-food expenditure respectively. The consumption pattern of consumers revealed high market potential for VCO and the marketers may try to take advantage of this situation. Regional differences observed in the awareness and preference of brands may be due to the inappropriate and inadequate distribution of the products to which the marketers should give more attention. Even among the elite classes of respondents only 82 per cent was aware and 78 per cent was using VCO.
Conclusion: Since VCO is an upcoming product in the market irrespective of rural and urban areas appropriate awareness and promotional activities should be conducted by the marketers.
Key words: Consumer awareness, Consumption pattern, Virgin coconut oil

12-10

AN ETHNOBOTANICAL INVESTIGATION ON ZINGIBERALES OF KERALA

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Background: Zingiberales is a monophyletic order consisting of eight families with immense medicinal values is distributed widely throughout the tropics, particularly in Southeast Asia. It constitutes a vital group of rhizomatous medicinal and aromatic plants characterized by the presence of volatile oils and oleoresins of export value. Previous studies indicate that the documentation of traditional knowledge about this ethnic plant order will promote prospective drug development (Raghupathy et al., 2008). The identification of traditional healers who were uses plant species of Zingiberales and the quantitative documentation of indigenous knowledge on the utilization of these plants may promote the drug development technologies and other industries.
Methodology: An ethnobotanical study was carried out in Kerala, India, inhabited by 34 different tribal communities, who still depend on plants of Zingiberales for medicinal use and most of them have a basic knowledge on the use of plants for disease remedies. We collected information from tribal practitioners of our study area and compared this with results obtained during earlier visits. The present study covered 18 tribal communities distributed over 10 districts of Kerala and 394 informants were interviewed during house to-house surveys. The following data was recorded for plants used by tribal people: family, scientific name, local name, parts used, mode of preparation, medicinal uses, etc. Based on this information we categorized the reports into 10 ailments and three other categories viz. Genito Urinary Ailments (GUA), Respiratory System Disorder (RSD), Dermatological Infections/Disorders (DID), Gastro Intestinal Ailments (GIA), Ear Infection (EAI), Eye Infection (EYI), Tooth Pain (TP), Endocrinal Disorders (ED), Kidney Stone (KS), Poisonous Bites (PB), Food (FP), Spice (SP), Others (OT). The estimated plant species were passed through taxonomical evaluations and the collected voucher specimens were deposited for further investigations at CATH and live conservation strategy adopted for them in the Catholicate College Botanical Garden (CCBG). Then the data were analyzed for the informant consensus factor (Fic) (Heinrich et al., 1998) and use values (Phillips et al., 1994).
Results: A total of 27 ethnobotanically important plant species distributed in five familie: Zingiberaceae (20 species), Marantaceae (2), Costaceae (2), Cannaceae (1) and Musaceae (2).
In the present study, ear infection, eye infection and tooth pain had the highest ICF. The most commonly used species was Curcuma longa with 179 use reports from 89 informants, giving the highest UV of 2.01.
Conclusion: Traditional beliefs, concepts, knowledge are to be documented and valuable plants should be conserved for future generations. The proper documentation of this indigenous knowledge have great role in promotion and production of modern drugs for diseases.
Key words: Ethnobotany, Zingiberales, Kerala, Use value, Informant consensus factor.

12-11

COMPARATIVE EVALUATION OF SALAD CUCUMBER CULTIVATION UNDER DIFFERENT DESIGNS OF POLYHOUSE STRUCTURES

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Back ground: In the present scenario of perpetual demand of vegetables and shrinking land holdings drastically and uncertainty in climatic conditions, protected cultivation is the best alternative and drudgery-less approach for using land and other resources more efficiently. The cucumber yield in protected structures can be increased manifold as compared to than in open field cultivation. In this study, the performance of two popular varieties of salad cucumber was tested under different designs of poly house structures so as to select the best structure suitable for Kerala for commercial cultivation of salad cucumber.
Methods: Three naturally ventilated poly houses (Gable type, Quonset type and Mansard type) have been constructed at Farming Systems Research Station, Sadanandapuram, Kottarakkara. Establishment of drip system with fertigation facility, fogger units is installed in each of the structures. Performance of salad cucumber varieties was evaluated in soil, soil less media, soil + coir pith media and soil with plastic mulch treatment. The selected hybrid varieties are Multistar and Rica. A digital temperature and humidity meter was used to record the temperature and relative humidity inside each structure and outside the poly house.
Results: Gable type structure recorded highest yield followed by Quonset and Mansard type for both Multistar and Rica varieties. Rica variety of salad cucumber recorded highest yield than Multistar. Maximum per plant yield of Rica variety was observed in soil + coir pith media (5.36 Kg) followed by soil+ mulch (4.84 Kg) , soil (4.79 Kg) and lesser yield was observed in soil less media (4.02 Kg). Earlier flowering was noticed in Gable type structure followed by Quonset type structure and Mansard structure. The tallest plants, maximum number of branches/plant and higher leaf area expansion rate were found in the plants grown under Gable type poly house as compared to other poly house structures. Lowest temperature was recorded in Gable type followed by Quonset and Mansard type. Relative humidity was also high in Gable type followed by Quonset and mansard type.
Conclusions: The best structure suitable for commercial cultivation of salad cucumber in Kerala is Gable type poly house. Rica variety of salad cucumber recorded highest yield than Multistar. Highest yield was observed from soil with coir pith treatment followed by soil with plastic mulch treatment in all types of structures. Lowest temperature was recorded in Gable type followed by Quonset and Mansard type. Year round cultivation of vegetables even under the extreme climatic conditions is possible using these structures. Better quality of produce, high yield and minimizing pesticides can be ensured. Efficient use of water and fertlilizer can be achieved. Continuous monitoring of crops is needed inside the poly house.
Key words: Poly house structure, salad cucumber, yield, temperature, humidity

12-12

SOCIAL INTERVENTIONS ON IMPROVING THE QUALITY OF LIFE OF WOMEN LIVING IN SC SETTLEMENTS IN KAVUMKAL DESOM, KOLLAM

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The scheduled caste comprise only of a minor proportion of the population in Kerala, especially in the Southern areas like Kollam. In spite of several welfare programmes and policies, put forward by the Government from time to time, significant changes cannot be still made in the overall quality of life and empowerment of the tribal people. Henceforth, the present study on "Social Interventions on improving the Quality of life of women living in SC settlements in Kavumkal Desom, Kollam" was carried out to find out the quality of life of people living in those settlements, with special focus on the role and extend of participation of self help groups in empowering the people living there. A sample of 100 people was taken for the study using random sampling method. A well structured questionnaire was used to collect the socio economic data, regarding the samples. An empowerment scale was used to study the level of empowerment

of the samples, along with a quality of life index to understand the extend of quality of life enjoyed by them. The level of empowerment was found to be higher among women and may be due to their active involvement in self help group. An intervention was also carried out among the women group. The women group was identified based on the concept of "Woman to Woman" approach. And was based on the assumption that these women can be the change agents and can bring significant impact on their family members as well as the neighbourhood. The effectiveness of the implemented programme was evaluated using a check list. Significant visible changes could be made on the life of the people, especially the women, on their attitude towards health, especially reproductive health, interest in extending the participation for more programmes etc

Keywords: Quality of life, SC settlements, Empowerment, Social intervention

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