University of Peradeniya

Postgraduate Institute of Science

PROCEEDINGS

PGIS Research Congress 2022

VOLUME 9

POSTGRADUATE INSTITUTE OF SCIENCE

UNIVERSITY OF PERADENIYA

SRI LANKA

PGIS RESEARCH CONGRESS 2022

PROCEEDINGS

28th – 30th October 2022

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ISBN 978-955-8787-09-0

Published by

Postgraduate Institute of Science (PGIS)
University of Peradeniya
Peradeniya
20400
SRI LANKA

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Message from the Director, Postgraduate Institute of Science

The Postgraduate Institute of Science (PGIS) of the University of Peradeniya was founded to promote innovative research and outreach strategies in a stimulating and supportive academic environment, to encourage the development of a globally recognized society with social sensitivity and economic prosperity. Since its founding, PGIS has been set up to develop the area of science disciplines and advance related fields to satisfy national and international demands. PGIS has introduced several postgraduate taught programmes covering many scientific fields and research projects leading to MPhil and PhD degrees. In the recent past, the Institute introduced a research grant scheme and obtained high-tech instruments from its earned funds to strengthen the research culture of young researchers. Eleven Boards of study such as Biochemistry & Molecular Biology, Biomedical Sciences, Chemical Sciences, Environmental Science, Earth Sciences, Mathematics, Physics, Plant Sciences, Science Education, Statistics & Computer Science, and Zoological Sciences conduct the PhD, MPhil, M.Sc. and Master's Degrees as well as Postgraduate Diploma and Certificate courses at the PGIS.

For the main annual research event of PGIS, Research Congress-2022 has received many research papers from national and international academic and research institutes and non-governmental organizations covering various topics. I look forward to sharing and discussing all our views at the conference, in the knowledge that all ideas are welcome to advance the growth of scientific disciplines.

I want to thank the members of the organizing committee and referees for their significant cooperation during the review process. A conference of this extent depends on the work of organizing committee, many academics, organizations, and well-wishers. I acknowledge all the authors who contributed to the conference with their effort and offer my congratulations to those presenting their findings.

On behalf of the PGIS, it is my pleasure to welcome you all to RESCON 2022.

Professor H.M.T.G.A. Pitawala
Director/Postgraduate Institute of Science

Message from the Congress Chairperson

The Postgraduate Institute of Science (PGIS), University of Peradeniya has organized its Annual Research Congress, RESCON 2022 for the 9th consecutive years, and will be held from 28th to 30th October, 2022. On behalf of the Organizing Committee of RESCON - 2022, it is with great honour I am welcoming you all to this important event. This annual event provides a fitting podium to academics, research scientists, and postgraduate students with an outstanding opportunity to showcase their research findings, innovations, and novel concepts and share their insights and ideas with others. We are holding this event when the country is facing many challenges due to the worst economic crisis since the independence. Despite all this, the RESCON - 2022 received an unprecedented response from the researchers all over the country that eventually led us to extend the technical sessions by a day. With nearly 300 abstracts, the highest number ever received for a RESCON, it is all set now to present them in two consecutive days under five themes, Earth and Environmental Science, ICT, Mathematics and Statistics, Life Sciences, Physical Sciences, and Science Education. Authors of these abstracts are from all major state-owned and non-state universities, research institutes and even from industries, highlighting the importance of this event for local researchers. On behalf of the Organizing Committee, I would be grateful for the authors and co-authors for keeping their confidence on this prestigious event in the Sri Lanka's research calendar.

We are honoured to have Prof. Nadira Karunaweera, President, National Academy of Sciences of Sri Lanka, as the Chief Guest, and Prof. Justin Dillon, University College London, UK as the keynote speaker. Due to economic constraints, the Organizing Committee was compelled to conduct the keynote speech and also the technical sessions in a virtual mode. Since the pandemic starts in 2019, we are more acquainted with conducting such forums through digital mode, thus these digital platforms provide us the researchers an opportunity to reach a larger audience in a more cost-effective manner.

The success of an event of this magnitude is not possible without a collective and a tireless effort by a group of people steered towards a common goal. First, I would like to acknowledge the unstinted support and guidance given by Prof. H.M.T.G.A. Pitawala, Director, PGIS to make this event a reality. In addition, my indebted gratitude goes to Dr. Piyumali Perera for her excellent secretarial work and Prof. Rupika Rajakaruna for her immaculate editorial work, all conveners and members of sub-committees for their valuable contributions and suggestions to make this event a success. Dr. Ashwini Amarasinghe's vision and tireless efforts in organizing the Pre-Conference on 'International Collaborative Research' through Zoom Events with the participation of eminent researchers from all over the world. The Organizing Committee also expresses its gratitude and appreciation to all reviewers for their expertise, session chairs, members of the Young Researcher Forum, and all members of the PGIS. Ms. Sankhapali Polgolla contributed enormously to the editorial process and managing the CMT system till to the end.

Last but by no means least, the greatest enthusiasm and cooperation shown by the plenary speakers to spend their valuable time to add more colour to this event are greatly appreciated. I sincerely hope that this important event will be an intellectually stimulating forum for all participants who join us in technical sessions virtually.

Prof. Sumedha Madawala
Chairperson/PGIS RESCON 2022

Message from the Editor-in-Chief

Welcome to the proceedings of the RESCON 2022!

Building on the success of the last two congresses on hybrid mode, this year's event is once again hailed on a hybrid platform showing much professionalism and resilience. Although the traditional platform of in-person events is currently an option, hybrid meetings are becoming the norm and preferred by many. This year congress made a significant move promoting the green concept. The Chairperson, Prof Sumedha Madawala, took on the challenge to walk the walk rather than just talk the talk, by encouraging the organisers to move towards a plastic-free congress. Online proceedings saved the paper and significantly reduced the on-site single-use plastics and flex posters. As some of us had research findings of microplastics and stories of plastic pollution, the conference promoting a plastic-free environment add glory to the platform. Despite all the challenges we suffered through current economic crises in the country marked by soaring inflation, fuel shortages and depleting foreign reserves, this year we received a record-high number of abstracts. These have now gone through a careful review process to select the best for inclusion in the agenda, with more than a 23% rejection rate ensuring a high-quality congress. A notable exception in the abstract submissions this year is a visible shift in the abstracts received from other universities— both state and private, as well as research institutes adding up to 61%. Among these 13% were from the University of Sri Jayewardenepura, followed by 11% from the University of Kelaniya. Among the rest, the universities of Uva Wellassa and Rajarata and Jaffna are some notable mentions. This diversity in the program has shaped the congress to be outstanding, providing a great platform for networking and collaboration among scientists across the country. At this juncture, I deliver a special thank you note to the authors whose technical contributions are presented in these proceedings. It is because of their excellent contributions and hard work that we have been able to prepare these proceedings. Many thanks to those involved in the review process— highly qualified theme coordinators, dedicated members of the editorial committee and especially the Chairperson, Prof. Madawala who read every abstract meticulously and supported tremendously throughout the review process. I extend my humble gratitude to the Director PGIS, Prof. H.M.T.G.A. Pitawala for placing your trust in me and allowing me to serve as the Editor-in-Chief. Reiterating what I stated in my last year's message, it is truly an honour to be the Editor in Chief of RESCON once again. I add my best wishes for a successful and fruitful conference.

Together with the editorial team, I look forward to making RESCON your conference of choice.

Professor Rupika S. Rajakaruna
Editor-in-Chief, PGIS RESCON 2022

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A brief biography of Prof. Justin Dillon

Keynote Speaker, RESCON 2022

Justin Dillon is a Professor of Science and Environmental Education at University College London (UCL), UK. His research focuses on learning and engagement in and out of schools. After studying for a degree in chemistry, Justin trained as a teacher and taught in London schools before joining King's College London in 1989, where he worked as a researcher and teacher educator until 2014. Prof. Justin was President of the European Science Education Research Association (ESERA) from 2007-11 and is President of the UK National Association for Environmental Education. He edits the journal, Studies in Science Education, and is an editor of the International Journal of Science Education.

Title of the Keynote Speech

Rethinking Scientific Literacy in an Era of Pandemics, Conspiracies and Climate Emergencies

Recent events have called into question the extent to which science education has prepared the general public for today's challenging world. Scientists are now more visible in public life however significant numbers of adults and young people do not trust what they say. It is also clear that many people do not have a basic understanding of key scientific concepts or of how science works. It could be argued that science education has failed and that we need to reconceptualise what we mean by scientific literacy. This talk will outline the problem and some possible ways forward.

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Abstract No: 3 ***Earth and Environmental Sciences***

STAND COMPOSITION AND DISTRIBUTION OF CRITICALLY ENDANGERED MANGROVE *LUMNITZERA LITTOREA* (JACK) VOIGT IN SRI LANKA

B.H.S.M. Gunawardana[1*], K.B. Ranawana[2] and M.G.M. Prasanna[3]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Zoology, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[3]Ministry of Environment, 416/C/1, Robert Gunawardana MW, Baththaramulla, Sri Lanka
[*]shashimadhushanka2@gmail.com

Lumnitzera littorea is a critically endangered true mangrove species recorded only from the Madu Ganga RAMSAR site until the recent past. A new population was recently recorded from the Bentota estuary, indicating an expansion of its population size and distribution range in Sri Lanka. The objective of this study was to discuss the stand structure and distribution of *L. littorea* in Sri Lanka. A transect, divided into 10 m × 10 m quadrats, was used to collect density data and to examine differences between *L. littorea* populations between the two sites. The Shannon Diversity index, together with the Hutcheson t-test, Shannon Evenness, and Simpson index, were used to calculate and compare the diversity in both sites. The diversity indices indicate that the two sites were not significantly different in terms of diversity. A total of 31 trees of *L. littorea* from the Madu Ganga and > 200 trees and saplings from the Bentota estuary were recorded. Moreover, the mean gbh (4.49±1.56 cm) and the mean height (4.74±1.29 m) of *L. littorea* in the Bentota estuary indicate that this population is represented by a young population. In contrast, the population in the Madu Ganga is a mature population with low regeneration potential (height - 13.56±2.4 m; gbh - 30.56±8.49 cm). Therefore, this new population could significantly contribute towards seed production; thus, future efforts are imperative to conserve this Critically Endangered mangrove in Sri Lanka. Since the *L. littorea* patch in the Bentota estuary is facing numerous anthropogenic threats, appropriate conservation strategies are recommended to protect this new population.

Keywords: Bentota estuary, Critically endangered, Distribution, *Lumnitzera littorea*, Madu Ganga

Abstract No: 9 ***Earth and Environmental Sciences***

SIMULATION OF COASTAL FLOOD AND RIVER FLOOD IN NILWALA RIVER BASIN

I.S. Sooriyabandara and R.S.M. Samarasekara*

Department of Civil Engineering, University of Sri Jayewardenepura, Rawatawatta, Sri Lanka
**isharasulo63@gmail.com*

Ocean wave and tide fluctuations significantly impact the duration of flooding in downstream floodplains. However, studies on the combined effect of coastal and river floods are lacking in the Sri Lankan context. To fill this gap, a case study based on numerical simulation of the river and coastal floods is carried out in the Niwala River. This aimed to identify a one-dimensional river flood model to couple both flood waves and coastal waves and to simulate the effect on kinematic, diffusion, and dynamic behaviour of the one-dimensional shallow water equation. The one-dimensional non-linear shallow water equation is solved by the finite difference method. The model results are verified by a real flood that occurred at Nilwala River in May 2017. Hourly flood discharge at Pitabaddara from May 24th to May 28th 2017, and hourly water level change at sea outfall are the upstream and downstream boundary conditions for the model, respectively. Digitized riverbed elevation, river width, cross-sectional river area, and hydraulic radius were fed to the model. The downstream flood can be accurately simulated by the dynamic equation, but computational time is approximately five times higher than the kinematic equation. However, upstream flooding can be simulated with kinematic equations, and computational time is comparatively less. Floods in other river basins can also be simulated from this model. The accuracy of the analysis can be increased by using more detailed topographic data in future studies.

Keywords: Coastal flood, Nilwala river, River flood, 1D shallow water equation

Abstract No: 12 ***Earth and Environmental Sciences***

BIOFILM-ENRICHED EPPAWALA ROCK PHOSPHATE AS A POTENTIAL FERTILIZER FOR RICE CULTIVATION: A STEP TOWARDS REDUCING CHEMICAL FERTILIZERS

J.P.H.U. Jayaneththi[1*], G. Seneviratne[2], H.M.S.P. Madawala[3] and M.G.T.S. Amarasekara[1]

[1]Department of Agricultural Engineering and Soil Science, Faculty of Agriculture, Puliyankulama, Anuradhapura, Sri Lanka
[2]National Institute of Fundamental Studies, Hantana Road, Kandy, Sri Lanka
[3]Department of Botany, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]harshaniupulika@gmail.com

Eppawala Rock Phosphate (ERP) has been identified as an alternative to Triple Super Phosphate (TSP). However, its application as a phosphate fertilizer is limited due to its low solubility. If the solubility can be increased, ERP can use as a phosphorous (P) fertilizer for annual crops. The National Institute of Fundamental Studies (NIFS) has developed four biofilm formulations (BF1, BF2, BF3 and BF4) with abilities to biosolubilize phosphates, of which BF3 has shown promising results. Hence, the present study was conducted to explore the potential of BF3-treated ERP as a P fertilizer in rice under field conditions. Two field trials were conducted in two consecutive cropping seasons, Yala 2018 and Maha 2018/2019. The chemical fertilizer dosage (CF_E) recommended by the Department of Agriculture (DOA) for rice was modified by replacing TSP-P with BF3-enriched ERP-P (ERP-BF3), together with 65% reduced doses of nitrogen and potassium (CF_{NK}). Three different rates, 65, 80 and 100% of ERP-BF3 (equivalent to TSP-P recommended by the DOA) were tested (CF_{NK} + 65ERP-BF3, CF_{NK} + 80ERP-BF3 and CF_{NK} + 100ERP-BF3) against CF_E. The results revealed that CF_{NK} + 100ERP-BF3 could produce significantly higher yields ($p < 0.05$) in both cropping seasons than that of other treatments (CF_{NK} + 65ERP-BF3 and CF_{NK} + 80 ERP-BF3) and the control (CF_E). Moreover, plant growth parameters, *viz.* plant shoot and root dry mass, plant height and panicle length, were also higher with CF_{NK} +100ERP- BF3 in comparison to the CF_E. Therefore, the 100 ERP-BF3 can be recommended as an alternative to TSP, with 65% of reduced doses of N and K (CF_{NK}) for rice cultivation. These results are important to today's context, where there is a scarcity of chemical fertilizers for rice cultivation. Further studies are needed to test the use of ERP-BF3 under different soil and climatic conditions in the country before introducing it to farmers.

Financial assistance from Rajarata University of Sri Lanka (Grant No. RJT/R&PC/ 2017/FOA/R/03) is acknowledged.

Keywords: Biofilms, Eppawala rock phosphate, Rice cultivation, Triple super phosphate

Abstract No: 14 ***Earth and Environmental Sciences***

ANALYSIS OF PAST RECORDS ON CAPTIVE BREEDING OF *ELEPHAS MAXIMUS* AT PINNAWALA ELEPHANT ORPHANAGE (PEO), SRI LANKA

U.G.M.S. Medawala[1,2], B.H.S.M. Gunawardana[2*] and K.B. Ranawana[3]

[1]Department of National Zoological Gardens, Pinnawala, Rambukkana, Sri Lanka
[2]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[3]Department of Zoology, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]shashimadhushanka2@gmail.com

Pinnawala Elephant Orphanage (PEO) was established in 1975 to house abandoned wild Asian elephants in Sri Lanka. The elephants are housed in semi-captive conditions where they have the freedom to roam within large enclosures during the day. Elephant Orphanage currently houses 66 elephants. The first captive-bred elephant birth was reported in 1984 at PEO. However, the captive birth rate has declined in the past decade. This study aims to improve the captive breeding facilities at PEO in the future. Retrospective breeding data of PEO elephants from 1984 to 2022 were analyzed. A total of 70 successful births (excluding 5 stillbirths) from 32 mothers were recorded. The sex ratio of live births was 1:0.84, with one birth per mature cow per 20 years and a stillbirth rate of 0.1±0.4 per year recorded, respectively. Fifteen live births were recorded in 2011, making it the most successful year in terms of births. The number of live births per year ranged from zero to 15 and appeared to have decreased over time. The main reason for this was the lack of breeding bulls at PEO. The births and deaths show a negative relationship (0.8). Currently, for 15-year-olds or older, the captive-born: rehabilitated from the wild ratio is 1:3, whereas, for 14-year-olds or younger, it is at 1:0.5, suggesting that the captive population is on the rise. This could result in inbreeding and the reduction of the population's genetic diversity in the future. Therefore, breeding within PEO has to be managed to ensure genetic diversity. Additionally, noninvasive endocrinological monitoring should be introduced to improve our understanding of female and male elephants' reproductive endocrinology.

Keywords: Captive breeding, *Elephas maximus*, Endangered, Pinnawala Elephant Orphanage

Abstract No: 19 ***Earth and Environmental Sciences***

ENHANCEMENT OF PHOTOVOLTAIC PERFORMANCE OF DYE-SENSITIZED SOLAR CELLS USING COOH FUNCTIONALIZED SINGLE-WALLED CARBON NANOTUBES IN TiO_2

V. Gurunanthanan and H.C.S. Perera*

Department of Physics, University of Peradeniya, Peradeniya, SriLanka
Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
**chanip@sci.pdn.ac.lk*

Titanium dioxide (TiO_2) is a promising wide bandgap semiconductor for dye-sensitized solar cells (DSSCs). The light-harvesting properties of the photoanode are a crucial factor that determines the overall efficiency of DSSCs. Dip-coating could be used to improve the light-harvesting properties of the photoanode by tuning the bandgap of the semiconductor. Further, carbon nanotubes (CNTs) have a high potential for finding unique applications in wide areas. This work reports the possibility of enhancing the power conversion efficiency (PCE) of DSSCs by employing COOH functionalized single-walled carbon nanotube (SWCNTs-COOH) dip-coated TiO_2 photoanodes. P25- TiO_2 films were dip-coated in SWCNTs-COOH (diameter 0.8-1.4 nm, length $\geq$ 5 μm) solution by systematically varying the SWCNTs-COOH concentration from 50 to 500 μg/ml in steps of 100 μg/ml. The SWCNTs-COOH dip-coated TiO_2 nanomaterials were characterized by X-ray diffraction (XRD) and UV-visible (UV–Vis) spectroscopy. The presence of mixed anatase and rutile phases of TiO_2 was observed with the XRD patterns of pure and SWCNTs-COOH dip-coated TiO_2 nanomaterials. The estimated bandgap values obtained from Tauc-plot using UV-Vis spectroscopy were found to be 3.20, 2.79, 2.66, 2.43, 2.35, 2.31, and 2.22 eV for the pure TiO_2, 50, 100, 200, 300, 400, and 500 μg/ml SWCNTs-COOH dip-coated TiO_2 nanomaterials, respectively. This narrowing down of bandgap can be due to the formation of a mid-band gap between valence and conduction bands of TiO_2 as a result of the introduction of SWCNTs-COOH. It was also observed that incorporating SWCNT-COOH increases the absorption of light by the TiO_2/dye electrode and, thus, enhances the short circuit current density (J_{SC}). Optimized cells with 200 μg/ml SWCNTs-COOH dip-coated TiO_2 electrodes showed efficiency (η = 6.31%), which is more than 23% of the efficiency of the control cell (η = 5.14%) due to the effect of SWCNTs-COOH under-stimulated illumination (100 mW cm-2, 1 sun) with AM 1.5 filter. These improvements were attributed to the reduced bandgap energy and the reduced charge recombination by dip-coating of SWCNTs-COOH on TiO_2.

Financial assistance from Higher Education and Research collaboration on the Nanomaterials for Clean Energy Technologies (HRNCET) project (Grant number NORPART/2016/10237) is acknowledged.

Keywords: Dye-sensitized solar cells, Dip-coated, Enhancement, P25-TiO_2, SWCNTs-COOH

Abstract No: 27 ***Earth and Environmental Sciences***

IDENTIFICATION OF POTENTIAL GEM-BEARING DEPOSITS IN THE UPPER 'WALAWA' RIVER BASIN, SRI LANKA

M.B.M. Wimalasiri*, T. Cooray and R.G.C. Jaliya

Department of Applied Earth Sciences, Uva Wellassa University, Badulla, Sri Lanka
**bhagyawimalasiri@gmail.com*

Sri Lanka has a lengthy history of gem production that dates back over 2,000 years. The primary gem bearings in the Rathnapura District, which is known as Sri Lanka's gem capital, are related to the 'Kalu', 'Kuru', and 'Walawe' rivers. Despite the fact that the upper 'Walawa' river basin is recognized as one of the best-known gem-bearing areas, appropriate studies and surveys about gem deposits are seldom carried out. As a result, delineating potential gem-mining sites may provide comprehensive information for future gem-mining prospects. Thus, in this study, 37 gravel samples were collected from river banks (12) and gem pits (25), and the 0.500 mm to 0.125 mm fractions were used for microscopic analysis. The gems in gravel were identified using a KRUSS Optronic GmbH gemological microscope at 10x magnification with light field and dark field illumination. Colour, shape, and surface reflectance were used to identify garnet, spinel, tourmaline, ilmenite, rutile, and zircon. In addition, in gem mining areas, a questionnaire survey was conducted to identify previously mined gemstones. Finally, using integrated geospatial technologies, potential gem-bearing deposits in the upper 'Walawa' river basin were mapped based on collected gravel samples and a questionnaire survey. The results of this study indicate that the Waleboda, Pinnawala, and Amupitiya areas of the upper 'Walawa' river basin had the best potential for having blue sapphire, tourmaline, spinel, and garnet gemstones. The reason for having a higher gem potential in the Waleboda area is that it is a floodplain. Further, there is a marble rock around Amupitiya and Pinnawala areas which is considered a gem-bearing rock type.

Keywords: Gem potential mapping, Geo-spatial technologies, Walawa river basin

Abstract No: 43 ***Earth and Environmental Sciences***

COMPARING TEMPORAL CHANGES OF LAND USE IN COLOMBO AND KOLONNAWA DIVISIONAL SECRETARIAT DIVISIONS

D.L.N.P. Liyanage*

Postgraduate Institute of Humanities and Social Sciences, University of Peradeniya, Peradeniya, Sri Lanka
**nimeshaliyanage95@gmail.com*

Rapid urbanization, development projects, and industrial growth lead to converting or modifying the natural environment to a built-up environment. After the post-war boom, the Sri Lankan government implemented several development projects, which led to an increase in the trend of urbanization in the Colombo and Kolonnawa Divisional Secretariat (DS) Divisions. The main objective of this paper is to identify the spatial and temporal land use changes in Colombo and Kolonnawa and analyze issues related to land use conversion. Data was collected through Landsat satellite images in 1992 and 2014. The statistical data were analyzed quantitatively using Excel and ArcGIS Software. The study revealed that being a top destination in the tourism industry and a hub of economic and urban growth, Colombo DS Division has increased built-up areas drastically from 1992 to 2014, with -18 ha of annual change in non-built-up areas. From 2001-2021, the Kolonnawa DS Division, which has accommodated a large volume of non-residential activities, has lost 18 ha of tree cover with a -45.3 ha of annual decline in non-built-up areas. This is equivalent to a 3.2% decrease in tree cover since 2000, extending over 12% of its land area. The study revealed that there was a decline in green spaces in both DS Divisions, resulting in high risks of environmental issues due to enhanced pollution, and reclamation of low-lying lands.

Keywords: Development Projects, Land use, Land cover change, Urbanization

Abstract No: 51 ***Earth and Environmental Sciences***

FRACTIONATION OF RARE EARTH ELEMENTS FROM SOILS OF TROPICAL LOWLAND RAINFORESTS IN SRI LANKA

H.M.K.S. Bandara[1*], H.M.S.K. Herath[1], S.M.T.N. Samarakoon[2], R.L.R. Chandrajith[2] and W.A.J.M. de Costa[3]

[1]Department of Export Agriculture, Faculty of Animal Science and Export Agriculture, Uva Wellassa University, Badulla, Sri Lanka
[2]Department of Geology, University of Peradeniya, Peradeniya, Sri Lanka
[3]Department of Crop Science, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka
[*]kasunbandarass95@gmail.com

Lanthanide series elements (La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu) in the periodic table are well-known as rare-earth elements (REEs). They are useful in assessing the soil formation processes under tropical weathering and are considered highly immobile and mostly retained in the soil profile. In this study, we investigated two undisturbed soil formations in order to understand the mechanisms that are responsible for both the mobility and fractionation of REEs under tropical weathering conditions. Soil samples were collected from tropical lowland rainforests (TLRFs) of Kanneliya and Pitadeniya-Sinharaja in southern Sri Lanka. Sampling was carried out in two predefined plots of each forest. Soils were collected systematically up to 25 cm depth from the surface after removing the surface litter. Air-dried, sieved (<2 mm) and powdered soils were acid-digested with reverse aqua regia using a high-pressure microwave reaction system. REE contents were quantified by ICP-MS with appropriate quality control. The total average REE content was 147 and 154 mg/kg in two plots from Kanneliya and 28.7 and 31.2 mg/kg in Sinharaja plots. The mean REE content varied in the order Ce>La>Nd>Pr>Gd>Sm>Dy>Er>Tb>Eu>Ho>Tm>Lu in all four forest plots. Higher light-REEs (LREEs; La to Eu) with depleted Eu were significant features of forest soils. The upper-continental crust normalized REE distribution patterns also showed that LREEs are enriched in Kanneliya compared to the Sinharaja sites. These variations can be attributed to differences in primary mineralogy and degree of weathering, which controls the type and amount of secondary minerals in the soil profiles. In general, more intense weathering produced kaolinite group minerals that are preferentially retained REE, in particular LREE leading to higher fractionation of LREE/HREE. Further studies are required to investigate the soil clay mineralogy of selected TLRFs to build up relationships with already available REEs data.

Financial assistance from the National Research Council of Sri Lanka under Grant No 19-072 is acknowledged.

Keywords: Rare-earth elements (REEs), tropical lowland rainforest (TLRF), Upper-continental crust REEs patterns

Abstract No: 53 ***Earth and Environmental Sciences***

SPECIES RICHNESS AND DISTRIBUTION OF PTERIDOPHYTIC FLORA IN DUNUMADALAWA FOREST RESERVE, KANDY DISTRICT, SRI LANKA: A PRELIMINARY SURVEY

L.D.K. Marasinghe* and P.W.H.K.P. Daulagala

Department of Botany, Faculty of Natural Sciences, The Open University of Sri Lanka, Polgolla, Sri Lanka
**ldkum@ou.ac.lk*

Dunumadalawa Forest Reserve, located at 7º17'00" N; 80º38'49" E and 548 - 972 m above sea level and popularly known as Wakarawatte, is a semi-isolated, mid-country, wet zone forest fragment. It comprises mainly of secondary growth forest since the site has been used for tea and cocoa plantations in the past. The forest is not explored floristically, and the species composition of flora and its diversity has not been studied yet. In addition to the forest trees, the ecosystem setting provides an ideal habitat for pteridophytic flora, which grows opulently in the damp and shaded understory and as epiphytes. Preliminary observations and the sample collection of pteridophytes were carried out over a one-year period in several locations of the forest. Collected specimens were tagged and dried, and herbarium specimens were prepared. Species were identified using morphological characters with the aid of available literature. Identified species were verified with the help of specimens deposited at the National Herbarium of Sri Lanka, Royal Botanic Gardens, Peradeniya, Sri Lanka. A total of 10 families of Pteridophytes from different habitats were recorded, consisting of 15 genera and 30 species. Family Pteridaceae was the dominant family, represented by 15 species, followed by the Family Polypodiaceae consisting of four species. In addition, families, Tectariaceae (3 spp.), Thelypteridaceae (2 spp.) and one species each from the families Marattiaceae, Selaginellaceae, Gleicheniaceae, Nephrolepidaceae, Blechnaceae and Anemiaceae were recorded. A majority of fern species collected in this study were terrestrial species except for *Pyrrosia lanceolata* (L.) Farw., *Microsorum scolopendrium* (Burm.f.) Copel., and *Drynaria quercifolia* (L.) J. Smith was epiphytic. Among the terrestrial ferns, *Blechnum occidentale* L. was the most abundant and widely distributed species, which grows well, forming thickets in many places. According to the national Red List Sri Lanka 2020, among the 30 species of Pteridophytes recorded, 27 species were locally common, two Vulnerable (*Tectaria polymorpha* (Wall.ex.Hook.) Copel, *Chirstella hispidula* (Decne) Holttum.) and *Selaginella crassipess* Spring. Near Threatened. This study provides baseline taxonomic information to assist sustainable conservation and management activities of the pteridophytic flora in Dunumadalawa Forest Reserve.

Keywords: Dunumadalawa Forest Reserve, Pteridophytes, Sri Lanka

Abstract No: 54 ***Earth and Environmental Sciences***

SOIL PHYSICAL PROPERTIES IN TROPICAL MONTANE AND SUB MONTANE FORESTS IN SRI LANKA ALONG AN ALTITUDINAL GRADIENT

S.M.T.N. Samarakoon[1, 2*], R. Chandrajith[1] , H.M.S.K. Herath[3] , H.M.K.S. Bandara[3] and W.A.J.M. de Costa[4]

[1]Department of Geology, University of Peradeniya, Peradeniya, Sri Lanka
[2]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[3]Department of Export Agriculture, Uva Wellassa University, Badulla, Sri Lanka
[4]Department of Crop Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]nishika.samarakoon@gmail.com

Tropical Montane Forests (TMFs) and Tropical Sub Montane Forests (TSMFs) play an important role in watershed function, climate change mitigation and conservation of biodiversity. In the past few decades, increased deforestation has reduced their potential ecosystem roles and services. Although to-date, above-ground information on these forests is sufficiently available, below-ground properties are scarce. The present study investigated the soil physical properties of TMFs and TSMF in Sri Lanka. Soil samples were collected according to standard protocols adopted by the RAINFOR in 1 ha sampling plots at Piduruthalagala (PDG) and Horton Plains (HNP) and two plots from the sub-montane forest at Enasalwatta (ENS). Twenty near-surface (up to 25 cm) representative soil samples were collected, and bulk density, porosity, volumetric water content (VWC), field capacity (FC) and permanent wilting point (PWP) were measured using standard methods. Soil aggregate stability was determined by using the Le Bissonnais method following (i) fast wetting (FW), (ii) slow wetting (SW) and (iii) mechanical breakdown (MB). All measured parameters were significantly ($p<0.05$) different among the plots except soil aggregate stability for FW. Bulk density, porosity and VWC ranged between 0.88-1.38 mg m^{-3}, 48.0 - 66.6% and 10.6 - 19.8%, respectively, whereas FC and PWP were between 44.1-46.9% and 10.8-14.7%, respectively. Aggregate stability ranged between 1.25-1.43 in FW, 1.18-1.70 in SW and 1.16-1.58 in MB. The size of the major aggregate fraction was >2 mm for FW and SW treatments of all plots, while MB was >0.25 mm. The most stable and the least stable soil aggregates were found in PDG and HNP, respectively. In conclusion, soil porosity increased, and bulk density decreased with the increase in altitude, but there was no clear relationship between altitude and other physical properties tested. Correlation analysis showed the positive and negative relationships among the above-measured soil physical properties.

Financial assistance from the National Research Council (Grant No NRC 19-072) is acknowledged.

Keywords: Below-ground soil properties, Soil physical properties, Sub Montane Forest, Tropical Montane Forests

Abstract No: 57 ***Earth and Environmental Sciences***

SOIL PHYSICO-CHEMICAL PARAMETERS ALONE DO NOT REFLECT PADDY YIELD INCREASE UNDER BIOFILM BIOFERTILIZER APPLICATION: A CASE STUDY IN AMPARA DISTRICT

W.M.K.D.S. Warnakulasooriya*, M. Premarathna, S.N.B. Ekanayake and G. Seneviratne

Microbial Biotechnology Unit, National Institute of Fundamental Studies, Kandy, Sri Lanka
**dilan.wa@nifs.ac.lk*

Soil physico-chemical parameters, which reflect nutrient-supplying capacity, determine crop yields under chemical and organic fertilizer practices. Soil nutrient availability can also be enhanced by biofilm biofertilizer (BFBF), thus used as an effective alternative to reduce chemical fertilizer (CF) in Sri Lanka. The present study was designed to assess the effect of BFBF practice [i.e. 65% of farmers' conventional rate of CF + BFBF (2.5 L ha^{-1} of BFBF with Urea 150, TSP 35 and MOP 40 kg ha^{-1}] in comparison to farmers' conventional practice of 100% CF application (Urea 222, TSP 54 and MOP 60 kg ha^{-1}) in terms of selected soil physico-chemical parameters and paddy grain yield in large-scale farmer-managed paddy fields in the Ampara District. Results revealed that the BFBF with the reduced CF rate significantly ($p=0.03$) increased soil organic carbon (SOC) over that of 100% CF. Moreover, the BFBF practice enhanced ($p=0.07$) paddy yield by ca. 15% compared to 100% CF practice. However, no significant differences were observed in terms of total soil nitrogen, phosphorus, moisture, pH and electrical conductivity between the two practices, possibly due to the short span of the study. The results indicate that the soil physico-chemical parameters alone do not reflect the positive impacts of BFBF application. Therefore, long-term studies together with microbial and plant parameters are needed to evaluate the effects of BFBF on creating eco-friendly and sustainable agricultural systems.

Keywords: Biofilm biofertilizers, Chemical fertilizers, Paddy, Soil organic carbon

Abstract No: 60 ***Earth and Environmental Sciences***

EFFECTIVENESS OF COMBINED TREATMENT OF ADSORPTION AND PHYTOREMEDIATION OF A TEXTILE DYE

M.S. Ekanayake[1,2], D. Jayawardana[3] and P. Manage[2,4*]

[1]Department of Aquaculture and Fisheries, Faculty of Livestock, Fisheries and Nutrition, Wayamba University of Sri Lanka, Sri Lanka
[2]Centre for Water Quality and Algae Research, Department of Zoology, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
[3]Department of Forestry and Environmental Science, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
[4]Faculty of Graduate studies, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
[*]pathmalal@sjp.ac.lk

The textile sector is one of the major driving forces of the Sri Lankan economy. However, the generation of heavy loads of textile dyes containing wastewater leads to various detrimental effects on the ecosystem. Therefore, the present study aimed to evaluate the effectiveness of the combined physical adsorption and phytoremediation to remove an anionic textile azo dye: CI Direct Blue 201 (DB 201). Based on the preliminary studies, a laterite soil collected from the Western Province of Sri Lanka was selected as the filter material for the physical treatment unit (2 kg of soil filled in an acrylic column with 0.0015 m^3 of total volume) and water hyacinth (*Eichhornia crassipes*) for the phytoremediation unit (four plants in 2 l tank). Three separate feeding sessions (0.25 l of 50 mg l^{-1} DB 201 textile dye with 25 ml min^{-1} flow rate) were maintained with 2 h of facilitating trickling time. After each three feeding sessions, one day gap was maintained and continued for 119 days. The effluent colour, pH, electric conductivity, and oxidation-reduction potential were measured using standard meters. The changes in dye structure and soil filter material were analyzed using Fourier-Transform Infrared Spectroscopy (FTIR) and Powder X-ray Diffractometer (PXRD), respectively. During the study period, laterite soil removed 90-80% of colour without leaching of major heavy metals present in the original soil (Zn^{2+}, Cu^{2+}, Ni^{2+}, Pb^{2+}), and complete removal of colour (100%) was achieved after the treatment by phytoremediation unit. Low concentrations of Ca^{2+} (< 643.5 mg ml^{-1}) and Mg^{2+} (<1027 mg ml^{-1}) were detected in the effluent after the physical treatment unit and reduced below the detectable level after passing through the phytoremediation treatment unit. PXRD indicated the presence of goethite, gibbsite and hematite as the major components in the laterite soil. Results suggest the potential applicability of laterite soil and water hyacinth as a combined treatment method to treat textile dyes in an environmentally-friendly approach.

Financial assistance from the University of Sri Jayewardenepura (Grant No: IIVCC/IICE/2018/68) is acknowledged.

Keywords: Adsorption, Decolorization, Laterite soil, Textile dye, Water hyacinth

Abstract No: 63 ***Earth and Environmental Sciences***

SHORELINE CHANGES OF SOUTHERN AND EASTERN COASTS OF SRI LANKA OVER 15 YEARS: A GIS APPROACH

P.H.C.J. Thennakoon[1], A.P. Madarasinghe[1], E.P.D.N. Thilakarathne[1*] and T.W.S. Warnasuriya[2]

[1]Department of Animal science, Uva Wellassa University, Badulla, Sri Lanka
[2]Faculty of Fisheries and Ocean sciences, Ocean University of Sri Lanka, Tangalle, Sri Lanka
[*]epdarshananuwan@gmail.com

The shoreline is a dynamic and complex area that is specified as a boundary between land and sea. Its changes arise as short or long-term by leading to erosion or accretion. Since its vast socio-economic, ecological, and cultural values, those changes are highly important to monitor. GIS and Remote Sensing techniques are cost-effective and accurate for investigating coastal monitoring activities quantitatively and qualitatively. Therefore, this study aimed to determine the shoreline changes on the southern and eastern coasts of Sri Lanka. The position of shorelines was delineated by high-resolution satellite images from Google Earth (GE) Pro software from 2005 to 2020. Shoreline changes were estimated by calculating shoreline change statistics using by Digital Shoreline Analysis System (DSAS) in Arc-GIS 10.8 software. Average End Point Rate (EPR) and Net Shoreline Movement (NSM) values were used to identify the erosion and accretion rates. Results show that these coasts are highly dynamic, with site-based erosion and accretion along with them. On the southern coast, the average coastal accretion rates are recorded in Galle and Matara Districts as 0.37±1.18 m yr^{-1} and 0.02±0.99 m yr^{-1}, respectively. However, an average erosion rate is recorded in the Hambanthota District as -0.45±1.21 m yr^{-1}. On the eastern coast, the average erosion rates are recorded as -0.38±0.42 m yr^{-1} in the Trincomalee District, -0.8±0.29 m yr^{-1} in the Ampara District, while the average accretion rate is recorded as 0.05±0.5 m yr^{-1} in Batticaloa District. Both coasts have widely applied different protective methods to control these changes. Both natural and human influences, such as coastal development activities and physical alterations, might have contributed to these changes. Therefore, continuous monitoring of changes in coastal morphology is essential to environmental management, conservation, protection and development along the coastal regions.

Keywords: Coastal erosion, East coast, Remote sensing, Satellite images, Shoreline changes

Abstract No: 64 ***Earth and Environmental Sciences***

TOXIC METAL CONTAMINATION OF INLAND FISH (*Etroplus suratensis*) IN MAHAKANADARAWA RESERVOIR: A STUDY IN A CKDu PREVALENT AREA, SRI LANKA

L.V. Perera[1], R.T. Perera[2*], R.A. Perera[1] and J.A. Liyanage[1] and W. A. P. J. Premaratne[1]

[1]Department of Chemistry, Faculty of Science, University of Kelaniya, Sri Lanka
[2] Department of Indigenous Medical Resources, Faculty of Indigenous Health Sciences and Technology, Gampaha Wickramarachchi University of Indigenous Medicine, Sri Lanka
[*]wprtp@gwu.ac.lk

Fish is a great source of protein, polyunsaturated fatty acids (PUFA), lipo-soluble vitamins, and essential minerals. Meanwhile, people who live in the dry zone of Sri Lanka consume inland fish species collected from irrigation reservoirs. Toxic metals tend to accumulate in fish; thus, it is important to investigate the safety of the consumption of inland fish. This study evaluated the toxic metal contamination status of the edible fish (*Etroplus suratensis*) in the Mahakanadarawa tank and assessed the risk of fish consumption. Mihintale Divisional Secretariat Division was identified as a major CKDu-prone area in the Anuradhapura District. Mahakanadarawa tank is a major fishing source in the area. Fifteen *E. suratensis* samples were collected from the Mahakanadarawa tank in April 2022. The fish muscle parts, gut, and gills were removed, stored in sterile polyethene bags, and kept at 4°C during transport. The concentration of metal elements, including Mn, Co, As, Cd, Cr, Pb, Cu, Zn, Al, Fe, and Ni, was determined in an acid-digested sample using inductively coupled plasma mass spectrometry. The average contents of the nephrotoxic heavy metals/metalloids such as As, Cd, Pb, and Cr in the gut tissues of *E. suratensis* had reported elevated values compared to other tissue parts (gills and muscle). The average Pb content in the tissues of the gills, muscles, and gut of *E. suratensis* exceeded the permissible limits given by WHO/FAO. Average Cd contents did not exceed the permissible level in all analyzed tissue types, while average Zn and Cu levels have also complied with the WHO/FAO standard limits. The edible part of the fish consisted of an average of As = 0.01($\pm$0.01) mg/kg, Cr = 0.22 ($\pm$0.03) mg/kg, Mn = 1.19 ($\pm$ 0.36) mg/kg, and Al = 180.8 ($\pm$137.0) mg/kg. Even small amounts of toxic metals are reported in edible tissues of the *E. suratensis*; long-term consumption of fish may generate a negative health effect on consumers. Further risk assessment of toxic metals in *E. suratensis* in different reservoirs, including reference areas (CKDu-non-endemic areas), needs to be investigated in future studies.

Financial assistance from establishing a "CKDu Information and Research Center" at the University of Kelaniya, Sri Lanka (Grant No. PS/DSP/CKDU/06/3.5) is acknowledged.

Keywords: CKDu, Contamination, Heavy metals, Inland fish

Abstract No: 72 ***Earth and Environmental Sciences***

ESTIMATION OF TOTAL LIVE CORAL COVER OF PROMINENT CORAL REEFS ON THE EASTERN COAST OF SRI LANKA

E.P.D.N. Thilakarathne*, S.W.R. Sewwandi, S.C. Jayamanne and N.P.P. Liyanage

Department of Animal Science, Uva Wellassa University, Badulla, Sri Lanka
**epdarshananuwan@gmail.com*

Coral reefs are highly diverse ecosystems and biodiversity hotspots in the world, providing many ecosystem services. However, these ecosystems have changed in the last few decades due to natural and anthropogenic impacts. Therefore, it is important to monitor their status for conservation and management purposes. Thus, Pigeon Island (PIR), Adukkuparu (AR), Salli Beach (SBR), Kayankerni (KR), and Passikudah (PR) reefs which are considered the most prominent coral reefs on the Eastern coast of Sri Lanka were surveyed in 2020, 2021, and 2022 by using the line intercept transect method. The total coral cover of the respective sites was demarcated by the Allen Coral Atlas online platform that offers high-resolution and up-to-date images of the coral reefs with their structure and composition. Data were taken by snorkelling or diving over, randomly selected, 30 of 30 m long permanent transects per site. According to Allen Coral Atlas data, the Coral/Algae covers were 0.03 km^2, 0.16 km^2, 0.16 km^2, 0.60 km^2, and 0.38 km^2 for PIR, AR, SBR, KR, and PR, respectively. The live coral percentages at PIR, AR, SBR, KR, and PR were 59%, 12%, 13%, 38%, and 21% in 2020, 59%, 16%, 19%, 37%, and 20% in 2021, and 60%, 28%, 34%, 36%, and 20% in 2022, respectively. Therefore, the live coral covers for PIR, AR, SBR, KR, and PR were 0.0177 km^2, 0.0192 km^2, 0.0208 km^2, 0.2280 km^2, and 0.0798 km^2 in 2020, 0.0177 km^2, 0.0256 km^2, 0.0304 km^2, 0.2220 km^2, and 0.0760 km^2 in 2021, and 0.0180 km^2, 0.0448 km^2, 0.0544 km^2, 0.2160 km^2, and 0.0760 km^2 in 2022. The live coral cover (as a percentage) has increased by 1%, 16%, and 21% in PIR, AR, and SBR, respectively, while reduced by 2% and 1% in KR and PR during the past three-year period. The study recommends declaring AR and SBR as Marine Protected Areas (MPAs) to conserve these emerging live corals.

Keywords: Adukkuparu, Kayankerni reef, Live coral cover, Passikudah Reef, Pigeon Island, Salli Beach

Abstract No: 74 ***Earth and Environmental Sciences***

IMPACT OF DISASTER MANAGEMENT PROGRAMS ON MEDICAL AND NON-MEDICAL PERSONNEL AND PUBLIC DURING CRISES

A.I. Kodithuwakku[1*], S.P.K. Malaviarachchi [2] and M.D. Lamawansa[3]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Geology, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[3]Department of Surgery, Faculty of Medicine, University of Peradeniya, Peradeniya, Sri Lanka
[*]ivanthi.kodithuwakku@gmail.com

The increased frequency of disasters in Sri Lanka in recent decades has pressured the need for better emergency preparedness and response. This study aimed to identify the importance and impact of the training programs conducted at the Health Emergency and Disaster Management Training Centre (HEDMaTC), Faculty of Medicine, University of Peradeniya. The centre conducts training programs on public health emergency management and sexual and reproductive health during crises. The questionnaire-based feedback of the past participants (n=75) of the programs conducted by the HEDMaTC was considered in the analysis. Results showed that the training and knowledge provided by these programs were highly effective and valuable during crises. From the sample, 23% of the participants confirmed that they used the knowledge gained from these programs in actual crises to manoeuvre through them successfully. 36% of the participants stated that they could use this knowledge to draw plans for disaster management policies and formulate strategies for sexual and reproductive health during crises. In comparison, another 30% of the respondents confirmed that they had the opportunity to apply this knowledge during crises in their real life. All the participants recommended the programs conducted by the centre and also indicated that they wished to participate in future programs. However, these training programs have placed HEDMaTC at the forefront of conducting medical-related disaster management training programs in Sri Lanka. This study identified many areas that require improvement in the training programs, such as child abuse during crises and leadership in public health. We recommend that HEDMaTC shall develop and maintain a live directory of the trained personnel to facilitate quick access to them during disasters in the future.

Keywords: Disaster management, Public health emergency, Reproductive health, Training programs

Abstract No: 77 ***Earth and Environmental Sciences***

POTENTIAL OF AQUATIC MACROPHYTES IN PHYTOREMEDIATION OF FARM EFFLUENT

T. Kulangana and M.C.M. Iqbal*

Plant and Environmental Sciences, National Institute of Fundamental Studies, Kandy, Sri Lanka
**iqbal.mo@nifs.ac.lk*

Water bodies are increasingly polluted from excess fertilizer run-off and industrial wastewater, resulting in nutrient enrichment and creating algal blooms. The addition of nitrogen and phosphorus is significant in eutrophication, and phosphorus most often limits the growth of phytoplankton than nitrogen. Farm effluents have high phosphorus (P), and this study aims to recover the phosphate using phytoremediation using macrophytes, *Salvinia molesta* and *Pistia stratiotes*. Cattle farm effluent was collected from the Mawelawaththa farm, Faculty of Agriculture, University of Peradeniya. Initial nutrient composition, pH and electrical conductivity (EC) of the effluent were determined. *S. molesta* and *P. stratiotes* were weighed (100.0 g) and introduced to 3.0 L of farm effluent in 6 trays (40 x 30cm^2) to determine the P removal. As a control, 100 g of the two macrophytes were introduced to tap water-filled trays. Residual phosphate concentration in the trays was measured after 3, 6, 9, 12, 15, 18 and 21 days from the introduction of macrophytes using the Ascorbic Acid Blue method. Concentrations were calculated and compared using basic statistics in Minitab 17 statistical software. The phosphate removal efficiency for *S. molesta* was 25.02±2.60% and for *P. stratiotes* was 72.56±5.13%. As uptake per fresh weight during the 21 days, this was equivalent to 0.07506±0.00781 mg g^{-1} for *S. molesta* and 0.2177±0.0154 mg g^{-1} for *P. stratiotes*. As a whole, *P. stratiotes* was more efficient in P uptake compared to *S. molesta*. Similar efficiencies were noted in previous research studies in Sri Lanka. Hence, the cultivation of the macrophytes was effective as a phytoremediation process to remove the residual phosphorus present in farm effluents. These findings suggest the possibility of utilizing farm effluents treated with *S. molesta* and *P. stratiotes* to make organic fertilizer. Therefore, P-rich macrophyte fertilizer can be used as a substitute for inorganic P fertilizers such as Triple Super Phosphate on a commercial scale.

Financial assistance from the National Institute of Fundamental Studies is acknowledged.

Keywords: Macrophytes, P removal efficiency, Phosphate, Phytoremediation

Abstract No: 85 ***Earth and Environmental Sciences***

PHENOL VAPOUR DEGRADATION WITH THE AID OF CATION-MODIFIED ZEOLITE-Y CATALYSTS IN THE ABSENCE OF OXIDIZING AGENTS

R.A.L.R. Amarasena[1,2*], M.D.R. Perera[1,2], W.M.A.T. Bandara[3], R. Weerasooriya[1] and I.P.L. Jayarathne[1]

[1]National Institute of Fundamental Studies, Kandy, Sri Lanka
[2]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[3]Department of Chemistry, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]lrlasanga@gmail.com

Air pollution remediation is increasingly important due to the enhancement in the emission of hazardous vapours into the atmosphere due to rapid industrialization. Hazardous vapour can be removed by using various methods, and the common methods are adsorption, photocatalytic oxidation and catalytic oxidation. The main focus of this study is to identify the effect on the degradation of phenol vapour with different metal cation-modified faujasite zeolite catalysts in the absence of oxidizing agents, i.e. under normal air conditions. Faujasite (FAU) zeolite Y was synthesized in the laboratory and subjected to cation modification. For this case, Ferrous(II), Copper(II), Nickel(II) and Silver(I) cations were used for the comparison. Synthesized zeolite catalysts were characterized using Fourier Transform Infrared spectroscopy (FTIR) and powder X-ray diffraction (PXRD). Results obtained from FTIR showed that Zeolite-CuY has successfully loaded into the acid site of zeolite Y. Characteristic peaks in PXRD showed that the FAU type zeolite has successfully synthesized, and metal modification has been completed for Zeolite-CuY, Zeolite-NiY and Zeolite-AgY. The crystallinity of Zeolite-FeY was less when compared to other catalysts, and it may be because of the formation of ferric oxides. According to the particle size analysis, these catalysts were in the 2 - 4 µm size range. To identify phenol degradation products qualitatively and quantitatively, the GCMS headspace method was used, and degradation products were analyzed according to the database library. Benzoquinone degradation product was observed from Zeolite-CuY with a phenol removal percentage of 76.6%. It can be suggested that the mechanism may undergo a Fenton-type reaction and provide OH radicals from the zeolite framework. When phenol was treated with Ni and Ag-modified zeolite catalysts, no apparent degradation products were shown in the chromatogram. However, the concentration of phenol had reduced, implying only adsorption occurred. This study concluded that the Zeolite-CuY partially degrades phenols under normal air conditions.

Keywords: Catalyst, Cation-modified, Degradation, Phenol, Zeolite Y

Abstract No: 92 ***Earth and Environmental Sciences***

REMOVAL OF Ca^{2+} IN HARD WATER USING MODIFIED CELLULOSE EXTRACTED FROM CORNCOB

Y.G.R.M.A.G Rathnayake[1*], I.D.D. Perera[1], K.K.D.C.S. Weerarathne[1], M.A.S.R. Senevirathna[1] and J.T. Cooray[2]

[1]Department of Science and Technology, Uva Wellassa University of Sri Lanka, Badulla, Sri Lanka
[2]Department of Applied Earth Sciences, Uva Wellassa University of Sri Lanka, Badulla, Sri Lanka
[*]ayesha.gayathri@gmail.com

Hardness in water is a severe problem in many parts of the world, including Sri Lanka. Hard water causes many difficulties at domestic and industrial levels and makes it unpalatable for drinking. Since the existing methods for water hardness removal have several drawbacks, there is a growing interest in developing more environmentally- friendly softeners for reducing the water hardness. This study is conducted to develop a highly efficient metal ion adsorbent using modified cellulose extracted from agricultural waste since large quantities of corncob waste are typically dumped after harvest in agricultural areas. This study investigates whether the ethylenediaminetetraacetic acid (EDTA) modified cellulose isolated from corncobs can adsorb calcium (Ca) in hard water. The cellulose isolation from the corncob consists of de-hemicellulose, delignification, and bleaching. Cellulose fibres, thus extracted from corncob, were modified using the esterification method with EDTA. Modified cellulose was used as a calcium ion adsorbent, and it was tested using EDTA titrations. A solution of 100 mg/l calcium ion (Ca^{2+}) was used as raw water for the purpose of studying adsorption efficiencies, and the effect of dosage of modified cellulose (Cell-EDTA) on sorption capacity was studied. Cellulose, modified cellulose (Cell-EDTA), and calcium-adsorbed modified cellulose were characterized using Fourier Transform Infrared (FTIR) spectrometer. It was found that cellulose extracted from corncob waste can be successfully modified with EDTA and can be used as an adsorbent for calcium. The ability of Ca^{2+} adsorption of modified cellulose from corncob is calculated as 0.223 mg/g at a concentration of 100 mg/l of the adsorbate.

Keywords: Adsorption, Calcium, Corncobs, EDTA, Extracted cellulose

Abstract No: 116 ***Earth and Environmental Sciences***

MICROBIAL SOURCE TRACKING OF RIVER WATER USING HOST-SPECIFIC *BACTEROIDES* AND *FAECALIBACTERIUM* ENDPOINT-PCR ASSAYS

G.K. Kapukotuwa[1*], C.L. Abayasekara[2], K.C. Weerakoon[3] and R.S. Rajakaruna[4]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Botany, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[3]Department of Zoology, The Open University of Sri Lanka, Nugegoda, Sri Lanka
[4]Department of Zoology, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]kapukotuwag@gmail.com

Microbial source tracking is helpful in the effective management of water pollution. The objective of this study was to identify faecal pollution sources spatially and temporally along the Rawan-Oya tributary of the Mahaweli River using host-specific *Bacteroides* and *Faecalibacterium* markers. Water samples were collected aseptically over 19 months from June 2020 to March 2022 from nine sites representing pristine, agricultural, rural, semi-urban and urban areas along the river. Water samples (n = 171) were filtered through 0.45 µm sterile membrane filters. DNA was extracted from faecal samples of humans, cattle and dogs to test the specificity of markers and from isolates on membrane filters using the gDNA Tissue Miniprep System. The Bac32 assay was performed for general *Bacteroides spp*, while human and cattle faecal contamination was tracked using Bacteroides HF183 and CF193 markers, and dog faecal contamination was tracked using *Faecalibacterium* ED-1 marker. All the samples were positive for the universal *Bacteroides* marker, confirming faecal contamination of water collected from all the sites. Every site along the stream was positive for human-faecal contamination except for the pristine area. Urban and semi-urban sites had high levels of human-faecal contamination, which could be attributed to the presence of toilets and wastewater outlets in the vicinity. The recreational sites had human-faecal contamination, while agricultural areas with paddy fields, cattle farms and urban sites with meat shops in the vicinity of the stream had cattle faeces contamination. Urban and semi-urban areas had high dog faecal contamination. Both human-specific ($\chi^2 = 29.18$; $p < 0.0001$) and dog-specific ($\chi^2 = 4.23$; $p = 0.039$) faecal contaminations were significantly higher during the wet season compared to the dry season. This study represents a significant and pioneering step towards using PCR tools to identify faecal pollution sources in the Rawan-Oya tributary, showing diverse faecal contamination patterns along the waterway.

Financial assistance from the National Science Foundation of Sri Lanka (Grant No. NSF/SCH/2019/04) is acknowledged.

Keywords: Faecal contamination, Host-specific genetic markers, Microbial source tracking, PCR, River water

Abstract No: 117 ***Earth and Environmental Sciences***

DENGUE VECTOR CONTROL PROGRAMS IN AREAS SUITABLE FOR PROMOTING ECOTOURISM IN THREE DIVISIONAL SECRETARIAT DIVISIONS OF TRINCOMALEE DISTRICT, SRI LANKA

S. Dissanayake[1,2,3*], W.A.P. de Silva[1,2], V. Premananth[3] and R. S. Rajakaruna[1,2]

[1]Department of Zoology, University of Peradeniya, Peradeniya, Sri Lanka
[2]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[3]Ministry of Health, Sri Lanka
[*]shanumck@gmail.com

The Trincomalee District is a famous tourist destination; however, in the past few years, it has been heavily affected by dengue. We assessed the effectiveness of dengue vector control programs (*i.e.* thermal fogging and source reduction) in three Divisional Secretariat Divisions (DSDs): Trincomalee Town and Gravets, Mutur and Kinniya. Despite recording high dengue incidences in DSDs, they are suitable areas for promoting ecotourism. A monthly larval survey was conducted from June 2020 to March 2021 in 21 Grama Niladari (GN) areas; the Premise Index (PI) and Container Index (CI) were calculated. A questionnaire assessed the knowledge, practices and attitudes (KPAs) of the community towards dengue control. Reported dengue cases per 1,000 population were analyzed for 2019 and 2020 and correlated with the meteorological data. Overall, 3,085 premises were visited, and 8,835 potential containers (3,865 wet, 4,970 dry) were recorded. Of wet containers, 8.9% were vector-positive (67.2% with *Aedes aegypti* and 32.7% with *Aedes albopictus*). The overall PI (7.9%) and CI (8.9%) values were moderate in the study areas. Five GN areas with PI > 12.8% were identified as high-risk to recommend the application of larvicides to potential breeding sites. Household water-storing items were the main wet container type (36.2%), while discarded containers were the main dry container type (50.8%), contributing to larval indices. The majority in the community has identified dengue as a serious health problem (81.0%) in the area and was also aware of the risk of infection (92.0%). However, only 50.0% knew about dengue-controlling activities in the district, and 69.0% of respondents claimed they did not participate in any community-based dengue control programs. There was no correlation between dengue cases and temperature, while a strong positive correlation was observed with rainfall for 2019 (p=0.001) but not in 2020. The community stated the direct and/or indirect benefits of tourism (65.0%) and culturally appropriateness (73.0%), but only 18.0% had heard the term 'ecotourism'. Increased community awareness on dengue control, regular tap water supply or providing covered overhead tanks, and increased attentiveness on ecotourism are recommended.

Keywords: Dengue, Ecotourism, Trincomalee, Vector breeding

Abstract No: 120 ***Earth and Environmental Sciences***

COMPARISON OF TOPSOIL WATER CONTENT BY TIME DOMAIN REFLECTOMETRY AND GRAVIMETRIC METHOD

S.S. Garusingha[1*], Y.N.S. Wijewardana[2] and D.T. Udagedara[1]

[1]Department of Applied Earth Science, Uva Wellassa University, Badulla, Sri Lanka
[2]Department of Engineering Technology, Uva Wellassa University, Badulla, Sri Lanka
[*]sawbhaggya10@gmail.com

Soil water content (SWC) is an important ecological element in natural ecosystems. The objective of this research is to measure and compare the SWC in topsoil (0-10 cm) using time domain reflectometry (TDR) and gravimetric method. Soil samples were collected from Uva Wellassa University premises (N 6^0 $58^{'}$ 52.53708, E 81^0 $4^{'}$ 30.26964). The measurements were obtained along the five survey lines in the selected area (L1 to L5). The study was carried out in March 2022, with the parallel use of the TDR and gravimetric method. TDR measurements were taken as *in-situ* measurements, and oven-dry water content was measured using disturbed soil samples. The soil bulk density and soil texture were measured using the soil core method and the hydrometer method, respectively. Finally, the correlation coefficients of measured parameters were analyzed. The coefficient correlation indicates a strong relationship (r=0.9) between TDR values and gravimetric measurements, which exhibit a 1:1 relationship. The study concludes that the two methods used in measuring SWC give some comparable results.

Keywords: Gravimetric method, Soil water content (SWC), Time domain reflectometry (TDR) method, Topsoil

Abstract No: 124 ***Earth and Environmental Sciences***

SURFACE-COATED SAND FOR CONCURRENT REMOVAL OF FLUORIDE AND TURBIDITY IN DRINKING WATER

P.M.C.J. Bandara[1,3*], N.W.B. Balasooriya[2,3] and R Weerasooriya[1]

[1]National Centre for Water Quality Research, National Institute of Fundamental Studies, Kandy, Sri Lanka
[2]Department of Geology University of Peradeniya, Peradeniya, Sri Lanka
[3]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]jayani.ba@nifs.ac.lk

Drinking water treatment using sand filters has a long history in water purification plants, and it is one of the most energy-intensive components. Sand filters have many variants, such as rapid sand filters, etc., to enhance their efficiency. The majority of sand filters are used to trap suspended solids and colloid particles in the water. In the present study, the sand granules are modified to improve their efficiency by simultaneously removing fluoride and turbidity. The sand particles were chemically modified using iron oxide in the presence or absence of graphene oxide (labeled as Fe_2O_3-S for Fe_2O_3 coated sand, or Fe_2O_3-GOS for Fe_2O_3 and graphene oxide coated sand) mimicking the natural sand coating processes that occur in the environment. The graphene oxide (GO) was synthesized using Sri Lankan vein graphite as a starting material. The surface properties of sand composites were characterized by IR spectroscopy, X-ray diffraction, and surface titration methods conducted to probe their sites' reactivity. According to the surface titration data, the pH_{zpc} was at 6.30 for GOS, Fe_2O_3-S, and Fe_2O_3-GOS surface titration are in progress. Compared to Fe_2O_3-S, GOS and Fe_2O_3-GOS showed enhanced stability in water. The fluoride removal efficiency of sand, Fe_2O_3-S, GOS, and Fe_2O_3-GOS were 4.3, 17.0, 69.0, and 73.0%, respectively, at 2 mg l^{-1} initial fluoride loading. In the presence of bare sand, the water turbidity values increased from 0.85 to 1.04 NTU due to the presence of negatively charged colloids. However, when sand was chemically modified, the turbidity was decreased by 60% in Fe_2O_3-S, 90% in GOS, and 96% in Fe_2O_3-GOS (from 0.85 NTU to 0.34 NTU, 0.08 NTU, and 0.03 NTU). Our data suggested that the Fe_2O_3-GOS is the most stable for excess fluoride and turbidity removal in water. All these experiments were conducted in batch mode, and column mode experiments are in progress for reactor designs.

Financial assistance from the National Research Council (Grant No: TO 16-015) is acknowledged.

Keywords: Coated sand, Fluoride, Graphene oxide, Sand filters, Turbidity

Abstract No: 133 ***Earth and Environmental Sciences***

BIRD DIVERSITY AND CONSERVATION ON FRAGMENTED KALU RIVER ESTUARY

W.N. Madusanka*

Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
**weerappuli20nadun@gmail.com*

Estuaries are unique wetland ecosystems that provide habitats and resources for birds. They are often vulnerable to fragmentation due to anthropogenic activities. One such estuary in Sri Lanka is Kalutara estuary. This study was carried out to measure and compare bird diversity in two different habitat types, including brackish water and coastal habitat. Birds were surveyed using point counts along a 1,500 m long line transect for 18 consecutive months starting from July 2020. Surveys were conducted between 0600 h and 1000 h. Bird diversity was measured using Shannon and Simpson's (1-D) diversity indices. A total of 1,441 individuals belonging to 15 orders, 30 families, and 55 species were recorded. Commonly observed species included Common Tern (*Sterna hirundo*), Great Crested Tern (*Thalasseus bergii*), Kentish Plover (*Charadrius alexandrinus*), Little Ringed Plover (*Charadrius dubius*), Whiskered Tern (*Chlidonias hybrida*) and Blue-tailed Bee-eater (*Merops philippinus*) and two endemic species: Sri Lanka Swallow (*Cecropis hyperythra*) and Red-backed Flameback (*Dinopium psarodes*). In addition, migratory birds, including Barn Swallow (*Hirundo rustica*), Rosy Starling (*Pastor roseus*), Gull-billed Tern (*Gelochelidon nilotica*), Little Stint (*Calidris minuta*), Common Sandpiper (*Actitis hypoleucos*) and Whimbrel (*Numenius phaeopus*) were observed. For the brackish area, Shannon and Simpson's values were 3.13 and 0.93, and for the coastal area, they were 2.80 and 0.90, respectively. Bird diversity is greater in brackish water habitats compared to coastal areas. Intense fisheries activities in the coastal belt may impact bird diversity in the area. However, Kalutara estuary deserves more research to identify the disturbance effects of anthropogenic activities on avifaunal diversity in this ecosystem.

Keywords: Birds Diversity, Conservation, Kalu River Estuary

Abstract No: 136 ***Earth and Environmental Sciences***

DINOFLAGELLATE, *PERIDINIUM*: A SUCCESSFUL COLONIZER IN NUTRIENT-POOR MAUSSAKELLE RESERVOIR

M.H.M.A.S.V. Gunawardana[1], K. Sanjaya[2], K.S.S. Atapaththu[2], Y.M.A.L.W. Yapa[3], K. Masakorala[1] and S.M.K. Widana Gamage[1*]

[1]Department of Botany, Faculty of Science, University of Ruhuna, Matara, Sri Lanka
[2]Department of Limnology and Water Technology, Faculty of Fisheries and Marine Sciences & Technology, University of Ruhuna, Matara, Sri Lanka
[3]Department of Chemistry, Faculty of Science, University of Ruhuna, Matara, Sri Lanka
[*]shirani@bot.ruh.ac.lk

Maussakelle reservoir provides the main water supply to the Laxapana Hydroelectric Power Station, one of the main hydropower stations in Sri Lanka. The villagers nearby depend on this reservoir for drinking water and fishing. The presence of algal blooms in reservoirs may cause health problems as well as they can interfere with operational procedures in hydroelectric power stations by clogging filters and turbines. Hence, this study aimed to identify bloom-forming algae and potential environmental factors that induce excessive growth of algae in Maussakelle reservoir. Water samples were taken from 20 different locations in the reservoir. *In-situ* physicochemical properties of water were measured using a multi-parameter water quality meter and a dual-channel chlorophyll and phycocyanin sensor. The results revealed that the phytoplankton community in the reservoir was dominated by a single species of dinoflagellate, *Peridinium*, with an average cell density of 67.57 cells ml^{-1}. The P and N contents indicated poor nutrient status in the reservoir. Phosphate-P in all sampling sites were < 0.0001 mg $dm^{-3,}$ and nitrate-N ranged between 0.09 – 0.16 mg dm^{-3}. The successful growth of *Peridinium* indicates their resilience under low nutrient levels and reduced competition from other phytoplankton. *Peridinium* cell density is significantly correlated to nitrate-N (r = 0.85) and ammonium-N (r=0.83), suggesting the importance of N for the growth of *Peridinium.* Since *Peridinium* produces high levels of toxins at low P levels, there is a high possibility of accumulating these toxins in the reservoir. Our findings alarm the potential health risks to those communities that rely on the reservoir for drinking water. In parallel to the high *Peridinium* density, an elevated carotenoid concentration was also detected, signifying a strong correlation (r^2=0.969). Further, the spatial distribution pattern of *Peridinium* and carotenoid pigments in the reservoir highlights the application of carotenoid spectral reflectance as a biomarker in remote sensing of *Peridinium* and related dinoflagellate blooms in freshwaters.

Financial assistance from the Accelerating Higher Education Expansion and Development (AHEAD) Operation of the Ministry of Higher Education funded by the World Bank is acknowledged.

Keywords: Carotenoid, Dinoflagellates, Maussakelle, Remote sensing, Water quality

Abstract No: 138 ***Earth and Environmental Sciences***

STRATEGIES FOR ENHANCING PERSONAL COMMITMENT TOWARDS BIODIVERSITY CONSERVATION AMONG URBAN DWELLERS IN THE GAMPAHA DISTRICT

J.K.W.N. Subashini[1*], K. Yakandawala[1] and E.S. Minor[2]

[1]Department of Horticulture & Landscape Gardening, Wayamba University of Sri Lanka, Sri Lanka
[2]Department of Biological Sciences, University of Illinois, Chicago, USA
[*]subashini@wyb.ac.lk

Urban nature is considerably less valued. Nevertheless, as cities grow larger and denser along with environmental degradation, the importance of urban biodiversity conservation has been increasingly recognized. Hence, perceiving conservation as a social and people-centred approach would be highly successful in meeting both ecological and developmental needs. For this, the urban residents play a key role since their choice of practices will directly affect the conservation of biodiversity in urban landscapes. Further, the success of any related action heavily depends on the attitudes and socio-economic behaviours of urban dwellers. Therefore, this study attempted to identify the motivational drivers of urban residents on biodiversity enhancement in residential neighbourhoods in the Gampaha District. Hundred and fifty households were selected randomly. A pre-tested, self-administered questionnaire was used to acquire the socio-economic details and the perceptions of residents on different methods that could be adopted for biodiversity enhancement in urban settings. The respondents were predominantly females (72%), with a mean age of 51-65 years. The highest education level was G.C.E. A/L (53%), followed by degree/diploma level qualification (35%). Retired household heads accounted for a higher fraction of the sample (27%), followed by private sector employees (26%). 36% of respondents received a monthly income ranging from LKR 81,000-120,000. Most respondents strongly agreed that government rules/policies could influence gardening towards biodiversity conservation in urban landscapes (Mean Score [MS]=4.89), while 55% of the respondents strongly opposed imposing a taxation process to enhance conservation practices. The implementation of a rewarding system was ranked as the second-best motivational mode (MS= 3.95) in place of gardening for biodiversity enhancement, followed by the provision of incentives (MS=3.85). According to behavioural economics, 85% of the study population was willing to pay a fee for enhancing the biodiversity in their residential neighbourhood, whereas around 37% agreed to a monthly payment of LRK 500, based on the stated preference approach. The impression that the conservation of biodiversity is the sole responsibility of the government and therefore should be funded through municipal revenues was the main reason for rejecting the contingent scenario by the respondents. The age, education level, employment and income were significantly associated ($p<0.05$) with the perception of the motivators for biodiversity enhancement. The results of the present study delivered the antecedents of the motivational factors of urban residents towards biodiversity conservation. This behavioural information of public valuation on biodiversity enhancement could help society to make sensible and socially-inclusive choices in implementing urban biodiversity conservation strategies.

Acknowledgements: Authors would like to thank the support from the Wayamba University Research Grant-SRHDC/RP/04/19-02 and AHEAD grant- AHEAD/PhD/R3/Agri/448 for the financial assistance.

Keywords: Biodiversity enhancement, Urban landscapes, Urban dwellers, Willingness-to-Pay

Abstract No: 148 ***Earth and Environmental Sciences***

ISOLATION AND CHARACTERIZATION OF THERMO-STABLE CELLULASE ENZYME PRODUCING BACTERIA FROM WAHAVA HOT SPRING, SRI LANKA

H.D.D. Sadeepa[1,2], P.M. Manage[1*] and K.A. Sirisena[3]

[1]Centre for Water Quality and Algae Research, Department of Zoology, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
[2]Faculty of Graduated Studies, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
[3]Department of Environmental Technology, Faculty of Technology, University of Colombo, Colombo, Sri Lanka
[*]pathmalal@sjp.ac.lk

Microbial enzymes are used in multifold applications in industrial processes as they are. Eco-friendly and cost-effective alternatives for chemical catalysts. This study aimed at the isolation and characterization of thermo-stable, cellulase-producing hot spring bacteria. Triplicate samples were collected from two sites of the Wahava hot spring. Temperature, Electrical Conductivity (EC), pH, and Dissolved Oxygen (DO) were measured. The standard pour plate method was performed to isolate bacteria and primarily screened for cellulase production by Congo red assay on Carboxymethyl Cellulose (CMC) agar plates. Secondary screening of cellulase-producing bacteria was performed using the Di-nitro salicylic acid (DNS) assay. The most potential bacterial candidates for enzyme production were selected, and optimum temperatures, pH and effect of cations on enzyme activity were measured using a temperature range of 30-80 ℃, pH range of 4-10 and cation concentration of 1-5 mM. Molecular-level identification of bacterial isolates was performed using the 16S rRNA gene sequencing method. Temperature, EC, pH, and DO of the Wahava artesian tube well and dug well springs varied from 42.0-42.8 ℃, 1,378 - 1,474 µS/cm, 7.91-7.97 and 3.50-1.05 mg/L, respectively. Three morphologically different cellulase-producing bacterial isolates were observed (W2, W3 and W8) at the primary screening. Bacterial isolate W3, identified as *Aeromonas veronii*, showed the highest cellulase enzyme activity of 3.63 U/ml at an optimum temperature of 60 ℃ and optimum pH 7 for cellulase enzyme. The enzyme activity of W3 was accelerated by Ca^{2+} ions. The highest enzyme activity of 18.36 U/ml was recorded at 5 mM concentration of Ca^{2+}. Hence, the bacterial isolate W3 isolated from Wahava hot spring would be successfully used for industrial settings operating at temperatures around 60 ℃ and neutral pH conditions. Calcium (Ca^{2+}) solutions can be used as cofactors to enhance the cellulase enzyme activity. Thus, the bacterium *A. veronii* is a promising candidate for industrial applications.

Financial assistance from the University of Sri Jayewardenepura (Grant No ASP/01/RE/SCI/ 2017/52) is acknowledged.

Keywords: Hot Springs, Enzymes, Cellulase, Biotechnology, Thermophiles

Abstract No: 149 ***Earth and Environmental Sciences***

CYTOTOXICITY OF FLUORIDE AND HARDNESS ON VERO, MONKEY KIDNEY CELL LINE: SULFORHODAMINE-B ASSAY

K.T. Dilrukshi[1,2], H.A.S.N. Abeysiri[1,2], D.H. Beneragama[3], J.K.P. Wanigasuriya[4] and P.M. Manage[1,2*]

[1]Centre for Water Quality and Algae Research, Department of Zoology, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
[2]Faculty of Graduate Studies, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
[3]Department of Pathology, Faculty of Medicine, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
[4]Centre for Kidney Research, Department of Medicine, Faculty of Medical Sciences, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
[*]pathmalal@sjp.ac.lk

Recent studies have suggested that the synergistic effect of fluoride and the hardness of drinking water could cause Chronic Kidney Disease of Unknown aetiology (CKDu) in Sri Lanka. Hence, the present study focused on determining the cytotoxicity of fluoride and hardness of drinking water through sulforhodamine-B (SRB) assay using a Vero, a monkey kidney epithelial cell line (ATCC® CCL-81™). Cells were seeded in 96-well plates as $5x10^3$ cells/well to determine cell viability. Cells in different wells were exposed to different concentrations of fluoride (0.5, 2.5, 5.0, 7.5, 10.0, 12.5, 15.0 mg l^{-1}), hardness (60, 100, 200, 400, 600, 800, 1000 mg $^{-1}$) and fluoride: hardness ratios (0.5:60, 2.5:100, 5.0:200, 7.5:400, 10.0:600, 12.5:800, 15.0:1000 mg l^{-1}). Non-viable cell percentages and CC_{50} values were determined. Non-viable cell percentage of the cells exposed to the fluoride concentration series ranged from 32.6 to 55.8%, while the cells exposed to hardness concentrations ranged from 17.6 to 54.6%, indicating an increment with the high concentrations. The non-viable cell percentage was increased from 36.6 to 63.8% in the cells exposed to fluoride and hardness ratios. CC_{50} values of fluoride, hardness alone and fluoride: hardness ratios were recorded as 10.67, 804.04 and 5.74:318.72 mg l^{-1}, respectively. Significantly lower non-viable cell percentages were recorded in cells exposed to fluoride alone than cells exposed to fluoride: hardness ratio ($p<0.05$); as well, a significantly lower value was observed in cells exposed to hardness alone than cells exposed to fluoride: hardness ratio ($p<0.05$). Lower CC_{50} values were observed for the fluoride: hardness ratio compared to the CC_{50} values obtained for fluoride and hardness alone. Thus, the synergistic effect of fluoride and the hardness of water causes a more significant reduction in cell viability of Vero cells than the effects of fluoride and hardness alone. Hence, the synergistic effect of fluoride and the hardness of drinking water causes cell damage, and it may contribute to the development of CKDu.

Financial assistance from the University of Sri Jayewardenepura (Grant No. ASP/01/RE/SCI/2018/39) is acknowledged.

Keywords: Fluoride, Hardness, Non-viability, SRB assay, Vero cells

Abstract No: 154 ***Earth and Environmental Sciences***

CYTOTOXICITY OF CYLINDROSPERMOPSIN, MICROCYSTIN-LR, MICROCYSTIN-RR AND NODULARIN ON RENAL CELLS

H.A.S.N. Abeysiri[1,2], K.T. Dilrukshi[1,2], I.C. Perera[3] and M.M. Pathmalal[1,2*]

[1]Centre for Water Quality and Algae Research, Department of Zoology, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
[2]Faculty of Graduate Studies, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
[3]Department of Zoology and Environment Sciences, University of Colombo, Colombo, Sri Lanka
[*]pathmalal@sjp.ac.lk

Cyanotoxins are secondary metabolites produced by different types of cyanobacteria. Among them, Cylindrospermopsin (CYN), Microcystins (MCs) and Nodularin (NOD) stand out due to their wide geographical distribution. The toxicity of cyanotoxins in various organs, including the kidney, has been documented using animal models. However, studies on renal toxicity of CYN, MCs and NOD are limited. Thus, the present study evaluated the cytotoxicity of CYN, MC-LR, MC-RR and NOD on the Vero renal cell line. Cell viability was measured using sulphorhodamine B (SRB) assay following exposure of cells to pure CYN, MC-LR, MC-RR and NOD at different concentrations (0.5, 1.0, 5.0, 10.0, 50.0, 100.0, and 200.0 µM) for 24 h and calculating the half maximal Inhibitory Concentration ($IC_{50)}$ values. The highest cell mortality was recorded for different concentrations (0.5, 1, 5, 10, 50, 100, and 200 µM) of CYN. Cells exposed to 200 µM concentration of CYN, MC-LR, MC-RR, and NOD showed 94.31±0.01, 92.92±0.01, 84.71±0.01, and 78.74±0.01% mortality percentages, respectively. Significant results were obtained for the dose-dependent cytotoxicity of the Vero renal cells exposure to CYN, MC-LR, MC-RR, and NOD at $p<0.05$. The results revealed that CYN had the lowest IC_{50} value (23.30) while NOD had the highest (72.35). Therefore, the finding of the study showed that cyanotoxins could cause cytotoxicity in renal cells, with CYN having the highest effect and NOD the least.

Financial assistance from the Centre for Water Quality and Algae Research and National Research Council (Grant No:16-078) is acknowledged.

Keywords: Cell mortality, Cyanotoxins, IC_{50}, Vero Renal Cells

Abstract No: 158 ***Earth and Environmental Sciences***

EXPERIMENTAL FEASIBILITY OF BIODIESEL PRODUCTION USING WASTE COOKING OIL FROM A LARGE-SCALE HOTEL AND A RESTAURANT IN SRI LANKA

S.A.K. Navodye, W.G.S. Nisansala, K.G.S. Kavindi and M. Rathnayake*

Department of Chemical and Process Engineering, University of Moratuwa, Katubedda, Sri Lanka
**mratnayake@uom.lk*

Rising concerns about energy security, evident climate change, and depleting petroleum resources have accelerated the exploitation of potential renewable fuels around the globe. Biodiesel is one such renewable liquid fuel that has attracted significant research interest, as it can be easily blended with petro-diesel or directly used in diesel engines without modifications. Edible oils, non-edible oils, waste cooking oil (WCO), animal fats, and algae have been tested as commercial feedstocks for biodiesel production worldwide. WCO generated from the large-scale hotel and restaurant chains within the country can be identified as a potential feedstock to implement decentralized biodiesel production systems requiring minimum transportation for feedstock collection. However, the Free Fatty Acid (FFA) content and dissolved impurities in WCO can adversely affect biodiesel processing by promoting soap formation and other issues in the transesterification reaction as well as in the layer separation stage. In this study, filtered WCO samples from a five-star hotel and a large-scale restaurant were experimentally analyzed for the FFA content using the phenolphthalein indicator. Next, transesterification with 20% ($v_{methanol}/v_{WCO}$) methanol and 1% (w_{NaOH}/w_{WCO}) NaOH, phase separation and purification steps were conducted at the laboratory scale to determine the feasibility of biodiesel production. According to the results, the FFA contents of the WCO samples were below 2%, while samples from the hotel showed a slightly higher FFA content than that of the restaurant oil samples. Hence, the FFA reduction step was bypassed, and biodiesel was prepared *via* direct transesterification. Both WCO samples from the hotel and the restaurant recorded a 91% (v/v) biodiesel yield. Properties of biodiesel samples were obtained as; flashpoint: 175 ºC and 182 ºC (Cleveland open cup tester), density (at 29 ºC): 859.32 kg m^{-3} and 863.04 kg m^{-3}, viscosity (at 40 ºC): 3.36 mm^2 s^{-1} and 3.65 mm^2 s^{-1} for hotel and restaurant samples, respectively. This study demonstrates the feasibility of biodiesel production from WCO and thus can be further extended to economic analysis.

Keywords: Biodiesel, Free Fatty Acid, Renewable Fuel, Transesterification, Waste Cooking Oil

Abstract No: 166 ***Earth and Environmental Sciences***

DETECTION OF LAND USE CONVERSION IN GAMPAHA DISTRICT USING LAND USE CHANGE MATRIX

G.N. Kaushalya[1*] and V.P.I.S. Wijeratne[2]

[1]Postgraduate Institute of Humanities and Social Sciences, University of Peradeniya, Peradeniya, Sri Lanka
[1,2]Department of Geography, University of Colombo, Colombo, Sri Lanka
[*]gnnipuni011@gmail.com

Land use and Land cover (LULC) is considered one of the critical areas influencing the climate, hydrology, ecosystem processes, biological cycles and biodiversity changes. With the decrease in the natural environment, an increase in the built-up areas and agricultural sites can be observed in every part of the world, including Sri Lanka. Urbanization, rapid population and economic growth are the main reasons for this situation. Moreover, this situation has influenced the existing land use patterns. The land use change matrix is one of the main methods to quantify land use conversion in a selected time period. Therefore, this study mainly focused on estimating the LULC changes in the Gampaha District using the Land Use Change Matrix. Furthermore, it studied the spatial and temporal changes in land use in the Gampaha District. The Landsat 8 data downloaded from the USGS GloVis online resource for 2014, 2018 and 2021 were used to identify the land use in the study area. Descriptive Analysis Methods and the Land Use Change Matrix were used to detect the LULC changes. The results showed that the decrement of 11.77% of high vegetation areas (162.62 km^2) in parallel to the increment of 0.10% of high built-up (1.95 km^2), 2.30% built-up (32.37 km^2) and 8.38% home garden (115.78 km^2) and 0.90% paddy areas (13.06 km^2). According to the land use change matrix, it can be identified that the high vegetation areas have been converted to the high built-up (7.25 km^2), home gardens (180.62 km^2) and paddy areas (45.22 km^2) from 2014 to 2021. Approximately 107.19 km^2 of paddy area has been converted to a home garden area during the period. Therefore, this type of study enables land use planners to make more real-time decisions to enhance the quality of their projects in the Gampaha District.

Keywords: Gampaha District, Landsat 8, Land Use Change Matrix, Land use conversion, LULC changes

Abstract No: 169 ***Earth and Environmental Sciences***

MOST SUITABLE GROUT CURTAIN DESIGN FOR PROPOSED *HASALAKA OYA* DAM PROJECT, SRI LANKA

S.M.S.P. Kumara and J. Gunatilake*

Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.
**jagathpgis@gmail.com*

With the rapid increase in population, high-rise dams are constructed to meet the demands of hydropower and irrigation. Most of the dam failures are due to leakages/seepages from the dam foundation and embankments. Hence, the importance of sealing the dam foundation cannot be underestimated and attended to based on the geological condition of the foundation. This study mainly focused on designing a suitable grout curtain for the *Hasalaka Oya* dam based on detailed geological investigations. The geomorphology of the considered area shows that the most suitable dam is a Roller Compacted Concrete due to the existing narrow gauge. The study includes geological mapping, a seismic refraction survey, and borehole drilling, along with water pressure tests (Lugeon method). The Stereographic projection and geological map of the dam foundation provided the best-suited grout hole orientation, which is 20º to the left-bank side since the best-suited grout hole should cut all the rock beddings. Seismic refraction survey work clarified the weak geological conditions of the left-bank side. Low Core Recovery and Rock Quality Designation (RQD) values and the high percentage of core losses indicated weaker geological conditions on the left-abutment side up to deep depths. High Lugeon values indicated turbulent water flows on the left-bank side, and they confirmed linked and open discontinuity conditions of the foundation. The final grout hole depth was decided using the Lugeon map drawn from all the Lugeon test results along the dam axis. The final grout curtain was designed with 24 primary and 25 secondary holes. The depth of grouting is determined by extending the Lugeon map until the rock mass has a Lugeon value of less than 5, and a single-line grout curtain was designed with overall geological conditions.

Keywords: Geomorphology, Grout curtain, Lugeon method, Rock beddings, Stereographic projection

Abstract No: 171 ***Earth and Environmental Sciences***

OXIDATIVE STRESS AND ANTIOXIDANT RESPONSES OF BLOOM-FORMING CYANOBACTERIAL GENUS *Pseudanabaena* IN PRESENCE OF CYANOLYTIC BACTERIUM *Pseudomonas fluorescens* BG-E

M.M. Wijesooriya, K. Masakorala* and S.M.K. Widana Gamage

Department of Botany, Faculty of Science, University of Ruhuna, Matara, Sri Lanka
**mas@bot.ruh.ac.lk*

In antagonistic interactions, cyanolytic bacteria may alter the physiology of cyanobacteria leading to cell death. The characterization of physiological alterations in cyanobacteria by the action of cyanolytic bacteria is important in the determination of cyanolytic mechanisms. Therefore, this study aimed to determine the oxidative stress and antioxidant responses generated in *Pseudanabaena* species against the cyanolytic bacteria *Pseudomonas fluorescens* BG-E (NCBI Acc. No. MZ007859) during the cyanolytic process as biomarkers. Based on the results of the preliminary screening study, 15% (v/v) of the total volume of bacterial suspension (6×10^7 cells ml^{-1}) and cell-free supernatant of bacteria were inoculated into axenic cultures of *Pseudanabaena* sp. and *P. lonchoides* grown in BG11 medium at a cell density of 0.020 (OD730) respectively, in triplicates. The H_2O_2 content, peroxidase (POD) activity, and catalase (CAT) activity were analyzed on the date of incubation and following 2, 5, 8, and 10 days of experimental time. Initially, the H_2O_2 contents increased with time and reached the maximum values of 0.1622 and 0.1448 µM g^{-1} f wt in *Pseudanabaena* sp. and *P. lonchoides*, respectively, at the end of the fifth day and decreased thereafter. The CAT and POD activities of both species showed a similar trend as H_2O_2 contents. On the fifth day, the CAT activities of both species were recorded at a similar value, 0.0029 U g^{-1} f wt. Thereafter, in *P. lonchoides*, the CAT activity started to decrease and was even lower than the control on the tenth day. In *Pseudanabaena* sp., it was equal to the control (0.0011 U g^{-1} f wt). The POD activity was highest in *Pseudanabaena* species (0.0081 U g^{-1} f wt) compared with *P. lonchoides* (0.0069 U g^{-1} f wt) on the fifth day. The elevated levels of H_2O_2 contents and CAT and POD activities infer that the cell suspension and cell-free supernatant of *P. fluorescens* BG-E have induced oxidative stress in *Pseudanabaena* sp. and *P. lonchoides*, respectively, and the antioxidant defence mechanisms in the cyanobacterial cells might have been activated to prevent damages as a response. The significant differences ($p < 0.05$) in the antioxidant levels of the two *Pseudanabaena* species could be due to their structural and morphological differences. The overall results infer the applicability of oxidative stress and antioxidant responses in cyanobateria as physiological biomarkers in the determination of cyanolytic mechanisms.

Financial assistance from the Accelerating Higher Education Expansion and Development (AHEAD) Operation of the Ministry of Higher Education funded by the World Bank (Grant No. DOR 10) is acknowledged.

Keywords: Cyanolytic bacteria, Catalase activity, H_2O_2 content, Peroxidase activity

Abstract No: 177 ***Earth and Environmental Sciences***

MANNAR ISLAND: A CENTRE FOR THE MOVEMENT OF WATERBIRDS WITHIN THE PALK BAY AND GULF OF MANNAR

P.A.B.G. Panagoda[1,2], F. Meng[3], B. Zhang[3,4], S.W. Kotagama[1], T. Mundkur[5], S. Balachandran[6], C. Lei[3,4] and S.S. Seneviratne[1,2*]

[1]Field Ornithology Group of Sri Lanka, Department of Zoology and Environment Sciences, University of Colombo, Colombo, Sri Lanka
[2]Avian Sciences and Conservation, Department of Zoology and Environment Sciences, University of Colombo, Colombo, Sri Lanka
[3]State Key Laboratory of Urban and Regional Ecology, Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, China
[4]University of Chinese Academy of Sciences, Beijing, China
[5]Good Earth Environmental, De Pas 148, Arnhem, 6836HN, The Netherlands
[6]Bombay Natural History Society, Hornbill House, Shahid Bhagat Singh Rd, Lion Gate, Fort, Mumbai, Maharashtra, India
[*]sam@sci.cmb.ac.lk

The Mannar Island of northwestern Sri Lanka is a critical site of the Central Asian Flyway. Despite this recognition, our understanding of its usage by migrant waterbirds is limited. We initiated a waterbird tracking program in Mannar in 2020, using GPS tagging to fill that gap. By July 2022, 21 waterbirds of 11 species were tagged and monitored their movement within the Palk Bay and Gulf of Mannar, during the non-breeding season, along northward/southward migrations and as summer loiterers. The movement of birds within Mannar Island and the adjacent mainland was observed linking the key wetlands, including Rama's Bridge and Urumalei mudflat, Korakulam tank, Erukkalampiddy lagoon, Vankalei Sanctuary and Vidataltivu Nature Reserve. The birds moved along Mannar's both coasts and across Mannar Island. Further, four main movement corridors across the region were observed: (A) along the northwest coast from Mannar *via* Iranativu, Jaffna across Palk Strait to Point Calimere and above, (B) along Rama's Bridge *via* Dhanushkodi to Point Calimere and above, (C) direct northward route across Palk Bay and (D) Mannar to Dutch Bay across Gulf of Mannar. The crab plover, *Dromas ardeola* (130,690 data points from five birds), utilized three routes, A, B and C. Brown-headed gull, *Chroicocephalus brunnicephalus* (1,260 data points, two birds), using A and C routes. In contrast, lesser crested tern, *Thalasseus bengalensis* (10,106 data points, two birds), used A and D routes. Eurasian wigeon, *Mareca penelope* (4,017 data points, two birds), and arctic skua, *Stercorarius parasiticus* (152 data points, one bird), took only route A, as Heuglin's gull, *Larus heuglini* (3,880 data points, three birds), solely used route B. Grey plover, *Pluvialis squatarola* (11,147 data points, one bird), took direct route C. Iranativu Island, Pooneryn, Chavakachcheri Lagoon and Kayts of Jaffna, Rama's Bridge and Point Calimere were identified as key stepping stones for waterbird movement across the region. This study highlights the connectivity of wetlands across the Palk Bay-Gulf of Mannar region and the necessity of preserving this network. This study provides the first unbiased records of waterbird movement across the region that would be highly useful in conservation planning and making informed management decisions in the rapid development process in northwest Sri Lanka.

Acknowledgements: Financial assistance - Palmyrah House (Pvt) Ltd. and Vayu Resort, technical assistance – Field Ornithology Group of Sri Lanka, Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences & Wetlands International.

Keywords: Central Asian Flyway, Mannar, Movement patterns, Satellite Tagging, Waterbirds

Abstract No: 194 ***Earth and Environmental Sciences***

CLINICAL AND ENVIRONMENTAL FACTORS AFFECTING GOITRE IN SRI LANKA

S.H.V. Kumari[1*], H.T.K. Abeysundara[1] and G.W.A.R. Fernando[2]

[1]Department of Statistics and Computer Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Physics, Faculty of Natural Sciences, Open University of Sri Lanka, Nugegoda, Sri Lanka
[*]himansik@sci.pdn.ac.lk

Goitre, an enlargement of the thyroid gland, is one of the main health problems in tropical countries. It is generally believed that the development of goitre is directly related to iodine deficiency; however, complex interactions between clinical, environmental and genetic factors also influence the incidence of goitre. This study aims to identify a plausible relationship between clinical and environmental factors affecting the occurrence of goitre in Anuradhapura, Colombo, Kurunegala, Nuwara-Eliya and Ratnapura districts covering all climatic zones of Sri Lanka. A hospital-based preliminary study was conducted from 2012 to 2014 with 994 goitre patients attending to receive treatments in five Base Hospitals in Sri Lanka. A structured questionnaire survey was conducted at each hospital to record clinical examinations and investigation findings of patients. Moreover, 562 water samples for iodine and 147 samples for selenium were collected from the nearest water sources, which they used for drinking and cooking. The mean age of patients in the study was 43 years, and the majority (98%) of the population was females, with 36% having a family history of goitre. The goitre grades 3 and 4 were more prominent among the six goitre grades in the population. There was an increasing trend of a grade of goitre with the increasing age in all three climatic zones. It is noteworthy that patients in the wet zone had higher grades of goitre even at younger ages compared to two other climatic zones. Hierarchical cluster analysis was performed based on environmental factors consisting of iodine and selenium concentrations and clinical factors including thyroxine (T_4), triiodothyronine (T_3) and Thyroid-stimulating hormone (TSH). The study classified patients into seven clusters, with a dominant feature in each cluster. Patients from Nuwara-Eliya formed the most prominent cluster where a significant negative correlation is visible between iodine and selenium with T4 level. These clusters reveal the classification of patients other than district or zone-wise, which breaks the traditional methods to diagnose endemic goitre. These results can be used as baseline data for better planning to avoid and treat goitres.

Keywords: Clinical factors, Environmental factors, Goitre, Hierarchical cluster analysis

Abstract No: 202 ***Earth and Environmental Sciences***

PHYSICOCHEMICAL ANALYSIS OF MANGROVE SOIL: MUTHURAJAWELA - NEGOMBO WETLAND COMPLEX, SRI LANKA

W.S.B. Wickramasingha* and V.P.A. Weerasinghe

Department of Zoology and Environmental Management, University of Kelaniya, Kelaniya, Sri Lanka
**buddhikasa10@gmail.com*

Mangroves are unique and valuable ecosystems. This study examined some selected physicochemical parameters of mangrove soil and the mangrove distribution according to the salinity and pH levels at the Muthurajawela-Negombo wetland complex. Twenty sampling sites were selected based on the judgmental sampling technique by creating a fishnet grid of 30 m × 30 m. Soil samples were taken from 0 - 15, 15 - 30 and 30 - 45 cm depths from the surface. Soil temperature was measured using a soil thermometer, and other physicochemical parameters such as pH, salinity, and soil organic matter (SOM) were analyzed using standard laboratory methods. Further, a vegetation survey was carried out to study the distribution of mangrove plants in relation to the soil pH and salinity. Results showed that temperature varied spatially from 25.2 °C to 30.0 °C, with the highest temperature recorded in the topsoil layer. Soil pH and salinity spatially varied from 5.39 to 8.31 and 0.56% to 8.83%, respectively. Soil pH did not significantly vary with depth ($p > 0.05$), while salinity increased with the increasing depth. Soil organic matter spatially ranged from 2.56 to 15.70% and also increased with depth. Soils with high salinity tend to accumulate SOM. The correlation analysis revealed a lower positive relationship between soil pH and temperature ($r = 0.15$; $p < 0.05$), and a positive relationship between salinity and SOM ($r = 0.316$; $p < 0.05$). Rhizophora apiculata, Rhizophora mucronata and Avicennia marina were associated more in soils with high salinity (3.72 - 7.15%) and neutral to weakly alkaline pH. Bruguiera gymnorrhiza was more prevalent in soils with higher salinity (7.69 - 8.83%) and lower pH, while Lumnitzera racemosa was found in acidic to slightly alkaline pH but with low salinity (1.35 - 1.92%) soils. Sonneratia caseolaris was recorded in soils with the lowest salinity (0.83 - 1.04%). The findings of the study contribute to decision-making on the conservation and restoration of mangrove projects.

Keywords: Mangrove forests, Physicochemical parameters, *Rhizophora* sp., Salinity, Soil pH

Abstract No: 209 ***Earth and Environmental Sciences***

FIRST EVIDENCE OF MICROPLASTIC POLLUTION IN REEF-BUILDING CORALS OF SRI LANKA

K.U.D.N. Hansani[1*], E.P.D.N. Thilakarathne[1], A.P. Abeygunawardana[1], K.P.U.T. Egodauyana[2], B.G.D.O. Perera[1], W.G.I.T. Gunathilaka[1] and W.M.P.U. Weerasingha[1]

[1]Department of Animal Science, Faculty of Animal Science and Export Agriculture,Uva Wellassa University, Badulla, Sri Lanka
[2]Key Laboratory of Tropical Marine Bio-resources and Ecology, South China Sea Institute of Oceanography, Chinese Academy of Sciences, Guangzhou, China
[*]nipunikahansani@gmail.com

With the emerging global concern on marine microplastic, studies reveal that exposure of corals to microplastics poses a threat to the reef ecosystems by coral bleaching, necrosis and yet unstudied consequences. Even though microplastics were detected in different marine matrices across the nation, the abundance and characteristics of microplastics in reef-building corals of Sri Lanka received poor scientific attention. Therefore, the present study is an endeavour to assess the microplastic abundance and characteristics of reef-building corals of Sri Lanka. Coral samples of six different species, *Acropora nasuta*, *Acropora muricata*, *Pocillopora verrucosa*, *Pocillopora damicornis*, *Montipora millepora* and *Goniastrea edwardsi*, collected from the four most prominent coral reefs (Pasikudah, Pigeon Island Marine National Park, Ahangama and Ussangoda) were studied. Microplastics were extracted from coral tissues under laboratory conditions with saturated NaCl and 37% HCl solutions, following quality control measures. Extracted microplastics were characterized based on their shape, size, colour and polymer type. Results showed that microplastics are ubiquitous in each scleractinian coral species. The mean abundance of microplastic in corals was 578.5±77.2 items kg^{-1} (wet weight). The highest abundance of microplastic was encountered in *Pocillopora verrucosa*. Fibres were the most abundant shape, while blue and red were the most prevalent colours. Fourier Transform Infrared Spectroscopy (FTIR) analysis revealed that low-density polyethene (LDPE) (60%), polyamide (20%) and polystyrene (20%) were the main types of microplastic polymers present in corals. Though no significant differences in microplastic concentrations were observed among coral species or study sites, the study provides the first evidence for the aggregation of microplastic in reef-building corals of Sri Lanka.

Financial assistance from the research committee of Uva Wellassa University (Grant No. UWU/RG/2022/05) is acknowledged.

Keywords: Microplastic pollution, *Pocillopora verrucosa*, Reef-building corals, Scleractinian corals

Abstract No: 214 ***Earth and Environmental Sciences***

LAND USE TRANSFORMATION AND ECOSYSTEM SERVICES: A CASE STUDY FROM THALANGAMA ENVIRONMENTAL PROTECTED AREA, SRI LANKA

R.R. Ranasinghe[1], D.D. Wickramasinghe[1*], E. Maltby[2], A. Withana[1] and G. Dharmarathne[3]

[1]Department of Zoology and Environment Sciences, University of Colombo, Colombo, Sri Lanka
[2]School of Environment Sciences, University of Liverpool, United Kingdom
[3]Department of Statistics, University of Colombo, Colombo, Sri Lanka
[*]deepthi@zoology.cmb.ac.lk

Ecosystem Services (ES) provided by wetlands for the community are being acknowledged by researchers and policymakers at present. As in many other natural habitats, urban wetlands are increasingly influenced by anthropogenic pressures. Transformation of natural elements in wetlands, whether they represent landscape or waterscape, to other land uses under human pressure could affect ES provided by them. In this context, the present study attempted to investigate the impact of Land Use and Land Cover (LULC) changes on ES in Thalangama Environmental Protected Area (EPA), which constitutes a major element in the Colombo wetland network. This study used a combination of remote sensing and the Geographical Information System (GIS) to investigate changes in LULC of Thalangama EPA and its surrounding over two decades from 2000-2020. A questionnaire survey was conducted using fifty local residents and six national experts to assess the provisioning and cultural ES of Thalangama EPA, and they were analyzed using Principal Component Analysis in SPSS Statistical software. Anthropogenic activities have transformed natural areas: the paddy fields were reduced by 3.95%, and an expansion of settlements by 3.72% within the wetland. The vegetation in the surrounding areas declined by 8.14%, with an expansion of settlements by 4.99%. Similarly, the provision of ES has changed from the provisioning of fibre, medicine, recreational and religious values in the past to the provisioning of flowers, fisheries, health values: and therefore; currently, the wetland plays a significant role in providing fresh water, flowers, fisheries, fuel, educational value, recreational value, tourism, making social relations and health and mental relaxation. This study sheds light on the link between land use and ES and highlights the importance of obtaining views of the communities in wetland management. Furthermore, the urgent need for the promotion of sound land use practices, community awareness and participatory conservation methods to address this issue is reflected in this study.

Financial assistance from the Department of Zoology and Environment Sciences, University of Colombo, is acknowledged.

Keywords: Changes of Land Use and Land Cover, Ecosystem Services, GIS, Public perception, Thalangama Environmental Protected Area

Abstract No: 215 ***Earth and Environment Sciences***

LAND USE AND LAND COVER CHANGE AND ECOSYSTEM SERVICES OF HORAGOLLA NATIONAL PARK, SRI LANKA

H.D.S.C. Jayarathna[1], D. Wickramasinghe[1], G. Dharmarathne[1] and S. Woroniecki[2*]

[1]Department of Zoology and Environment Science, University of Colombo, Colombo, Sri Lanka
[2]Linkoping University, Sweden
[*]shermilaresearch@gmail.com

Many natural habitats in urban areas are under anthropogenic pressure. Protected areas (PA) are no exceptions in the long run. Changes in Land Use and Land Cover (LULC) often affect Ecosystem Services (ESs) provided by PAs. This study attempted to investigate the impacts of changing LULC from 2000-2020 on ESs in Horagolla National Park (HNP) in the Gampaha District, where human activities are increasingly evident. LULC analysis was performed in and around (4 km buffer zone) Horagolla NP using Remote Sensing (RS) and Geographical Information System (GIS) approach. A questionnaire survey was carried out using 75 households to obtain their perception. A total of 22 prominent ESs (10 provisioning, 10 cultural ESs, and 2 supporting services) are currently provided by the HNP. According to Principal Component Analysis (PCA), the provision of fresh water, fresh air, recreation, and education were the prominent ESs. Vegetation around the HNP has declined by 18.9%, and paddy field area (16.8%) and built-up area (1.7%) have increased by 2020. The most prominent conversions of land use were the conversion of vegetation to built-up areas (5.1%) and paddy fields (18.7%). Over the two decades, the provision of food and firewood has declined while the opportunities for recreation and educational activities have increased. This study reveals ESs provided by PAs could change due to LULC changes and highlights the importance of developing novel approaches to manage PAs and their surrounding lands for future use. This study is significant in policy implications as the understanding of ESs impacts how natural forests are utilized and, thus, management strategies of forest ecosystems.

Financial assistance from the Department of Zoology and Environment Science of the University of Colombo is acknowledged.

Keywords: Ecosystem services, GIS, Land use and land cover change, Protected areas, Public perceptions

Abstract No: 216 ***Earth and Environment Sciences***

MAJOR NUTRIENTS OF PADDY CULTIVATED SOILS AND RICE GRAINS MANAGED UNDER ORGANIC AND INORGANIC FERTILIZERS

K.H.B.H. Delgoda, N.A.S.A. Neththasinghe, E.D.C.T. Chandrasekara and L.D.B. Suriyagoda*

Department of Crop Science, Faculty of Agriculture, University of Peradeniya, Sri Lanka
**lalith.suriyagoda@gmail.com*

Rice is a staple food which serves as the main source of energy, protein and other nutrients. Due to many health and environment-related consequences associated with the use of chemical fertilizers, Sri Lankan government has taken a decision to introduce organic fertilizer in rice farming. However, the soil and grain nutritional status of organically and inorganically managed rice fields in Sri Lanka is not yet explored. Hence, this study was conducted to determine the (i) concentrations and (ii) relationships of nitrogen (N), phosphorus (P) and potassium (K) in paddy soils and rice grains collected from organically (3 years) and inorganically cultivated soils. A total of 44 soil samples and grain samples were collected representing paddy lands in Anuradhapura, Polonnaruwa and Gampaha districts. Total N, available P and exchangeable K concentrations of soil samples were analyzed using Kjeldhal, Olsen and Flame photometric methods, respectively. The total N concentration of grain samples was measured using the Kjeldhal method, and total P and total K were determined through the colourimetric method. Relationships between soil N, P and K concentrations and grain N, P and K concentrations were analyzed separately for organically and inorganically grown paddy samples. Soil and grain N, P and K concentrations between the districts and fertilizer application method were similar ($p>0.05$). Only four significant correlations between the tested elements were observed. Soil K and N concentrations and soil K and P concentrations were significantly correlated in organically managed paddy fields ($r = 0.50$ and $r = 0.41$, respectively), thus maintaining the nutrient stoichiometry. For grains, K and P concentrations in organic ($r = 0.53$) and inorganic ($r =0.56$) paddy fields were correlated. The findings of the present study suggest that the application of organic fertilizers has also supplied sufficient N, P and K for rice grains similar to that of inorganic fertilizers.

Financial assistance from the World Bank, under the Accelerating Higher Education Expansion and Development (AHEAD) (Grant No. AHEAD/RA3/DOR/AGRI/PERA-No16)

Keywords: Correlation, Inorganic fertilizer, Organic fertilizer, Paddy

Abstract No: 217 ***Earth and Environment Sciences***

ACUTE TOXICITY EVALUATION OF CHEMICALLY SYNTHESIZED AND *TRICHODERMA LONGIBRACHIATUM* MEDIATED SILVER NANOPARTICLES IN AQUATIC CRUSTACEAN *DAPHNIA MAGNA*

W.G.T.N. Gunawardana[1], S.A.D.S. Perera[2], L.D. Amarasinghe[2] and S.R. Wickramarachchi[1*]

[1]Department of Chemistry, University of Kelaniya, Dalugama, Sri Lanka
[2]Department of Zoology and Environmental Management, University of Kelaniya, Dalugama, Sri Lanka
[*]suranga@kln.ac.lk

Silver nanoparticles (AgNPs) are used in many applications in various fields, including biolabeling, sensors, filters, and antibacterial agents due to their specific physico-chemical and biological properties. As a result, AgNPs are released into the environment, and ultimately their transformation products, such as nanoparticulate of Ag_2S, accumulate in wastewater treatment plants; thus, their toxicity and impacts on the environment are of growing concern. The purpose of this study is to evaluate the acute toxicity of chemically synthesized AgNPs (C-AgNPs), and green synthesized AgNPs using *T. longibrachiatum* biomass (Tl-AgNPs) in the aquatic crustacean *Daphnia magna*. Synthesized AgNPs were characterized by ultraviolet-visible spectroscopy (UV-VIS), Transmission Electron Microscopy (TEM) and Scanning Electron Microscopy (SEM). The colour change from pale yellow to dark brown of the solution indicated the formation of AgNPs initially. The surface Plasmon Resonance (SPR) band in the range of 415 - 400 nm in the UV-VIS confirmed the formation of Tl-AgNPs and C-AgNPs. TEM and SEM images confirmed that Tl-AgNPs and C-AgNPs were spherical. Aged less than 24 h (neonates) of *D. magna* were subjected to acute toxicity assay in a range of concentrations of Tl-AgNPs and C-AgNPs (2.00 -10.00 mg l^{-1}). The percentage immobility of the daphnids was dose-dependent. The EC_{50} value of C-AgNPs was 4.01 ± 0.07 mg $l^{-1,}$ whereas Tl-AgNPs was 5.33 ± 0.05 mg l^{-1} for *D. magna* at 48 h exposure. Hence, Tl-AgNPs exerted lesser toxic effects on *D. magna*. The presence of biomolecules as capping agents on AgNPs may reduce their toxicity towards *D. magna*.

Keywords: Acute toxicity, *Daphnia magna*, Green synthesis, Silver nanoparticles, *Trichoderma longibrachiatum*

Abstract No: 223 ***Earth and Environmental Sciences***

DIVERSITY AND DISTRIBUTION OF MANGROVES IN REKAWA LAGOON, SRI LANKA: GIS AND REMOTE SENSING APPROACH

A.G.J. Chathurika[1*], A.M.T.A. Gunaratne[2] and J. Gunatilake[3]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Botany, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[3]Department of Geology, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]jayanigunawardhana@gmail.com

Mangrove distribution in the Rekawa lagoon in the Hambantota District is decreasing mainly due to anthropogenic stresses. The challenges of conserving mangrove ecosystems can be overcome by the use of GIS and Remote Sensing methods. The objectives of this study were to determine the vertical distribution, horizontal distribution, species diversity and species distribution of mangroves in the Rekawa lagoon. Six quadrats (10 m × 10 m) were established in the identified three zones (two per zone): lagoonward zone (LAG), mid-zone (MID) and landward zone (LAN). The Shannon-Weiner Diversity Index, Simpson Diversity Index, Equitability of the Shannon Index and Equitability of the Simpson Index were calculated. Normalized Difference Vegetation Index, Normalized Vegetation Water Index and Combined Mangrove Recognition Index and mangrove distribution map were generated using Sentinel-2 satellite data and ArcMap (version 10.3). A total of 479 individuals of mangroves were recorded and represented by 8 species, 7 genera belonging to 5 families. As true mangrove species *Aegiceras corniculatum, Avicennia marina, Avicennia officinalis, Bruguiera gymnorrhiza, Ceriops tagal, Excoecaria agallocha, Lumnitzera racemosa* and *Rhizophora mucronata* were recorded. The highest density of species was recorded from zone LAG. The highest value for the Shannon-Weiner Diversity Index, the Equitability of the Shannon index, the Simpson's Diversity Index and the Equitability of Simpson were recorded by LAN (1.18, 0.9, 2.95 and 0.75, respectively). The vertical distribution maps revealed LAG and LAN were dominated by *R. mucronata and E. agallocha,* respectively. The overall accuracy and Kappa coefficients were 98.4% and 82.4%, respectively. Demarcation of species assemblages and distribution mapping of the mangrove ecosystem demonstrated the restricted distribution of mangroves due to encroachments. GIS and Remote Sensing, coupled with ecological studies, are promising tools to conserve and restore mangroves.

Keywords: GIS and Remote Sensing, Mangrove, Normalized Difference Vegetation Index, Rakawa lagoon, Sentinel-2

Abstract No: 227 ***Earth and Environmental Sciences***

SYNTHESIS OF HIGHLY OXIDIZED AND EXFOLIATED GRAPHENE OXIDE USING BORIC ACID AS A PROTECTIVE AGENT

W. D.R. Pramodika[1, 2*], N.W.B. Balasooriya[1, 2] and G.A.R. Kumara[3]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Geology, University of Peradeniya, Peradeniya, Sri Lanka
[3]National Institute of Fundamental Studies, Kandy, Sri Lanka
[*]ruvipramodika@gmail.lk

Sri Lankan natural vein graphite has a higher potential for industrial-scale uses due to its outstanding purity and high crystallinity. Over the last two decades, graphene oxide (GO) has attracted a lot of interest in the scientific and industrial world. However, more attention is needed to introduce and develop new rapid methods of graphene oxide synthesis. The modified Tour method was used to synthesize graphene oxide from Sri Lankan natural vein graphite. Natural vein graphite powder (<90 µm), which contains the highest carbon percentage (99%), was added to the mixture of H_2SO_4 and H_3BO_3 (acid ratio of 1:10). Then, $KMnO_4$ was slowly added to the beaker. The reaction mixture was maintained at 40 ^{0}C. Then the mixture was poured into the ice bath, and deionized water was added. The solution was heated to 70 ^{0}C and kept at this temperature for 30 min with stirring. The process was completed by reacting with H_2O_2 (50%). Structural evaluation of the synthesized GO was carried out using Raman analysis and X-ray diffractometry (XRD). Scanning Electron Microscopy (SEM) images were used for morphological analysis, and the chemical composition of the synthesized GO was determined using Fourier Transform Infrared (FTIR) spectroscopy. The oxidation of graphite is confirmed by developing the strong D, G, and 2D bands in Raman spectroscopy. Using the XRD data, the calculated values of d-spacing, crystalline size (D) and number of layers (n_l) for synthesized GO powder were 9.71 Å, 1.41 nm and 2.45, respectively. This modified, rapid Tour method can be introduced as a simple, environmentally-friendly and time-efficient method to prepare graphene oxide with a minimum number of layers.

Financial assistance from PGIS grant research (Grant No: PGIS/2020/18) is acknowledged.

Keywords: Graphene Oxide, Modified Tour's method, Protective agent, Sri Lanka Vein Graphite

Abstract No: 231 ***Earth and Environmental Sciences***

GIS-BASED SOIL EROSION VULNERABILITY MAPPING IN WELIMADA DIVISIONAL SECRETARIAT IN SRI LANKA

R.M.S.G.N. Medawela, N.M. Rathnayaka, M.S.M. Perera, N. Nagaruby and V.P.A. Weerasinghe*

Department of Zoology and Environmental Management, University of Kelaniya, Kelaniya, Sri Lanka
**primali@kln.ac.lk*

Soil erosion is a major environmental issue in watersheds in Sri Lanka. It is a severe problem in the up and mid-country with steep slopes, high-intensity rainfall, and unplanned land uses to reduce soil nutrients. Soil erosion is a particular concern in the hill country where the watersheds of major rivers are located. Welimada Divisional Secretariat is in Welimada electorate in Badulla District of Uva Province. Mountains are around in this part of the country, and 70% of the population, which counts 100,365 are living in agriculture. The objective of this case study is to develop a soil erosion vulnerability map for Welimada DSD, Sri Lanka. The main causative factor for soil erosion is rainwater runoff. Apart from that, some anthropogenic activities also affect soil erosion. Soil loss was estimated using the Revised Universal Soil Loss Equation (RUSLE) model. Digital Elevation Model, land use map, soil map, and rainfall data were used to create the soil erosion vulnerability map. Collected data were analyzed using GIS. Based on this study, Welimada DSD was classified into three soil erosion hazard classes as low ($0 \leq 25$ t ha^{-1} yr^{-1}), moderate (>25-50 t ha^{-1} yr^{-1}), and high soil erosion (<50-161.10 t ha^{-1} yr^{-1}). The 45.5% area of Welimada DSD falls into the low soil erosion hazard category, while 41.0 and 13.5% area of Welimada DSD fall into moderate and high soil erosion hazard categories, respectively. The annual mean average soil loss in Welimada DSD was estimated as 32.81 t ha^{-1} yr^{-1}. Moderate and highly eroded areas in the Welimada area are prone to high soil erosion. Steep topographic features, poor vegetation cover and poor land management practices, and high rainfall rate may contribute to the high erosion. Those lands require soil conservation measures and regular maintenance to prevent further soil erosion that can lead to agricultural yield reduction.

Keywords: Erosion hazard classes, GIS, RUSLE model, Soil erosion, Welimada DSD

Abstract No: 232 ***Earth and Environmental Sciences***

CYTO-GENOTOXICITY ASSESSMENT OF WASTEWATER FROM AUTOMOBILE SERVICE STATION BY USING THE *Allium cepa* TEST

W.A.S.Madushika, K.K.G.U. Hemamali and K. Masakorala*

Department of Botany, Faculty of Science, University of Ruhuna, Matara, Sri Lanka
**mas@bot.ruh.ac.lk*

Automobile service stations produce wastewater (WW) on a large scale with a combination of toxicants such as different types of hydrocarbons, detergents, etc. Therefore, the characterization of the potential cytotoxicity of WW before being discharged from automobile service stations is important. The study aimed to assess the cyto-genotoxic potential of wastewater generated in automobile service stations by using the Allium cepa test, which is widely used in the cyto-genotoxicity characterization of toxicants. Healthy, surface sterilized A. cepa bulbs grown in distilled water for 48 h under the dark were transferred to a series of treatments with 6.2, 12.5, 25.0, 50.0 and 100% WW and incubated for 48 h. Distilled water was used as the control. After the 48 h incubation period, the number and elongation of roots, mitotic index (MI) and frequencies of different types of aberrations were evaluated as endpoints. The complete randomized block design (CRB) was employed with three replicates per treatment and control. The data recorded from the endpoints were analyzed by one-way ANOVA followed by Tukey's posthoc test. The root number showed the contamination level-dependent significant reduction in treatments compared to the control (23.00±0.57), and the lowest (6.67±0.57) was recorded from the treatment with 25.0% WW. There were no visible roots in the 50.0% and 100%. The calculated mitotic index (MI) showed the contamination level-dependent downward trend, and the lowest value (36.9%) was recorded from the 100% WW compared to the control (82.5%). The higher frequencies of nuclear aberrations (NA), such as nuclear lesions, nuclear buds, binuclear cells and micro nucleus and chromosomal aberrations (CA), such as chromosomal bridges, chromosomal fragments, were recorded from the undiluted WW (100%), and the contamination level-dependent decrease in the cells with aberrations was observed in lower contamination levels. The highest frequency of aberrant cells (61.2%) was recorded from undiluted WW (100%). The calculated IC_{50} values (6.25%) were based on the inhibitions in root number, and the calculated MI inferred the potential cytotoxicity. Different types of NAs and CAs observed in the study inferred the potential genotoxicity even at the low level of contamination of WW, highlighting the significance of treating WW before being released into the environment.

Keywords: *Allium cepa*, Cyto-genotoxic potential, Mitotic index, Wastewater

Abstract No: 233 ***Earth and Environmental Sciences***

APPLICABILITY OF CLEAN AND FERTILITY INDICES AS TOOLS IN DETERMINING COMPOST QUALITY

A.W.R. Gallage and K. Masakorala*

Department of Botany, Faculty of Science, University of Ruhuna, Matara
**mas@bot.ruh.ac.lk*

With the increasing demand, the release of low-quality compost to the market under different brand names has become a significant issue. Since different inputs, such as agricultural waste, and municipal solid waste, are used in composting, there is a potential threat of containing heavy metals in compost. Therefore, it is crucial to have a mechanism to assess the nutrient composition and heavy metal contents to determine the quality of products. The study examined the applicability of the clean index (CI) and fertility index (FI) as tools to ensure the quality of compost in the market. Based on the results of a preliminary survey, eight commonly available compost brands in the market of the Southern Province, Sri Lanka, were collected and analyzed. The FI was calculated on the basis of the chemical properties, total organic carbon (TC), total nitrogen (TN), total phosphorus (TP), total potassium (TK) and carbon to nitrogen ratio (C: N), which were determined according to the standard methods. The CI was calculated by considering heavy metal contents (Zn, Cu, Cd and Pb), which were determined using Atomic Absorption Spectroscopy (AAS). To assure the quality, either a marketable class (A, B, C and D) or a restricted use class (RU-1, RU-2 and RU-3) was determined by considering both FI and CI values. The FI values varied from 2.10 to 4.50 with a mean value of 3.19, while CI values varied from 3.64 to 5.0 with a mean value of 4.55 (on a scale of 5). According to the results, 37.5% of tested brands were categorized under the restricted use class, RU-1, due to low fertilizing potential or low FI values, while 62.5% of brands were categorized under marketable classes due to their acceptable levels of heavy metals and fertilizing potentials. Hence, overall results highlight the significance of using FI and CI as tools in ensuring the quality of compost before being released to the market.

Keywords: Clean index, Compost, Fertility index, Quality

Abstract No: 234 ***Earth and Environmental Sciences***

ROOT MORPHOLOGICAL AND ANATOMICAL RESPONSES IN SELECTED RICE (*ORYZA SATIVA L.)* VARIETIES AGAINST EXCESS IRON (Fe^{2+})

H.M.M.Y. Mudalige and K. Masakorala*

Department of Botany, Faculty of Science, University of Ruhuna, Matara, Sri Lanka
**mas@bot.ruh.ac.lk*

Roots are the primary sensors of toxicity; their responses to excess Fe^{2+} can be used as biomarkers in the selection of Fe^{2+} toxicity tolerance rice varieties. Therefore, this study aimed to analyze root morphological and anatomical responses of selected rice varieties to excess Fe^{2+}. Two selected rice varieties from a preliminary study as tolerant (Ld408) and susceptible (Ld365) to excess Fe^{2+} were examined for morphological and anatomical responses. Seven-day old seedlings of both varieties were exposed to different levels of Fe^{2+} [150 mg l^{-1} (control), 450 mg l^{-1}, 650 mg l^{-1}, 850 mg l^{-1}, 1,050 mg l^{-1} and 1,250 mg l^{-1}] at pH 5.5 for seven days. The experiment was carried out in a modified flood and drain hydroponic system according to the randomized block design (RBD). The number of roots and length of the roots per plant were recorded, and the fully developed air channels in the root cortex were counted in the cross sections of the roots under the high power of the trinocular compound microscope. Data were analyzed by two-way ANOVA followed by Tukey's posthoc test using statistical software MINITAB 17. Ld365 showed a significant ($p<0.050$) reduction in the number of air channels in the tested Fe^{2+} levels higher than 650 mg l^{-1}. In contrast to Ld365, Ld408 showed Fe^{2+} level-dependent significant increase ($p<0.050$) in the number of fully developed air channels in the root cortex. This indicates a high root oxidation power in tolerant plants in order to form an iron plaque as a defence mechanism against excess Fe^{2+} uptake. Both varieties showed a significant ($p<0.050$) increase in root number with Fe^{2+} stress. Comparatively, a higher number of roots was exhibited by Ld408 in all treatments compared to Ld365, suggesting a higher oxidation power of roots in Ld408. However, Ld365 reported a significant ($p<0.050$) reduction in root length compared to Ld408 against Fe^{2+} toxicity indicating a reduction of root growth in Ld365 under excess Fe^{2+}. Overall results inferred that morphological and anatomical responses of rice roots are variety-specific in response to Fe^{2+} stress.

Keywords: Anatomical responses, Fe^{2+} toxicity, Morphological responses, Ld365, Ld408

Abstract No: 236 ***Earth and Environmental Sciences***

TOTAL ARSENIC AND ARSENIC SPECIES IN SELECTED MARINE FOOD FISH BY HPLC-ICP-MS AND ASSESSMENT OF TOXICITY

J.A.K.S. Jayakody[1*], E.M.R.K.B. Edirisinghe[1], S.A. Senevirathne[1] and L. Senarathna[2]

[1]Department of Chemical Sciences, Faculty of Applied Sciences, Rajarata University of Sri Lanka, Mihintale, Sri Lanka
[2]Department of Health Promotion, Faculty of Applied Sciences, Rajarata University of Sri Lanka, Mihintale, Sri Lanka
[*]ksjayakody@gmail.com

The toxicity of Arsenic (As) is mainly dependent on the As species and oxidation status. Thus, the total As concentration does not provide accurate information about the toxicity in the matrix. The objective of the present study was to assess the actual toxicity of As species in selected marine food fish to ensure safety for human consumption. Ten species (n=3 per each) of fish were collected from the Trincomalee fish market, and total As in fish muscles was determined using Inductively Coupled Plasma Mass Spectrometry (ICP-MS) after microwave digestion. Arsenic species were selectively separated and determined using High-Performance Liquid Chromatography (HPLC) hyphenated to ICP-MS following water bath extraction with 30 mmol dm^{-3} nitric acids. An anion exchange column was used for the separation of the five As species, including arsenobetaine (AsB), arsenite (AsIII), arsenate (AsV), monomethylarsonic acid (MMA), and dimethylarsinic acid (DMA) with 1 mL/min isocratic elution (run time-12 min) of 10 mM Ammonium phosphate (pH - 8.6) as the mobile phase. The employed operating conditions for ICP-MS-HPLC successfully separated and consecutively eluted AsB, AsIII, and AsV in all samples. The level of total Arsenic in the present study varied from a minimum of 0.547±0.038 mg/kg in *Carangoides fulvoguttatus* to a maximum of 13.403±1.075 mg/kg in *Nemapteryx caelata*. In all the species studied, the predominant As the compound was AsB which accounted for 83.2 to 99.4% of the total As ranging from 0.473-13.323 mg/kg. AsIII and AsV were found at low levels, whereas MMA and DMA contents were not detected in any sample. The concentration of inorganic As (sum of AsIII + AsV) ranged from 0.007 (*Carangoides fulvoguttatus*) to 0.040 (*Nemapteryx caelata*) mg/kg. Inorganic As concentrations in all the studied fish species were below the maximum admissible limit 2 mg (inorganic As)/kg, indicating that the species tested are safe for human consumption in terms of inorganic As.

Financial Assistance of AHEAD RIC Project "Encapsulation of Omega -3 fish oil from Sri Lankan Fishes and Development of Omega -3 Fortified Foods" of Faculty of Applied Sciences, Rajarata University of Sri Lanka, Mihintale is acknowledged.

Keywords: Arsenic speciation, HPLC-ICP-MS, Total Arsenic, Toxicity

Abstract No: 250 ***Earth and Environmental Sciences***

CLASSIFICATION SYSTEM FOR URBAN GREEN SPACES: A CASE STUDY FROM COLOMBO CITY, SRI LANKA

U.M. Abeysinghe* and H.U.C.P. Hewawasam

Department of Town and Country Planning, University of Moratuwa, Katubedda, Sri Lanka
**abeysingheum.21@uom.lk*

Urban Green Space (UGS) is a land area that is partly or wholly covered with grass, trees, shrubs, or other vegetation in urban areas. These UGSs provide multiple ecosystem services such as air and water purification, climate regulation, disaster risk reduction, habitat for species and biodiversity enhancement. Further, they present diverse opportunities to mediate the adverse effects of climate-induced disasters while simultaneously improving human health, well-being, and economic and social benefits. Strategic planning and management are vital in obtaining the optimal benefits of UGSs, and the absence of clear demarcation and proper classification of UGSs makes sustainable development goals unachievable. Thus, this study spatially mapped existing UGSs with clear demarcations using Sentinel 2 Level-A satellite images and ArcGIS 10.2. A systematic classification system was also developed for UGSs in Colombo city, Sri Lanka as a model. This would enable planners to devise effective urban management plans to create a climate-resilient city in the future. Based on the past literature, field observations, topographic maps, land-use maps, and high-resolution satellite images, a list of criteria and sub-criteria was used to develop the UGS classification system. The main criteria used for the classification are the structure and functionality of urban UGSs. Normalized Difference Vegetation Index (NDVI; using Band 8 and Band 4) technique was utilized for UGS extraction. Vegetated areas were further classified based on their vegetation density by using NDVI threshold values. The extent of UGS in the Colombo Municipal Council area is 35.4% of the total land extent. The analysis defined four categories of urban green spaces: parks and conservation green spaces (15% of total UGS), shadings and greenways (21%), community green space (13%), and residential and amenity green spaces (51%). This systematic classification of UGSs can be a first step towards categorizing urban green spaces and addressing issues in sustainable city development in the future.

Financial assistance from Senate Research Committee Long-Term (Grant No SRC/ LT/ 2021/ 07) is acknowledged.

Keywords: Climate-resilient city, Green space classification, Natural and semi-natural areas, Sustainable city development, Urban green spaces

Abstract No: 252 ***Earth and Environmental Sciences***

DORMANCY BREAKING METHODS: *IN-SITU* AND *EX-SITU* CONSERVATION OF SRI LANKAN ENDEMIC WILD RICE *ORYZA RHIZOMATIS*

N. Thasajini[1, 2*], S. Orsenigo[1], T.W.M.M. Wijayasinghe[3], K.M.M.G. Jayasuriya[4], M.N.G.M.V. Kumarage[5] and A. Mondoni[1]

[1]Department of Earth and environmental Sciences, University of Pavia, Italy
[2]Department of Biological Sciences, South Eastern University of Sri Lanka, Sammanthurai, Sri Lanka
[3]Departent of Biological Sciences, Rajarata University of Sri Lanka, Mihintale, Sri Lanka
[4]Department of Botany, University of Peradeniya, Peradeniya, Sri Lanka
[5]Department of Geology, Kansas State University, United States
[*]thasathasa91@gmail.com

Sri Lanka consists of five wild rice species. Among them, *Oryza rhizomatis* is endemic and distributed only in the low-country dry zone of Sri Lanka. According to the previous literature, some of the recorded populations of this species are declining due to natural and anthropogenic processes. Thus, this study was conducted to determine the conservation status and the seed biology of *O. rhizomatis*. *Ex-situ* conservation data were gathered from seed banks (43), the national herbarium (2) and literature (46) and were confirmed using field surveys. Seed germination and the effect of dormancy-breaking treatments were studied using freshly collected seeds. A field survey revealed that 13 out of 46 previously recorded populations have disappeared in the wild. Only 28% of the existing populations were inside protected areas, while only 26% of the population was conserved *ex-situ*. Thus, high priority should be given to the *in-situ* and *ex-situ* conservation of *O. rhizomatis*. Seeds were identified as dormant since no germination was observed for intact fresh seeds. Percentage mass increments, after 48 h of imbibition of scarified and non-scarified seeds, were not significantly different, revealing that seeds have no physical dormancy. The embryo had not developed prior to germination; thus, physiological dormancy could be the possible dormancy class. Chemical treatments with HNO_3, KNO_3 and H_2O_2 did not significantly improve seed germination. Only 12% and 9% of seeds germinated after exposure to wet heat at 45 and 50 ˚C, respectively. Only 5% of seeds germinated after dry storage at -20 ˚C. Nevertheless, 80% of seeds germinated when they were physically scarified just above the embryo, revealing their physiological dormancy. However, a more feasible dormancy-breaking treatment must be identified to assist the propagation of this species. Since this is an endemic and high-priority species for *in-situ* and *ex-situ* conservation, further studies must be conducted on seed germination and dormancy-breaking treatments.

Keywords: Conservation, Dormancy, Germination, Seed, Wild rice

Abstract No: 255 ***Earth and Environmental Sciences***

WHOLE-ROCK GEOCHEMICAL SIGNATURES OF DOLERITE DYKES IN SRI LANKA

S.A. Munasinghe[1], P.L. Dharmapriya[1*], S.P.K. Malaviarachchi[1], S.A.T.D. Kumarasiri[2] and S.A. Samaranayake[3]

[1]Department of Geology, University of Peradeniya, Peradeniya, Sri Lanka
[2]Wimpey Laboratories, Muscat, Oman
[3]National Ocean Affairs Committee, Ministry of Foreign Affairs, Sri Lanka
[*]prasanad@sci.pdn.ac.lk

So far, dolerite dykes have solely been reported from the Vijayan Complex (VC) of Sri Lanka. Samples of two localities have been geochemically analyzed for whole-rock major and trace element concentrations. Here, we present the whole-rock major and trace element geochemistry of seven Sri Lankan dolerite samples collected from five localities (two samples each at Wahawa, Rukkamputur, and one sample from Gallodai in the Vijayan Complex; one each in the Highland Complex - close to Badulla, and Wanni Complex - close to Kurunegala) to unravel the tectonic setting, nature of source magma and crustal contamination of dolerite magmatism. In the SiO_2 *vs* $Na_2O + K_2O$ diagram, the composition of dolerite magma varies from basalt to basaltic andesite and was plotted within the region of the sub-alkaline magma series. Major and trace element geochemical discrimination diagrams (AFM, Jensen cation plot, and Nb/Y vs Rb/Y diagram) of different magma series indicate tholeiite affinity and are differentiated through fractional crystallization. The wide ranges in MgO (3.03-7.47wt %), and patterns of other major trace elements (such as Fe_2O_3, TiO_2, and SiO_2) and compatible trace elements (such as Ni and Cr) with MgO indicate the typical trends of fractional crystallization. Chondrite normalized rare earth element (REE) patterns indicate enrichment of LREE relative to MREE and HREE. Chondrite normalized REE patterns and Primitive Mantle (PM) normalized incompatible trace element patterns of dolerites are mainly comparable with those of continental basalts. The pronounced negative Nb, Ti, and positive Pb anomalies in the PM normalized diagram and Nb/La ratios of <1 represent the signals of crustal contamination of parent magma. In tectonic discrimination diagrams (Y vs Cr, Zr/4-2*Nb-Y), dolerites fall in the within-plate basalt (WPB) field and continental basalt region. Hence, the studied dolerites indicate their origin from a differentiated contaminated-tholeiitic magma in an intra-continental tectonic setting.

Financial assistance from the National Research Council, Sri Lanka. (Grant No 19-092) is acknowledged.

Keywords: Continental basalt, Crustal contamination, Dolerites, Sri Lanka, Whole-rock geochemistry

Abstract No: 268 ***Earth and Environmental Sciences***

INEXPENSIVE FILTER TO REMOVE TOXIC HEAVY METALS FROM WASTEWATER USING SRI LANKAN RED EARTH

R.M.I.M. Rathnayake[1,2*], W.L.A.C.I. Weedagama[1,2], N.H. Koralegedara[1], R. Chandrajith[1], B. Athurupana[1], N.W.B. Balasooriya[1] and A. Senaratne[1]

[1]Department of Geology, University of Peradeniya, Peradeniya, Sri Lanka
[2]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]imanthika509@gmail.com

Bioaccumulation of heavy metals and metalloids poses both acute and chronic health issues in humans and animals. Hence, removing these toxic heavy metals from contaminated water is essential. The currently available treatment methods are costly and sometimes not appropriate for the current needs. Considering the high cost associated with advanced water purification technologies, developing low-cost and site-specific methods to remove heavy metals is an urgent need. Natural red earth (RE), mainly composed of iron-aluminium oxide-coated quartz sand, is found in the north-northwestern coastal belt of Sri Lanka. The size fraction <180 µm of RE is well-known for its metal adsorption ability. However, the use of the fine fraction of RE in water filtration may lead to certain practical issues, such as clogging the filter media and contamination of purified water with particles. Hence, this study examined the use of RE as a water filter media to overcome the aforementioned difficulties. Column adsorption experiments were performed using the medium-sized sand fraction (125 - 500 µm) of RE. Cylindrical, plastic columns (width =5.5.cm, length=30 cm) were filled alternatively with 125-250 µm, and 250-500 µm size RE fractions as layers. Synthetic wastewater (arsenic ~ 3 mg/l, chromium ~ 3 mg/l) was passed through the column against gravity at a rate of 15 ml/min for 10 h. Filtered samples were collected at every 15 min intervals and analyzed for As and Cr by inductively coupled plasma mass spectrometry (ICP-MS). Almost complete removal of both As (III/V) (from 3 to 0.0031 mg/l) and Cr (III/VI) (3 to 0.0060 mg/l) was confirmed by ICP-MS data. Hence, the medium-sized sand fraction of RE can be used as an effective filtering medium to remove As and Cr from contaminated water. Experiments are underway to determine the lifespan of the RE column.

Financial assistance from the Accelerating Higher Education Expansion and Development (AHEAD) Operation of the Ministry of Higher Education funded by the World Bank (Grant No. AHEAD/RA3/DOR/PDN/SCI/GEOLOGY/13) is acknowledged.

Keywords: Column experiment, Filter media, Heavy metals, Red earth, Sand fraction

Abstract No: 270 ***Earth and Environmental Sciences***

MICROPLASTICS IN COMMERCIALLY BOTTLED WATER IN SRI LANKA

G.K. Kapukotuwa[1*], B.A.P.C. Premathilake[2], N. Jayasena[3] and R.S. Rajakaruna[2]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Zoology, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[3]Department of Basic Veterinary Sciences, Faculty of Veterinary Medicine and Animal Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]kapukotuwag@gmail.com

Microplastics (MPs) are micro-sized plastic particles (< 5 mm) which have been detected in freshwater systems and in drinking water over the globe. MPs are conveyed through air and rainwater, contaminating natural water sources. This study quantified MPs in commercially bottled water in Sri Lanka. Bottled water was purchased from the market, and the samples were filtered through a 0.45 µm membrane filter to isolate MPs. The membrane filter was examined and enumerated under the Stemi508-ZEIZZ dissecting microscope at 40× magnification. The MPs were classified according to their colour, form, and shape. Confirmation of detected particles as MPs and identification of polymer type was performed using FTIR-spectroscopy. A Generalized Linear Model (GLM) with a negative binomial distribution was used to determine whether the concentration of MPs varied by the brand of bottled water. The major water source of bottled water was tube wells, followed by dug wells and spring water. All the bottles (n = 35) had MPs ranging from 3 - 19 MPs/l. The sizes ranged from 5 - 5,000 µm. Most MPs were present in the form of fibres (81%), followed by films (10%) and fragments (8%). Half of the MPs were transparent. Twelve types of polymers were identified, of which polyvinyl-alcohol, polyacrylamide, polyethene and polyethene-terephthalate were the most abundant. Brands, where the water sources were dug wells, contained a higher abundance of MPs compared to tube wells (GLM; $z = -3.06$, $p = 0.002$) and spring water (GLM; $z = -3.18$, $p = 0.001$). Further, it is likely that bottled water is contaminated with MPs during the manufacturing process. Our study stresses the importance of further investigation of MP contamination of bottled water due to its potential health risks.

Financial assistance from the National Science Foundation of Sri Lanka (Grant No. NSF/SCH/2019/04) is acknowledged.

Keywords: Bottled drinking water, Dug well water, FTIR, Microplastic, Spring water

Abstract No: 271 ***Earth and Environmental Sciences***

BIOREMOVAL OF FIVE LABORATORY DYES IN AQUEOUS SOLUTIONS USING GREEN ALGAE, *CHLOROCOCCUM AQUATICUM*

M.H.K.T. Rupasinghe[1], A.D.S.N.P. Athukorala[2*] and K.B. Jayasundara[3]

[1]Department of Environmental and Industrial sciences, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Botany, University of Peradeniya, Peradeniya, Sri Lanka
[3]Department of Chemistry, University of Ruhuna, Matara, Sri Lanka
[*]sarangiathu@sci.pdn.ac.lk

Dyes are one of the frequent contaminants in science laboratory wastewater which are highly water soluble, potentially toxic and carcinogenic. Their negative impact on aquatic and soil ecosystems urges treating laboratory effluents before discharge. Conventional removal of laboratory dyes from wastewater is a costly process. As an alternative, the current study investigated the potential use of phytoremediation to decolourize and detoxify five laboratory dyes: rose bengal, safranin, congo red, bromothymol blue and methylene blue using microalgal species *Chlorococcum aquaticum*. The percentage decolourization was determined using UV visible spectrometry with 400 nm – 800 nm for 14 days. The experiment was repeated twice. The microalgal species demonstrated a decolourization percentage above 50% for all dyes, except for safranin, with the highest colour reduction of 90% with methylene blue within 14 days. The percentage of live cells of *C. aquaticum* monitored using light microscopy indicated that a tolerance of over 85% was observed for all dyes except safranin after the investigation period. The reduction in toxicity of the dyes by *C. aquaticum* determined using a seed germination assay showed that there was no significant difference among percentage seed germination ($p=0.11 – 0.95$ for 5 dyes) in seeds treated with dye solutions with and without *C. aquaticum* at day 0. However, a significant increase in the percentage of seed germination ($p<0.0001$) was observed in seeds treated with dye solutions incubated with *C. aquaticum* from day 0 to day 14 for all dyes, while no significant change ($p=0.22 – 1.00$ for 5 dyes) was observed between day 0 to day 14 with the dye solutions without the algae added. This study revealed that *C. aquaticum* has the potential to decolourize and detoxify the five laboratory dyes tested, and therefore the method developed can be extended as a dye remover/detoxifier from laboratory wastewater.

Financial assistance from the Department of Botany and Department of Environmental and Industrial Sciences undergraduate research allocations, University of Peradeniya, are acknowledged.

Keywords: *Chlorococcum aquaticum*, Detoxification, Laboratory dyes, Phytoremediation

Abstract No: 285 ***Earth and Environmental Sciences***

EFFECT OF LIQUID HANDWASH ON SOIL BACTERIAL FLORA

D.M.S. Arunodi* and I.V.N. Rathnayake

Department of Microbiology, Faculty of Science, University of Kelaniya, Kelaniya, Sri Lanka
**sanduarunodi@gmail.com*

Frequent use of liquid handwash as a preventive measure against COVID-19 raises concern about its toxic effects on the soil microbiota. This study aimed to investigate the effect of four selected handwash products on soil bacteria over time. Composite soil samples were spiked with selected handwash at two different concentrations (12.5 and 25.0 ml kg^{-1}). It was assumed that nearly 25-50 persons wash their hands on 1 kg of soil, and 0.5 ml was taken as the volume that one person uses per wash when taking from a dispenser. Handwash samples were diluted before soil spiking, and one soil sample (300 g) was used for each concentration. A control soil sample was maintained without spiking, and all samples were incubated at room temperature (27 ℃). Soil bacterial counts of each sample were obtained after the 7^{th}, 14^{th}, 21^{st}, and 28^{th} days using the pour plate method. After a serial dilution, 10^{-6} to 10^{-10} dilutions were plated in triplicate on nutrient agar, incubated at room temperature for 24 h, and bacterial counts were taken. The relative growth of test samples based on Colony-Forming Units per gram of soil (CFU g^{-1}) was calculated. A repeated measures ANOVA was conducted to evaluate the null hypothesis that there is no change in the bacterial count with handwash concentrations in all products over time. There was significant evidence to reject the null hypothesis, and it was revealed that handwash concentrations had a significant effect on bacterial growth ($p<0.05$) in all products. The posthoc pairwise comparison revealed significant differences between each concentration and time ($p<0.05$). A decreasing pattern of bacterial counts was observed when handwash concentration and time increased. This may be due to the collective toxic effect of ingredients present in tested handwash products on soil bacterial flora.

Keywords: COVID – 19, Liquid handwash, Soil, Soil bacteria

Abstract No: 288 ***Earth and Environmental Sciences***

HEAVY METAL AND RADIOACTIVE CONTAMINANTS IN SELECTED COSMETIC AND PERSONAL CARE PRODUCTS IN SRI LANKA

S.G. Gamage and M.G.Y.L. Mahagamage*

Centre for Environmental Science and Sustainable Development, The Open University of Sri Lanka, Nawala, Sri Lanka
**mgyma@ou.ac.lk*

Cosmetic and personal care products (PCPs) are highly utilized products among the general public. Since the demand for more efficient products has emerged over the last few decades, product manufacturers have experimented with different chemicals and production processes. Ultimately, end products contaminated with various toxic metals have created numerous adverse health impacts and environmental consequences. Therefore, this study examined the presence of toxic metals in selected cosmetics and PCPs in the Sri Lankan market. Based on the questionnaire survey, five categories of products: face wash (FW), facial scrubs (FS), baby creams (BC), shaving creams (SC), and skin creams (SK) were identified for the study. From each category, three samples from three highly utilized brands were taken (n=45). Each product (0.200 ± 0.001 g) was digested in 4 ml of Aqua Regia solution and injected into ICP-MS. The analyses revealed that toxic metals: Cr (0.15 – 1.67 mg kg^{-1}), Cd (0.04 -0.19 mg kg^{-1}), As (0.02 – 0.15 mg kg^{-1}), and Pb (0.06 – 2.86 mg kg^{-1}) were present in many products. Further, the highest levels of Cr, Cd, As and Pb were detected in SC1, SK3, SK1/SK3 and SC1 samples, respectively. However, these limits were within the maximum permissible levels specified by the local regulatory body. Alarmingly, Uranium-238, a radioactive element, was detected in four product categories (FS, BP, SC and FW) in a range of 0.01 – 0.04 mg kg^{-1}. Additionally, large amounts of Mn, Fe, Cu, Zn, and Ag were observed in many products. Bioconcentration and biomagnification of such elements in the environment could cause many unforeseen impacts in the future. Hence, regular monitoring of products must be a requirement in the production process, and the regulatory authorities should ensure all cosmetics and PCPs are healthy and environmentally friendly.

Keywords: Cosmetics, ICP-MS, Metals, PCPs, Radioactive elements

Abstract No: 295 ***Earth and Environmental Sciences***

DISTRIBUTION AND ABUNDANCE OF COMMON COOT (*Fulica atra*) AND COMMON MOORHEN (*Gallinula chloropus*) IN THE JAFFNA PENINSULA, SRI LANKA

P. Rajkumar[1*] and C.S. Wijesundara[2]

[1]Wetland Conservation Society, Jaffna, Sri Lanka
[2]Department of Zoology, University of Peradeniya, Peradeniya, Sri Lanka
[*]vpkuma82@gmail.com

The Common Coot (*Fulica atra*) is a less common breeding resident in the lowlands of the Northern part of Sri Lanka, while the Common Moorhen (*Gallinula chloropus*) is a locally rather common breeding resident in the lowlands throughout the country. The significant extents of mangroves, lagoons, and ponds in the Jaffna Peninsula provide ideal habitats for both these species. Their distribution and abundance have not been studied in the area, and this may hinder the conservation activities of these species. Hence, the objective of the present study was to determine the distribution and abundance of these species in the Jaffna Peninsula. Point counts are used in this study, which was undertaken from 2013 to 2018. To observe birds, binoculars (8×40 and 10×42) and a spotting scope (25×50) were used. Peak observation hours were between 0630-0830 h and 1530-1830 h, and counts of these birds were taken monthly. Each of the 12 sites was visited multiple times throughout the study period. The total number of individuals averaged 1,724 for the Common Coot and 116 for the Common Moorhen from the 12 sites during the study period. The main sites frequented by these birds included mangrove areas such as Sarasalai, Anthanathidal, Nagar Kovil, Kudarappu and Mamunai-Chempiyanpattu, and paddy areas associated with ponds such as Nunavil, Maravanpulavu, and major ponds in the Jaffna town. The highest number of common coots (532) was recorded from the Anthanathidal area. These two species have also been recorded in the Island areas of Jaffna. The study showed that both are rare resident birds in the Jaffna Peninsula compared to other waterbird species. However, the Jaffna breeding population of both species does not currently appear to be exposed to any serious threats. The wetland areas of the Jaffna Peninsula are potentially good birding destinations, which provide opportunities for ecotourists to enjoy many rare resident species like these. Hence, more attention should be given to the conservation and ecology of such species.

Keywords: Common Coot, Common Moorhen, Jaffna Peninsula, Waterbirds

Abstract No: 299 ***Earth and Environmental Sciences***

RESPONSES FOR PALEOCENE-EOCENE THERMAL MAXIMUM: EVIDENCED BY CALCAREOUS NANNOFOSSIL ASSEMBLAGES OF THE MANNAR BASIN, OFFSHORE SRI LANKA

W.M.H.M. Wijesinghe[1,2], A.U. Wijenayake[1*], P.L. Dharmapriya[1], B.R. Gyawali[3,4], S.P.K. Malaviarachchi[1] and E.K.C.W. Kularathna[5]

[1]Department of Geology, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[3]Department of Geology, Tri-Chandra Campus, Tribhuvan University, Nepal
[4]Lumbini Engineering, Management & Science Campus, Pokhara University, Nepal
[5]Petroleum Development Authority, Sri Lanka
[*]apsarauwijenayake@gmail.com

The Paleocene-Eocene transition, spanning about ~170 to ~217 kyr, records a significant and extreme global warming event known as Paleocene-Eocene Thermal Maximum (PETM). PETM is marked by temperature elevations across ocean water columns and lateral temperature increments in the tropics to high latitude regions. The effects of these climatic events have been discussed by many researchers as a bloom of many biotic assemblages. In this research segment, we focused on identifying the paleoclimatic changes associated with the Mannar Basin during the period of PETM by using calcareous nannofossil assemblage. The samples were deep-marine carbonate-rich sediments selected within the depth of 2,400 – 2,605 m at 25 m intervals from the Dorado-North Hydrocarbon Exploration well drilled in the Mannar Basin, Sri Lanka. Simple smear slides were prepared and observed under the polarized microscope with an oil-immersion objective lens (magnification 1000x). Based on the calcareous nannofossil stratigraphy, the age determined for the section is Late Paleocene to Early Eocene (P/E), which traverses from biozone NP8 to zone NP10 and the subzones of NP9; NP9a and NP9b were identified. Calcareous nannofossils discovered at the P/E boundary are distinguished by a considerable rise in warm water taxa (e.g., *Sphenulithus, Discoaster, Ericsonia, Fasiculithus*). The pre-PETM and post-PETM periods were characterized by the presence of cold-water taxa (*Coccolithus, Toweius* and *Chiasmolithus*). The study samples showed evidence for an increasing temperature of the ocean surface, with an increase in the relative abundance of dissolution-resistant forms (*D. multiradiatus and F. tympaniformis*) and the decrease in the relative abundance of cold-water taxa (*C. pelagicus and T. pertusus*) during the PETM, while ceasing of the event could be inferred by the increasing of cold-water species (e.g., *Coccolithus, Toweius* and *Chiasmolithus*) upon reaching the Early Eocene.

Financial assistance from the Postgraduate Institute of Science (Grant No: PGIS/2020/03) is acknowledged.

Keywords: Biozones, Calcareous Nannofossil, Global warming, Mannar Basin, PETM

Abstract No: 5 ***ICT, Mathematics, and Statistics***

SKEW-t REPLICATED MEASUREMENT ERROR MODEL FOR METHOD COMPARISON DATA

J. Duwarahan[1*] and L.S. Nawarathna[2]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Statistics & Computer Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]sjeevana90@gmail.com

Method comparison studies are designed to determine whether the two methods of quantifying a continuous variable are compatible enough to be used interchangeably. The linear mixed-effects model is often used to model method comparison data when the methods have the same measurement scale. During the data collection, Measurement Errors (MEs) will occur in observations of covariates and response variables, and these mistakes may be caused by using different measuring scales or methods. If these MEs are not considered, the conclusion will be misleading. This study discusses the framework for modelling method comparison data for quantitative measurements with the MEs, called the 'Measurement Error Model' (MEM). These models generally assume normality for true covariates and errors. However, these assumptions are frequently violated in practice due to the skewness and heavy tails. The key objective of this research is to develop a Skew-t Replicated Measurement Error Model (ST-RMEM) under skew-t distribution for true covariate and t distribution for errors with a matching degree for analyzing the degree of similarity and agreement between the two methods. Further, the Skew-Normal RMEM (SN-RMEM) and Normal RMEM (N-RMEM) models were considered for comparative purposes. The expectation-maximization (EM) approach was used to fit the model. The simulation research was carried out to validate the proposed methodology using sample bias (BIAS), standard deviation (SD), root mean square error (RMSE), and coverage probability (CP) measures. These values under ST-RMEM were better than the N-RMEM and SN-RMEM in all cases. Moreover, this methodology is demonstrated by analyzing subcutaneous fat data. In addition, the Total Deviation Index (TDI) and Concordance Correlation Coefficient (CCC) were utilized to assess method agreement. The CCC estimate for ST-RMEM is 0.990, with a lower bound of 0.984, while the TDI estimate for ST-RMEM is 0.034, with an upper bound of 0.050, suggesting good agreement amongst the methods. These results indicate that our suggested model works well for analyzing replicated method comparison data with measurement errors, skewness, and heavy tails, which are frequent in many fields such as medical research, epidemiological studies, economics, and the environment.

Keywords: Agreement, Concordance correlation, EM algorithm, Replicated measurement error model, Skew-t distribution

Abstract No: 7 ***ICT, Mathematics and Statistics***

OPEN VEHICLE ROUTING PROBLEM WITH MOVING SHIPMENTS AT THE CROSS-DOCKING TERMINAL

S. R. Gnanapragasam[1, 2*] and W.B. Daundasekera[3]

[1]Department of Mathematics, The Open University of Sri Lanka, Nawala, Nugegoda, Sri Lanka
[2]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[3]Department of Mathematics, University of Peradeniya, Peradeniya, Sri Lanka
[*]srgna@ou.ac.lk

Vehicle Routing Problem (VRP) plays a vital role in supply chain (SC) management. The cross-docking (CD) strategy was introduced in the 1930s to reduce up to 70% of warehousing at traditional distribution centres in SCs. The research on integrating VRP with CD (VRPCD) was initiated in 2006. Open VRP (OVRP) is one of the variants of VRP, and it is more suitable for organizations which outsource the fleets of vehicles from third-party logistics (3PL) companies. In this study, one of the internal operations at the CD terminal (CDT), moving shipments (MS) from receiving doors to the shipping doors of CDT, is integrated with VRPCD. Consequently, this study considers open VRPCD with MS at CDT (OVRPCD-MS). As an additional feature in this study, two sets of fleets of vehicles with two different capacities are added for pickup and delivery processes separately. Furthermore, the service cost at each customer and at receiving and shipping doors of CDT is considered when calculating the total cost of transportation. Moreover, the asymmetric distance between any two customers is assigned by incorporating a characteristic of one-way routes between cities in real-life transportation. The objective of this study is to minimize the total transportation cost which incurs travelling costs between customers, service cost at customer points, service cost at the receiving and shipping doors of CDT, cost of moving shipments inside the CDT and finally, the cost of hiring fleets of vehicles from 3PL. To solve the OVRPCD-MS problem, a mixed integer linear programming (MILP) model is developed. The programming models was implemented in LINGO (version 18) optimization software. The branch and Bound algorithm is employed to solve ten small-scale instances generated randomly. The applicability of the proposed MILP model is observed. The required fleets of vehicles to be hired and the run time to reach the optimal solution is determined. The study revealed that the average run time is exponential for small-scale instances. Thus, it can be concluded that this proposed model can be used for the last time in the planning of similar, small-size instances. At the same time, the combinatorial nature of VRP makes OVRPCD-MS as NP-hard problem. Therefore, this study recommends that heuristic or metaheuristic methods are more appropriate for the medium and large-scale instances of OVRPCD-MS to reach near-optimum solutions. This further recommends incorporating additional constraints to the OVRPCD-MS model, such as time windows for each customer, budget allocations for fleets of vehicles and temporary storage capacity at CDT to cover a broader spectrum of a study under investigation.

Keywords: Cross-docking, Moving shipments, Open vehicle routing

Abstract No: 16 ***ICT, Mathematics and Statistics***

BASED ON MODIFIED ANT COLONY ALGORITHM FOR RESEARCHING THE MINIMUM WEIGHT SPANNING TREE

K.P.O. Niluminda* and E.M.U.S.B. Ekanayake

Department of Physical Sciences, Faculty of Applied Sciences, Rajarata University of Sri Lanka, Mihinthale, Sri Lanka
**kponiluminda@gmail.com*

A Minimum Weight Spanning Tree (MWST) is a mathematical technique for connecting a set of points with the least amount of connecting lines. The MWST problem is among the most fundamental and intensely studied problems in network optimization, with a wide range of theoretical and practical applications. A common and well-known problem in combinatorial optimization is the MWST problem. The MWST visits all vertices in the same related portion as the starting node. In this study, several strategies are considered to solve the generalized MWST problem, and a novel approach is used to solve the MWST. MWST can be obtained using the well-known Prim and Kruskal algorithms. These algorithms can be divided into two groups according to the implementation. MWST is divided into two types: line-based MWST and node-based MWST. Prim's algorithm is node-based, whereas Kruskal's is a line-based algorithm. However, in this paper, we present a method for solving the MWST problem using a Modified Ant Colony Optimization (MACO) algorithm. Ant Colony Optimization (ACO) is a probabilistic method and a type of metaheuristic that has gained widespread use for solving combinatorial optimization problems, as well as a technique for determining the shortest path between two points. It is based on how ants behave as they travel from their nest (colony) to a food source in search of food. The algorithm has been improved in this unique way by modifying the ACO algorithm and including the transition rule and pheromone update rule. A comparable result can be obtained by applying Prim's and Kruskal's algorithms.

Keywords: A minimum weight spanning tree, Ant colony optimization algorithm, Kruskal's algorithm, Prim's algorithm, Undirected graph

Abstract No: 28 ***ICT, Mathematics and Statistics***

SYNCHRONIZATION OF MULTI-MANUFACTURER MULTI-BUYER INTEGRATED INVENTORY SUPPLY CHAIN MODEL

M.S.M. Hisam[1*], Z.A.M.S. Juman[2] and W.B. Daundasekera[2]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Mathematics, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]mohamedhisam93@gmail.com

The manufacturer–buyer integrated inventory supply chain system is common practice and evolving into a significant factor in the more highly competitive environment encountered in today's global economy. Coordination between the manufacturer and the buyer offers benefits economically for both parties. Notable attention has been given to single-manufacture, single-buyer and single-manufacture multi-buyer integrated inventory systems with consideration of various realistic factors in the literature. This study was motivated by a real-world problem where six tea manufacturing factories produce a brand of tea and distribute their two buyers. However, to the best of our knowledge, only a few studies investigated multi-manufacturer multi-buyer integrated inventory systems in previous research. Further, we assumed manufacturers transfer the lot just after its production and buyers have limited storage capacity to accommodate the required inventory. So, we first develop a multi-manufacturer multi-buyer integrated inventory model by accounting for realistic factors such as capacity limitation of buyer storage. In our study, manufacturers produce a homogenous product and supply it to all buyers to satisfy their demands. Besides, we consider unequal batch size transferring policy and assume the batch sizes follow geometric series. Then, we derive an optimal solution technique for the model to obtain the minimum total cost. Further, a sensitivity analysis is performed, and real-world tea distribution data is solved to support the analytical findings.

Financial assistance from the Postgraduate Institute of Science (PGIS), University of Peradeniya. (Grant No.: PGIS/2020/24) is acknowledged.

Keywords: Integrated inventory, Multi-manufacturer, Multi-buyer, Unequal batch size

Abstract No: 29 ***ICT, Mathematics and Statistics***

SPATIAL AND TEMPORAL VARIATION OF TREE BIOMASS IN TROPICAL RAINFOREST OF SOUTHWEST SRI LANKA

H.M.S.I. Herath[1*], P. Wijekoon[1] and E.P.S.K. Ediriweera[2]

[1]Department of Statistics and Computer Science, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Science and Technology, Faculty of Applied Sciences, Uva Wellassa University, Badulla, Sri Lanka
[*]hsamitha619@gmail.com

Although tropical rain forests hold large amounts of carbon, there is uncertainty about the quantity and distribution stored in forests. The Above Ground Biomass (AGB) of forests provides estimates of the carbon pools, as 50% of AGB is carbon. Hence, the availability of reliable AGB estimates is important. This study was carried out in the 25-ha Sinharaja Forest Dynamic plot (FDP). This study aims to estimate the AGB in the FDP and analyze the spatial and temporal variation of the AGB of the FDP over 25 years. The stems of the selected species were analyzed at eight different diameter classes. The 20 most dominant species in the FDP were selected for analysis based on the Important Value Index (IVI). The estimated AGB of the selected species were analyzed at eight different diameter classes. The ANOVA repeated ANOVA and Kruskal-Wallis test were used to understand the significance of temporal variation and the variation of AGB across diameter classes. The total AGB in each quadrat was obtained in Mg ha^{-1} and they were analyzed and visualized through spatial maps at a scale of 0.04 ha to understand the spatial variation of AGB. Further, AGB gains and losses over the years were calculated. Even though a change in AGB was observed over the years, the temporal variation of the overall AGB was not significant. However, the AGB change at diameter classes was highly significant. The spatial variability within the plot was high, and the spatial variation at 0.04 ha level over the years was statistically significant ($p < 0.05$). Most of the quadrats (80%) had AGB < 60 Mg ha^{-1}, and around 42% of quadrats contained AGB < 20 Mg ha^{-1}. The overall distribution of AGB in the FDP was positively skewed. Further, the total AGB in the FDP has decreased with time, indicating its role as a carbon source rather than a carbon sink.

Keywords: ANOVA, Kruskal-Wallis test, Repeated ANOVA, Spatial variation, Temporal variation

Abstract No: 30 ***ICT, Mathematics and Statistics***

SOLVING TRAPEZOIDAL FUZZY TRANSPORTATION PROBLEMS USING GEOMETRIC MEAN

S.F. Sara* and E.M.U.S.B. Ekanayaka

Department of Physical Science, Faculty of Applied Sciences, Rajarata University of Sri Lanka, Mihinthale, Sri Lanka
**famila.1997.sara@gmail.com*

Optimization techniques are important in tackling real-world problems such as project timelines, assignment challenges, and network traffic analyses. As a result, this work focuses on the concept of fuzzy theory as it relates to transportation optimization. The application of fuzzy transportation problems has proven to be beneficial in the decision-making process. The proposed method utilizing the geometric mean technique to solve the fuzzy transportation problem has all the fuzzy demand and supply represented by trapezoidal fuzzy numbers. As a result, decision-makers will find this technique very simple to comprehend and apply to real-life transportation problems. In this work, instead of standard methods which are prevailing already, the geometric mean approach indices are used to convert the trapezoidal fuzzy transportation problem into a crisp transportation problem. A numerical case is solved to define the suggested method, and the result is compared with other well-known meta-heuristic methods. This approach is an easy and fast method to find solutions close to the optimal solution or near-optimal solution. Other types of issues, such as assignment issues, network flow issues, and project schedules, can also be resolved using this method.

Keywords: Fuzzy number, Fuzzy set, Fuzzy transportation, Multi-objective transportation

Abstract No: 33 ***ICT, Mathematics and Statistics***

PREDICTION OF TIDAL ELEVATION ALONG EASTERN AND WESTERN COASTAL AREAS IN SRI LANKA

J.A.R.M. Perera, P.A.D.A.N. Appuhamy* and E.M.P. Ekanayake

Department of Mathematical Sciences, Wayamba University of Sri Lanka, Kuliyapitiya, Sri-Lanka
**asankanidarshani@wyb.ac.lk*

Tidal height data provide vital information for the construction of ports, coastal buildings, development of the fisheries industry, and human activities. The conventional harmonic approach needs a significant volume of measurements to produce accurate predictions of tidal elevations. In order to overcome the difficulty in getting large volumes of data for conventional harmonic analysis, this research presents an Artificial Neural Network Technique called back-propagation procedure with a Stochastic Gradient Descent algorithm on limited data to forecast the tidal elevations in eastern and western coastal areas of Sri Lanka. Hourly tidal heights at Colombo and Trincomalee spanning from September 2020 to January 2021 were used for this study. The sine and cosine values of frequencies of significant tidal constituents at a particular hour were used as input neurons. Then the network structures were trained, validated, and tested for eight different periods *viz.,* 7, 10, 15 days, and 1, 2, 3, 4 and 5 months, with zero and one hidden layer up to 10 neurons to find the minimum data required for accurate predictions. Using the Mean Squared Error (MSE) and the coefficient of determination (R^2) to measure the accuracy of predictions, it was found that tides in Colombo are dominated by the mixed semidiurnal type, which is in contrast to the semidiurnal type observed in Trincomalee and in equatorial countries. Moreover, there was a substantial difference in mean tidal elevations at both locations. Out of 69 constituents, five were identified as significant with two months of hourly tidal measurements, which were the same for both locations. This corresponds to about 15% of data generally required for conventional harmonic analysis to identify the significant constituents. The optimal neural network structures for Trincomalee and Colombo areas were attained from fifteen days of data with 8 neurons and two months of data with 5 neurons, respectively, in the hidden layer, each of which yielded the minimum MSE and the highest R^2 value and thus efficiently predicting hourly tidal heights at each location.

Keywords: Artificial neural network, Back propagation, Constituent, Tide

Abstract No: 39 ***ICT, Mathematics and Statistics***

AN EFFICIENT HOMOMORPHIC IMAGE ENCRYPTION ALGORITHM FOR CLOUD STORAGE

N.N.D. Malshika* and G.S. Wijesiri

Department of Mathematics, University of Kelaniya, Kelaniya, Sri Lanka
**dulshanmalshika1199@gmail.com*

Today, an increasing amount of data is transmitted via the Internet. This data includes not only text but also audio, images, and other multimedia. Images are commonly used in our daily lives. However, it is vital to building a secure encryption scheme when delivering images over an unsecured network. Homomorphic cryptographic techniques protect privacy while allowing computation on encrypted data. Moreover, it is a type of encryption that allows users to compute encrypted content without decrypting it. Many public-key encryption techniques, including homomorphic encryption schemes, are theoretically proven but not deemed practical for various reasons, including the huge size of the public key. The study uses the Hermite Normal Form (HNF) encryption technique to provide an efficient homomorphic encryption algorithm for image processing operations on encrypted images saved in the cloud or transmitted over an unprotected connection. The HNF method has proven highly versatile and secure, making it ideal for homomorphic encryption. The scheme was tested using some generated codes in python language. Analyses like histograms and correlation are performed to verify the proposed scheme's efficiency. The experimental results demonstrate that the suggested strategy can accomplish efficiency and security for cloud users.

Keywords: Decrypt, Encrypt, HNF, Homomorphic encryption

Abstract No: 40 ***ICT, Mathematics and Statistics***

STOCHASTIC FLOW MODEL OF GROUNDWATER IN A SMALL SUBSURFACE AREA IN SRI LANKA

W.M.P.P. Jayaratne[1*], P. Wijekoon[1] and R. Weerasooriya[2]

[1]Department of Statistics and Computer Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]National Institute of Fundamental Studies, Kandy, Sri Lanka
[*]pabasarajayaratne97@gmail.com

Porous medium and fractured hard rocks are the two main domains where groundwater can be found. As no randomness is involved, deterministic models can be utilized to represent the water flow in the porous medium. In contrast, quantifying groundwater movement through fractures is difficult due to its irregular distribution. In a heterogeneous environment, we estimate the aquifer parameter hydraulic conductivity, which has a complex spatial variation and high uncertainty. These circumstances are addressed by stochastic models. As the relevant published studies are not available in Sri Lanka, the objective of this study is to apply stochastic modelling to groundwater flow for a 20 km^2 area in Neetiyagama, Anuradhapura. This study specifically aims to quantify the spatial relationships of hydraulic conductivity between sample values using semi-variogram models, simulate the spatial distributions using Simulated Annealing and interpolate the values using Kriging interpolation. The dataset consists of hydraulic conductivities with location coordinates East and North of 41 samples. The semi-variogram is used to quantify the spatial relationship between the sample values. Semi-variance values were plotted with respect to lag distance. A Spherical model was chosen from semi-variogram models, and nugget, sill and range values were initialized based on the behaviour of semi-variance values. Simulated annealing is an application of the Monte Carlo method, which minimizes the squared difference between the desired and actual semi-variogram by generating realizations that are guaranteed to fit the actual semi-variogram. Using Simulated Annealing, the converged objective function, nugget, sill and range values were obtained, and the best fit for the Spherical model was identified. To approximate the values of unknown points in the study area, the known values of the measured data are interpolated using Kriging interpolation, and 253 realizations were yielded. Model validation was carried out by visualizing actual and predicted data, as there are few sample points in the model validation dataset. This can be further carried out with a proper validation dataset. The results of this study can be applied to geologically heterogeneous terrains and will be able to obtain a spatial distribution of hydraulic conductivity over the location coordinates.

Financial assistance from the National Institute of Fundamental Studies (NRC 16-015) is acknowledged.

Keywords: Kriging interpolation, Semi variogram, Simulated annealing, Stochastic model

Abstract No: 52 ***ICT, Mathematics and Statistics***

COMPARISON OF RADIAL BASIS FUNCTION GLOBAL METHOD AND RADIAL BASIS FUNCTION-FINITE DIFFERENCE (LOCAL) METHOD AS AN INTERPOLATION TECHNIQUE

W.H.D.T. Karunarathna[1, 2*], K.M.N. Dissanayake[3] and M.T.M. Dewasurendra[1]

[1]Department of Mathematics, University of Peradeniya, Peradeniya, Sri Lanka
[2]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[3]Department of Mathematical Sciences, Appalachian State University, Boone, North Carolina, USA
[*]dulashinikarunarathna111@gmail.com

The Radial Basis Function (RBF) method is a numerical method that can be used to solve interpolation problems and partial differential equations (PDEs). There are two main types of RBFs: infinitely smooth RBFs and piecewise-smooth RBFs. Gaussian, Multiquadric, Inverse Multiquadric, and Inverse Quadric functions are examples of infinitely smooth RBFs commonly used with the global RBF approach. An important factor of the infinitely smooth RBFs is that they contain a shape parameter. When using the global RBF method, one has to choose a suitable value for the shape parameter as it dramatically impacts convergence. In addition, using the global RBF method is computationally expensive as it produces dense matrices. Therefore, the possibility of using the local RBF approach, known as the RBF-FD approach, is studied, along with shape parameter independent Polyharmonic Spline RBFs, to overcome the aforementioned obstacles. In order to create RBF-FD interpolation stencils, Polyharmoic Spline stencils augmented with polynomials were used. This is a common approach used to solve PDEs, which we adapt to solve interpolation problems. In this work, we interpolated $f(x,y) = xe^{-x^2-y^2}$ with various known nodes and fixed 6400 unknown 2D nodes on [-1, 1] by using Gaussian, Multiquadric and Polyharmonic Spline RBFs. Also, we calculated the error of the approximation for different known numbers of 2D nodes. The accuracy of the solution oscillated with the shape parameter. However, when we used the RBF-FD method, we observed a clear pattern of error decay when increasing the number of nodes. The order of convergence was in the realm of at least $O(h^p)$ to a maximum of $O(h^{p+2})$ where h is the fill distance and p is the degree of the appended polynomial. In addition, unlike the global approach, the RBF-FD method produced sparse matrices, which leads to a computationally efficient and stable algorithm.

Keywords: Interpolation method, Radial Basis Function method, Shape parameter

Abstract No: 56 ***ICT, Mathematics and Statistics***

IMPACT OF ELECTIONS ON PREDICTING STOCK MARKET CLOSING PRICES OF SRI LANKA

R.R.W.G.B.M.K.B. Hulangamuwa* and R.B.N. Dissanayake

[1]Department of Physical Science, Faculty of Applied Sciences, Rajarata University of Sri Lanka, Mihinthale, Sri Lanka
**mkb.hulangamuwa@gmail.com*

Accurate prediction of closing stock market prices during elections is important for investors. This study examined how the national (presidential and parliamentary elections) and provincial council elections influenced the prediction of the stock market closing price performance of the Colombo Stock Exchange (CSE) in Sri Lanka from 2000 to 2021. Multiple Linear Regression (MLR) and Long Short-Term Memory (LSTM) neural networks were used for this purpose. Predictor variables included the stock market's open, high, and low prices and volume of shares, whereas the closing stock price was considered the response variable. A binary variable named "election influence" was also introduced as a predictor variable under seven sensitivity intervals before and after ½, 1, 2, 3, 4, 5 and 6 months from the respective election's date. After being tested for multicollinearity, high price and election influence were considered in all the models' deployments. The accuracy of MLR and LSTM networks was evaluated with and without election influence using mean absolute percentage error (MAPE). Ten national (presidential = 4 and parliamentary = 6) elections and five provincial council elections were considered. MLR and LSTM showed the highest accuracy levels of 97.01% and 87.32% for two months post and prior to the national election compared to MLR and LSTM without election (96.98%, 86.66%). However, the highest accuracy for ½ months before and after the provincial council election was observed in MLR (97.00%) and LSTM (87.09%) compared to MLR (96.98%) and LSTM (86.66%) without election influence. In conclusion, 2 and ½ months before and after the national and provincial council elections, the election influence could be a statistically significant predictor of closing stock prices in Sri Lanka under both MLR and LSTM. This research would emphasize the significance of election aspects in future predictions.

Keywords: Colombo Stock Exchange, Elections, Long Short-Term Memory, Multiple Linear Regression

Abstract No: 75 ***ICT, Mathematics and Statistics***

ENHANCED OIL RECOVERY USING ONE-DIMENSIONAL NANOPARTICLES

C.W. Sahabandu[1, 2, 3] and M. Dewasurendra[1*]

[1]Department of Mathematics, University of Peradeniya, Peradeniya, Sri Lanka
[2]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[3]Department of Mathematics, The Open University of Sri Lanka, Nawala, Sri Lanka
[*]tharidew@gmail.com

Enhanced Oil Recovery (EOR) is based on three stages; primary, secondary, and tertiary oil recovery processes. In the primary oil recovery process, the natural pressure of the reservoir is used, and in the secondary process, water or gas is injected to enhance the oil recovery. The injection of nanofluids into the oil reservoirs is a recent approach to chemical flooding in the tertiary process. Unlike conventional EOR techniques used in the primary and secondary stages, it has the potential to produce an extra portion of oil. Aluminium oxide, magnesium oxide, silicon dioxide, carbon nanotubes, bacterial cellulose nanocrystals, graphene oxide, and clay materials can potentially be used in nano flooding. This study was carried out to compare the performance of selected one-dimensional nano powders (metallic oxides) for EOR, which are aluminium oxide, magnesium oxide, and silicon dioxide, by dissolving 0.4% of each nano powder into the brine (salted water: since it helps to reduce the dynamic interfacial tension) separately. A new mathematical model was built to find the saturation of nanofluids in the fingering phenomenon for the inclined oil layer. The fingering phenomenon occurs during the second and third oil recovery processes when a fluid contained in a porous medium is displaced through some other of lesser viscosity, as opposed to normal displacement of the entire front. Second-order approximate solutions for saturations of nanofluids for inclination angles 0^0 and 10^0 were obtained when the least squared residual error occurs using the Method of Directly Defining the inverse Mapping (MDDiM), which is a novel technique to solve nonlinear differential equations. The results revealed the highest saturation from the brine mixed with aluminium oxide compared to others and also noted that the mixture with magnesium oxide gives the lowest saturation. Since the oil recovery factor is directly proportional to the saturation of the injective fluid, we can conclude that the brine with aluminium oxide benefits the EOR.

Keywords: Aluminum oxide, Enhanced oil recovery, Magnesium oxide, Method of directly defining the inverse mapping, Silicon dioxide

Abstract No: 83 ***ICT, Mathematics and Statistics***

TIME SERIES ANALYSIS OF CRIME DATA OF ANURADHAPURA DISTRICT, SRI LANKA

R.K.R.K. Amarasinghe* and N. Varathan

Department of Mathematics and Statistics, University of Jaffna, Jaffna, Sri Lanka
**rajithkalindaa@gmail.com*

The global incidence of crime has grown dramatically in recent decades. A similar condition prevails in Sri Lanka, and according to the crime statistics of Sri Lanka Police, about 55,000 crimes are reported annually. Among them, a considerable proportion is occupied by property-related crimes. This study focuses on analyzing property-related crimes that occurred in the Anuradhapura District in the North-Central Province of Sri Lanka. The monthly property crime data has been collected from the police records of Anuradhapura Police Station from January 2003 to December 2019. The data has been analyzed using two different statistical techniques: Box-Jenkins' Autoregressive Integrated Moving Average (ARIMA) procedure and the Exponential smoothing techniques (Holt's model and Holt-winters model). Moreover, Akaike Information Criterion, Bayesian Information Criterion, and Mean Square Error were considered to identify the best-fitting model. Results revealed that ARIMA (0, 1, 1) model has higher fitting and forecasting accuracy than Holt's model and Holt-winters model for the monthly property crime data. This study may be useful for the government, especially the police authority and policymakers, to analyze the crime status of the country, anticipate the increased risk, and make predictions accordingly. Further, it can be used to determine the effectiveness of current policies against criminal offences and make appropriate adjustments to create a safer environment for society and, ultimately, a safer country.

Keywords: ARIMA, Crimes, Exponential smoothing, Forecasting

Abstract No: 95 ***ICT, Mathematics and Statistics***

METHOD TO COMPUTE POLYNOMIALS DEFINING DISTINGUISHED VARIETIES ON THE SYMMETRIZED BIDISK

N.B. Thilakarathne* and U.D. Wijesooriya

Department of Mathematics, University of Peradeniya, Peradeniya, Sri Lanka
**s16493@sci.pdn.ac.lk*

Let $\mathbb{D}$ be the unit disk, $\mathbb{T}$ be the unit circle, and $\mathbb{E}$ be the set $\mathbb{C}\backslash\overline{\mathbb{D}}$ in $\mathbb{C}$. For a polynomial $f(z,w) \in \mathbb{C}[z,w]$ such that its zero set $Z(f) \subset \mathbb{D}^2 \cup \mathbb{T}^2 \cup \mathbb{E}^2$, we say $Z(f) \cap \mathbb{D}^2$ is a distinguished variety on $\mathbb{D}^2$ and f is referred to as a polynomial defining a distinguished variety on $\mathbb{D}^2$. Let $\mathbb{G}$ be the image of $\mathbb{D}^2$ under the map $\pi: \mathbb{C}^2 \to \mathbb{C}^2$ provided by $\pi: (z,w) \mapsto (z+w, zw)$. The set $\mathbb{G}$ is called the symmetrized bidisk. Let Γ and $b\Gamma$ be the boundary of G and the distinguished boundary of $\mathbb{G}$, which is the image of $\mathbb{T}$, respectively. For a polynomial $g(s,p) \in \mathbb{C}[z,w]$ such that its zero set $Z(g) \subset \mathbb{G} \cup b\Gamma \cup \mathbb{C}\backslash\Gamma$, we say $Z(g) \cap \mathbb{G}$ is a distinguished variety on $\mathbb{G}$ and g is referred to as a polynomial defining a distinguished variety on $\mathbb{G}$. Every polynomial defining distinguished variety on $\mathbb{D}^2$, gives a polynomial defining a distinguished variety on $\mathbb{G}$ in the following manner: If f is a polynomial defining a distinguished variety on $\mathbb{D}^2$, then the polynomial $g(s,p) \in \mathbb{C}[s,p]$ given by $g(s,p) = f(z,w)f(w,z), s = z+w$ and $p = zw$ define a distinguished variety of $\mathbb{G}$. In this work, we consider the polynomials defining distinguished varieties on the bidisk that are of the form $f(z,w) = z^n - \lambda w^m, \lambda \in \mathbb{T}$, and derive a method to find the corresponding polynomial g, defining the distinguished variety on symmetrized bidisk efficiently. If $f(z,w) = z^n - \lambda w^m, \lambda \in \mathbb{T}$, then the corresponding polynomial g, defining the distinguished varieties on symmetrized bidisk can be given as,

$$g(s,p) = p^n + \lambda^2 p^m - \frac{\lambda}{2^{n+m-1}} \sum_{k=0}^{\frac{n+m-1}{2}} (-1)^k C_{2k}^{n+m} s^{n+m-2k} (\tilde{g})^k \; ; n+m \; is \; odd$$

$$g(s,p) = p^n + \lambda^2 p^m - \frac{\lambda}{2^{n+m-1}} \sum_{k=0}^{\frac{n+m}{2}} (-1)^k C_{2k}^{n+m} s^{n+m-2k} (\tilde{g})^k \; ; n+m \; is \; even$$

where $\tilde{g} = s^2 - 4p$, the polynomial defines distinguished variety on symmetrized bidisk corresponding to the polynomial $z - w$.

Keywords: Algebraic Isopairs, Distinguished varieties, Inner toral polynomials, Symmetrized bidisk

Abstract No: 98 ***ICT, Mathematics and Statistics***

ASSIGNMENT PROBLEM WITH FUZZY LINEAR PROGRAMMING

C.R. Welgama* and W.N.P. Rodrigo

Department of Mathematics, University of Peradeniya, Peradeniya, Sri Lanka
**chamodiwelgama97@gmail.com*

An assignment problem is a particular case of a transportation problem where the objective is to assign several resources to an equal number of activities to minimize the total cost or to maximize the total profit of allocation. Hungarian algorithm is applied to solve the assignment problem with minimization or maximization problems. If there is an assignment problem with at least two or more objective functions, then there are conflicting objective functions to determine the optimal assignment schedule satisfying all the objective functions and constraints represented in the mathematical model. The Multi-Objective Fuzzy Linear Programming Problem in which all the parameters and variables are represented by fuzzy numbers is known as the Fuzzy Linear Programming Problem. A fuzzy number is characterized by a membership function. Various shapes of membership functions that can be applied to real-world planning are linear, nonlinear, triangular and trapezoidal. This study proposes the Multi-Objective Fuzzy Linear Programming Problem to solve an assignment problem with conflicting objective functions. The linear membership function is used to formulate the fuzzy constraints for the assignment problems. A hypothetical example is used to compare the Hungarian algorithm with the Multi-Objective Fuzzy Linear Programming algorithm. In this study, two problems are solved, where one with an objective minimization function and the other with a maximization objective function solved by applying the Hungarian algorithm. The optimal schedule obtained for the minimization problem is used to obtain the optimal solution for the maximization problem and *vice versa*. Then, the same problem is solved using the Multi-Objective Fuzzy Linear Programming algorithm to determine the optimal schedule and optimal solutions for maximization and minimization assignment problems. As a result, a feasible schedule and optimal solutions for maximization and minimization problems are obtained by applying the Multi-Objective Fuzzy Linear Programming algorithm.

Keywords: Assignment problem, Fuzzy Linear Programming, Fuzzy objective, Membership functions

Abstract No: 101 ***ICT, Mathematics and Statistics***

UPPER EMBEDDABILITY IN TERMS OF BOUNDARY WALKS

P.A.D.S.P. Caldera*, S.V.A. Almeida and G.S. Wijesiri

Department of Mathematics, University of Kelaniya, Kelaniya, Sri Lanka
**sandunicaldera97@gmail.com*

Topological graph theory is the branch of graph theory that investigates graphs as topological spaces and the embedding of graphs in surfaces. An embedding of a graph G into a surface is a representation of the graph on the surface such that the edges only intersect at their shared vertices. If each face of the embedded graph is homeomorphic to an open disk, the embedding is called a 2-cell embedding. The maximal genus of a graph G is the largest integer n such that G can be 2-cell embedded into a connected sum of n tori. An embedding of the graph corresponds to a rotation system that we impose on the graph, and to each rotation system, we associate a set of boundary walks. A boundary walk corresponds to a walk around the border of the face of the embedding and is made up of directed edges in the graph. In this research, the relationship between the maximal embedding genus of a graph $G(V, E)$ and the number of boundary walks B needed for this embedding was studied with respect to some rotation system. 2-cell embeddings of hypercube and complete graphs were studied, and the findings have been generalized to any simple connected graph. More specifically, we characterise the upper embeddability of a simple connected graph G in terms of the number of boundary walks corresponding to a specific rotation system of G. That is, a graph G is upper embeddable if and only if there exists a rotation system that generates either a single boundary walks if $|E| - |V|$ is odd or two boundary walks if $|E| - |V|$ is even. As a corollary, we derive the inequality, $1 \leq B \leq |E| - |V| + 2$.

Keywords: Boundary walk, 2-cell embedding, Genus, Graph, Upper embeddability

Abstract No: 106 ***ICT, Mathematics and Statistics***

CENTRAL NODE IDENTIFICATION AND COST-EFFECTIVE ROUTING SYSTEM FOR GARBAGE COLLECTION NETWORK

K.A.T. Dewanthi* and K.K.K.R. Perera

Department of Mathematics, University of Kelaniya, Kelaniya, Sri Lanka
**thisharadewanthi10@gmail.com*

Environmental pollution is one of the most severe global challenges. It increases gradually and causes a grave impact on living organisms, including human beings. Therefore, waste management is a common issue in all developing countries. Colombo is Sri Lanka's most populated city that faces the biggest garbage problem than other cities. This research focuses on the Colombo municipal council area as it is a highly environmentally polluted city in Sri Lanka. The Colombo municipality area divides into six main administrative districts D1, D2A, D2B, D3, D4, D5, and each administrative district is divided into municipal wards. One municipal ward consists of several locations and streets for collecting garbage. Google map and Colombo municipal council website are used to find garbage collection places, and python software is used to construct a garbage collection network as an undirected graph, where each node represents a location. Each edge represents a path between two locations. In this study, centrality measures such as betweenness, closeness, degree, and eigenvector centrality measures are used to find central locations of the network. After calculating centrality measures, central nodes can be identified by choosing the highest closeness centrality values of the garbage collection network (GCN). Then central nodes of the GCN belonging to each municipal ward can be identified. By identifying central places, some machines or recycling trucks can be placed in those central places to deposit the waste. Those central locations help find the cost-effective route that could reduce the cost and collection time of the garbage collection procedure. The weighted graph was constructed by assigning average garbage amounts for the edges. Collected garbage weights, betweenness centrality and degree centrality, are used to identify the shortest garbage routings between central nodes in each municipal ward. Garbage collection trucks can use this shortest path in order to reduce their fuel cost and collection time.

Keywords: Centrality Measures, Garbage Network, Municipal Wards, Shortest Paths

Abstract No: 122 ***ICT, Mathematics and Statistics***

RAINBOW VERTEX CONNECTION NUMBER OF SOME LADDER-TYPE GRAPHS

W.D.D.P. Dewananda* and K.K.K.R. Perera

Department of Mathematics, University of Kelaniya, Kelaniya, Sri Lanka
**dilushapd1@gmail.com*

A vertex-coloured graph G is said to be rainbow vertex-connected if every two vertices of G are connected by a path whose internal vertices have distinct colours. The rainbow vertex-connection number of a connected graph G, denoted by $rvc(G)$, is the smallest number of colours that are needed to make G, a rainbow vertex-connected. When sending messages in a cellular network, each link between two vertices is assigned a separate channel. The rainbow connection numbers are used to find the required minimum number of separate channels. In this work, rainbow connectivity numbers on some ladder-type graphs were considered. Ladder-type graphs can be categorized as simple Ladder graphs, Roach graphs, Circular ladder graphs, Triangular ladder graphs, Diagonal ladder graphs and Circular, triangular ladder graphs. Most research has been done on the rainbow vertex connectivity number of pencil graphs, wheel graphs, star graphs, a cartesian product of two graphs, etc. Only a few types of research were available in the literature about ladder and Mobius ladder graphs. In this study, a simple ladder graph and a Roach graph were considered and derived formulae for the rainbow connectivity number of those graphs. We obtained the rainbow vertex connection number of the ladder graph L_n with order $2n$ as $n - 1$ and $rvc(G)$ of a Roach graph $R\ (2n, 2k)$, when, $n = 1$, $rvc(R(2n, 2k)) = k$, and $rvc(R(2n, 2k)) = 2n$ for $n \geq 2$ and $k = 2, \dots, 2 + (n - 1)$ and $rvc(R(2n, 2k) = k + (n - 1)$ for $k \geq 2 + n,\ n \geq 2$.

Keywords: Graph colouring, Ladder Graphs, Rainbow Vertex-Connection Number, Roach Graphs

Abstract No: 130 ***ICT, Mathematics and Statistics***

DEVELOPMENT AND APPLICATION OF COMPUTER VISION-BASED TOUCHLESS HMI SYSTEM FOR ATM SYSTEMS IN COVID-19 PANDEMIC

M.G.D. Supunsara[1*], O.R.D. Indunil[1], A.M.B. Rathnayake[2], A.C. Vidanapathirana[3] and T. Thevathayarajh[1]

[1]Department of Science and Technology, Faculty of Applied Sciences, Uva Wellassa University, Badulla, Sri Lanka
[2]Department of Computer Science and Informatics, Faculty of Applied Sciences, Uva Wellassa University, Badulla, Sri Lanka
[3]Department of Electrical and Electronic Engineering, Faculty of Engineering, University of Peradeniya, Peradeniya, Sri Lanka
[*]dinojsupunsara96@gmail.com

COVID-19 is a pandemic that is spreading rapidly worldwide. Direct contact with an infected individual is one form of transmission. This spread has a more prominent possibility in public areas such as ATMs (Automatic Teller Machines) that people use by touching. The spread would be much more significant if an infected person used such products. This research aims to analyze and convert a traditional touch-based ATM system into a touchless computer vision-based system. A new HMI (Human Machine Interface) application was developed for the system to be a more gesture-friendly interface to interact. The new system was able to replace the touch base operations of the old system with hand gestures. A separate health-checking unit was also developed with the touchless computer vision-based system. When an individual entered to use these systems, the health conditions of the person were checked by the health check unit. The unit mainly checks each individual's body temperature, saturated O_2 level, and pulse rate. Next, if the users' health data is normal, the individual can proceed to use the HMI ATM application. The data gathered by the health check unit was sent to a cloud server so these data could be stored and used to analyze the health conditions of the people using these systems for a certain period. A mobile application was also developed to gather user data on who uses the device and integrate health check data for each individual. This prototype displayed an ecosystem for integrating the health check unit and the touchless ATM application.

Keywords: ATM application, Cloud Server, Hand gesture control**,** Health check unit, HMI

Abstract No: 134 ***ICT, Mathematics and Statistics***

FORECASTING MONTHLY PRODUCTION IN MIHINTALE NATIONAL WATER SUPPLY SCHEME

R.A.N.S. Madhumali and A. Laheetharan*

Department of Mathematics and Statistics, Faculty of Science, University of Jaffna, Jaffna, Sri Lanka
**kalahee@yahoo.com*

Water resources have been one of the key factors in urbanization and the environment. Water scarcity occurs in many parts of the world, including Sri Lanka. Mihintale region is one of the prime tourist spots in Sri Lanka, and the majority of people in many Grama Niladhari (GN) divisions consume tap water. Therefore, a water production forecast is important in deciding the water supply schedule. The volume of water production depends on various factors, such as water demand, total population size, and atmospheric temperature. The objective of this study is to construct the best-fit forecasting model to predict water production in the Mihintale scheme based on the Autoregressive Integrated Moving Average (ARIMA) model. A Regression model with ARIMA errors (ARIMAX) was used to quantify the impact of the number of tap connections on water production in the Mihintale scheme. Model parameters were estimated by the maximum likelihood method. Forecasting accuracy measures, Root Mean Square Error (RMSE), Mean Absolute Error (MAE) and Mean Absolute Percentage Error (MAPE), were used to identify the best model based on the minimum measure of accuracy. The monthly time series data of water production and the number of tap connections have been collected from Mihintale National Water Supply and Drainage Board (NWSDB) for the period from June 2015 to September 2021. Based on the value of RMSE, MAE and MAPE, ARIMA$(0, 2, 2)$ and ARIMAX model with ARIMA$(1, 0, 0)$ error series was selected as the best-fitted model among the ARIMA and ARIMAX models. The forecasted value showed that future water production in the Mihintale scheme is expected to fluctuate in ARIMA and increase in ARIMAX for the next nine months. Finally, the minimum value of RMSE, MAE and MAPE revealed that the ARIMAX model is much better than the ARIMA model.

Keywords: ARIMA model, ARIMAX model, Accuracy measures, Forecasting, Water production

Abstract No: 135 ***ICT, Mathematics and Statistics***

A STATISTICAL ANALYSIS OF INFLUENTIAL FACTORS ON CRIME IN BADULLA DISTRICT

K.M.S.K. Gunathilake* and N. Satkunanathan

Department of Mathematics and Statistics, University of Jaffna, Jaffna, Sri Lanka
**shakilakalhari4596@gmail.com*

Crime is one of the critical social problems that Sri Lanka has been experiencing in recent years. It seriously affects communal harmony and socioeconomic status. Therefore, studying and identifying factors influencing crime is vital in policy-making and development. This study focuses on identifying factors influencing the crime rate in the Badulla District. For this study, the number of crimes was treated as a count response variable, while occupation, crime type, area and age group were treated as explanatory variables. The required data covering the period from January 2020 to December 2020 were collected from the Crime Unit of Badulla Police Station. Chi-squared test of independence was carried out to determine the significant relationship between crime type with other explanatory variables. Further, a log-linear model was applied as a linear modelling approach to identify the most significant variables, as it is appropriate for modelling counts in the contingency table. Model parameters were estimated by using the maximum likelihood method. The likelihood ratio test was also used to check the model's overall fit. Based on the results of the chi-squared test, it was noted that there is a significant relationship between crime type and occupation ($p=0.0008$), area ($p=0.0223$) and age group ($p=0.0182$). Therefore, based on the dispersion parameter and likelihood ratio test results, log-linear model fits well for the number of crimes. Moreover, the results of a log-linear model revealed that area and age group are significantly related to the number of crimes. While controlling other explanatory variables, it was observed that the expected number of crimes in rural areas was about twice the number in urban areas. Furthermore, the expected number of crimes committed by 25-54 in rural and urban areas was higher than in other age groups while controlling other explanatory variables.

Key words: Chi-Squared test, Contingency table, Likelihood ratio test, Log-Linear model

Abstract No: 142 ***ICT, Mathematics and Statistics***

NEW JACOBI ELLIPTIC SOLUTIONS OF THE FRACTIONAL (3+1)-DIMENSIONAL NONLINEAR SCHRÖDINGER EQUATION

T. Dilakshi*, S. Dishanthy and T. Mathanaranjan

Department of Mathematics and Statistics, University of Jaffna, Jaffna, Sri Lanka
**dilakshithava@gmail.com*

This research analyses the fractional (3+1)-dimensional nonlinear Schrödinger equation with Kerr law nonlinearity. This equation characterizes the propagation of attosecond light pulses over a nonlinear optical fibre. The new extended auxiliary equation method is applied to obtain the new Jacobi elliptic function solutions with the aid of the conformable derivative. The proposed method is an effective and more powerful mathematical tool for constructing exact solutions of nonlinear evolution equations. The obtained solutions have degenerated to bright, dark, singular and periodic solitary wave solutions. In addition, the condition for the modulational instability of continuous wave solutions for the equation is generated.

Keywords: Conformable fractional derivative, Jacobi elliptic function solutions Kerr law nonlinearity, Nonlinear Schrödinger equation, New extended auxiliary equation method

Abstract No: 144 ***ICT, Mathematics and Statistics***

IMPACT OF THALASSEMIA ON POPULATION DYNAMICS

A.M.P Chandrasiri[1,2*] and T.H.K.R. de Silva[3]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Science and Technology, Uva Wellassa University, Badulla, Sri Lanka
[3]Department of Mathematics, University of Peradeniya, Peradeniya, Sri Lanka
[*]milan@uwu.ac.lk

Thalassemia is an inherited blood disorder that causes the human body to have less haemoglobin than normal. Haemoglobin is essential because it lets human red blood cells carry oxygen to all parts of the body. The impact of thalassemia can range from mild to severe anaemia and be life-threatening. Thalassemia affects approximately 4.4 out of every 10,000 live births throughout the world. To develop thalassemia major, both parents must be carriers of the disease. As a result, an individual will have two mutated genes. On the other hand, an individual can become a thalassemia carrier by having only one mutated gene. The objective of this study is to develop a mathematical model using the basics of Lotka's model, which describes the pattern of inheritance of thalassemia disease from parents to offspring and the long-term impact of thalassemia disease by the Markov chain process. The developed model can be used to predict the propagation of thalassemia within a given population. After formulating the model, some fundamental properties of the model are analyzed. Further, it is proved that carrier screening prior to marriage or mating will contribute to the reduction in the population of those suffering from thalassemia disease. The Markov process reflects that the carrier class has greater potential to dominate the population in the long run. It is estimated that the population will stabilize at 25, 50, and 25% for a normal, carrier, and patient genotypic groups, respectively. Therefore, these findings should alert the authorities to take serious preventive measures to address the issue.

Keywords: Blood disorder, Markov process, Mathematical model, Thalassemia

Abstract No: 156 ***ICT, Mathematics and Statistics***

GROUP OBJECTS IN THE CATEGORY OF SIMPLE REFLEXIVE GRAPHS

W.K.M. Indunil[1] and K.M.N.M. Chathuranga[2*]

[1]Department of Physical Science, Faculty of Applied Sciences, Rajarata University of Sri Lanka, Mihintale, Sri Lanka
[2]Department of Mathematics, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]chathuranga.mudalige@sci.pdn.ac.lk

Category theory is the study of mathematical structures and the relationships between them, taking objects and morphisms as fundamental notions, as opposed to the elements and member relationships of the set theory. Despite being introduced only about 80 years ago, category theory has become the main language of contemporary mathematics. As a result of category theory providing a conceptual unification to different abstract mathematical disciplines, one of its branches (categorical algebra) studies finitary universal algebraic structures, such as groups, defined within various categories. If a category has all finite products, one can form these generalized groups, known as group objects internal to the ambient category, on its objects which are potentially more complicated than sets. Topological groups, Lie groups, algebraic groups, simplicial groups, localic groups, cogroups, and commutative Hopf algebras are a few well-known examples of group objects in various categories. In fact, abelian groups (in the category of groups) and finitely generated free groups (in the opposite category of groups) are also two special types of group objects. The goal of this project is to identify the group objects internal to a particular category of graphs, which we call simple reflexive graphs. Compared to other categories of graphs, this category has exceptional categorical properties. Our main result is a theorem that characterizes group objects in this category: H is a group object in simple reflexive graphs if and only if there exists a group structure on $V(H)$ such that $E(H)$ is a subgroup of $V(H) \times V(H)$, where $V(H)$ and $E(H)$ are the set of vertices and the set of edges of H, respectively. In this case, H is a disjoint union of complete reflexive subgraphs, and connected components are isomorphic to each other.

Keywords: Category theory, Group objects, Simple reflexive graphs

Abstract No: 161 ***ICT, Mathematics and Statistics***

RADIO ARITHMETIC MEAN LABELING OF CYCLES

G.H.S.N. Weerasinghe[1*] and A.A.I. Perera[2]

[1]Department of Physical Science, Faculty of Applied Sciences, Rajarata University of Sri Lanka, Mihintale, Sri Lanka
[2]Department of Mathematics, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]nethmini1026@gmail.com

A graph G is a pair of sets $\big(V(G), E(G)\big)$, where $V(G)$ and $E(G)$ are the set of vertices and the set of edges in G, connecting the pair of vertices, respectively. The diameter of a graph is the "longest shortest path" between any two graph vertices u and v, denoted by $max_{u,v}d(u,v)$, where $d(u,v)$ is the graph distance. The field of graph labeling has become one of the most active research areas today. Among all graph labeling methods, radiolabeling is the most practical labeling method. The radio labeling problem was first modelled by Hale in 1980. The concept of radio labeling of graph G was defined by Chartand in 2001. Also, Liu found radio numbers of some graphs in 2004. In 2014, Ponraj introduced the notion of radio mean labeling of G and they found the radio mean number of graphs and subdivided graphs. Telecommunications, biology, and physics are some of the areas in which radio labeling can be applied. A radio labeling f of G is an assignment of positive integers to the vertices of G satisfying, $|f(u) - f(v)| \geq diam(G) + 1 - d(u, v)$, where $u, v \in V(G)$ and $d(u,v)$ is the distance between any two vertices in the graph. The above result is generalized by including the arithmetic mean of labelings f instead of their difference, such that $\lceil \frac{[f(u)+f(v)]}{2} \rceil \geq diam(G) + 1 - d(u,v)$. The radio mean number of f, $rmn(f)$ is the maximum number assigned to any vertex of G. The radio mean number of G, $rmn(G)$ is the minimum value of $rmn(f)$ taken over all radio mean labelings f of$G$. Alternative proof for radio arithmetic means the number of cycles is presented in this research work. First, we consider cycles with an even number of vertices and even diameters. Initially, we assigned 0 to any vertex. Then, in accordance with the above formula, we determine how much labeling remains for each vertex. Next, we consider cycles with an even number of vertices and odd diameter, cycles with an odd number of vertices and even diameter, and cycles with an odd number of vertices and odd diameter. The idea of labeling introduced here is simpler and more creative than the existing methods.

Keywords: Radio Arithmetic Mean Labeling, Radio Mean Number

Abstract No: 184 ***ICT, Mathematics and Statistics***

CHROMATIC POLYNOMIAL OF LADDER GRAPH

E.H.W. Weerabaddana[1*] and A.A.I. Perera[2]

[1]Department of Physical Science, Faculty of Applied Sciences, Rajarata University of Sri Lanka, Mihintale, Sri Lanka
[2]Department of Mathematics, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]erushah84@gmail.com

The chromatic polynomial is one of the common sections in graph colourings, which is used in algebraic graph theory. The initial definition of the chromatic polynomial came from George David Birkhoff in 1912. It counts the number of graph colourings as a function of the number of k distinct colours in such a way that no two adjacent vertices are assigned the same colour. There are some general formulas for the number of chromatic polynomials $P_G(k)$ of a graph G. Most chromatic polynomials are obtained from the inspection and the Deletion-Contraction method. Our work focuses on ladder graphs (closed ladder graph) (CLn) and an open ladder graph (OLn) obtained by eliminating the side edges of the ladder graph. In this study, the general formula of the chromatic polynomial for open ladder graph (OLn) for $n \geq 3$ and closed ladder graph (CLn) for $n > 1$ is obtained by dividing the ladder graph into two graphs G_1 and G_2 by the common edge. We can identify a pattern of chromatic polynomials for both types of ladder graphs. The general formula of CL_n for $n > 1$ can be recognized as, $P_{CL_n}(k) = k(k-1)(k^2-3k+3)^{n-1}$. Also, the general formula of OL_n for $n \geq 3$ can be recognized as, $P_{OL_n} = k(k-1)^5(k^2-3k+3)^{n-3}$. The mathematical induction method can prove the correctness of the obtained general formulas.

Keywords: Chromatic polynomial, Closed ladder graph, Open ladder graph

Abstract No: 189 ***ICT, Mathematics and Statistics***

A NUMERICAL APPROACH FOR SINGLE-PHASE FLOW IN POROUS AND FRACTURED ROCKS

R.B.W.M.M.K. Rajaguru[2*], U.G.I.G.K. Udagedara[1, 2] and S.A.A. Nishantha[1, 2]

[1]Department of Mathematics, University of Peradeniya, Peradeniya, Sri Lanka
[2]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]mahishiraja90@gmail.com

Analysis of fluid flow through or/and over porous media has steadily received considerable attention due to its applications in Science and Engineering. Many analytical and numerical approaches have been developed to analyze fluid flow properties in porous media. In this study, we considered the pressure distribution in fluid saturated in fractured rocks. The fractured rocks were considered as a porous medium, and to model the flow through the fractured rocks, mass conservation and Darcy's law were used. The resulting governing equation is a parabolic-type partial differential equation. Directly solving these equations is not easy. Thus, this work uses a numerical approach based on the finite difference method and singular value decomposition method to solve the parabolic type governing equation. The forward Euler method is applied to the equations and the boundary conditions to obtain the numerical scheme. The resulting numerical scheme is solved using a computer program written in python. The results show a good agreement with the experimental solutions. Further, the results show how the pressure diffusion is distributed in the saturated fluid in the porous rocks. Future work will focus on finding the effect of the parameters in the saturated fluid in fractured rocks.

Keywords: Finite Difference Method, Porous media, Singular Value Decomposition

Abstract No: 207 ***ICT, Mathematics and Statistics***

STABILITY ANALYSIS OF FLUID FLOW THROUGH POROUS MEDIA

P.D.S.V. Sooriyawansha* and U.G.I.G.K. Udagedara

Department of Mathematics, University of Peradeniya, Peradeniya, Sri Lanka
**sadeepasooriyawansha@gmail.com*

Fluid flow through porous media occurs in many industrial, geophysical, and biochemical applications, such as filtration and biological tissues. In this study, the stability of the viscous fluid flow through 2D cylindrical porous media is studied. The steady Darcy-Brinkman equation as the governing equation is used to describe the fluid flow through the porous media. There are many methods that we can use for stability analysis. Galerkin approximation and the Homotopy perturbation method are some of them. By considering the accuracy of the method, under this study, the modal stability analysis is performed using the 2D Orr-Sommerfeld derivation method. Due to the efficiency and accuracy, the Chebyshev collocation method is used to solve the boundary value problem. In the Chebyshev collocation method, small disturbances to the velocity potential are applied. Then the equations are expanded in terms of Chebyshev polynomials. By doing a stability analysis, we can determine whether the flow is stable or unstable. The stability analysis was done using the eigenvalue analysis. The most unstable eigenvalues for the fluid flow through the 2D porous cylinder are used to obtain the stable or unstable flow conditions at various Reynolds numbers and for various wave numbers. Conclusions are obtained as follows; if the eigenvalue has a negative imaginary part that indicates the base flow is stable, if there exists one eigenvalue with a positive imaginary part that indicates the base flow is unstable. The base flow is stable or unstable when the largest imaginary part of the eigenvalue equals zero. It is shown that the stability of the flow field depends on the parameters, such as wave number and Reynolds number. Future work will be focused on determining the stability conditions for the free flow over porous media.

Keywords: Chebyshev collocation method, Darcy-Brinkman equation, Orr-Sommerfeld derivation method, Porous media.

Abstract No: 208 ***ICT, Mathematics and Statistics***

EFFECT OF DRAG REDUCTION DUE TO INSERTION OF A POROUS LAYER INSIDE A CYLINDER

D.M.N.J. Dissanayaka*, P.D.S.V. Sooriyawansha and U.G.I.G.K. Udagedara

Department of Mathematics, University of Peradeniya, Peradeniya, Sri Lanka
**niroshajayamali.dissanayaka@gmail.com*

Drag reduction is a physical phenomenon that causes friction to be reduced and fluid flow to be increased. In this study, the drag reduction effect due to the insertion porous layer is studied by considering steady, incompressible, fully developed, viscous fluid flow through two co-axial cylinders. The radius of one cylinder was bigger than the other. The fluid inside the middle cylinder, a free-flow region, is described using the Navier-Stokes equation, and the fluid inside the annular region, which is a porous layer, is described using the Darcy-Brinkman equation. Velocity and the shear stress at the interphase are considered the same. Velocity is finite at *r(*Radius) = 0, and slip boundary conditions at the wall of the cylinder are considered boundary conditions. Velocity profile for the flow inside the cylinder and drag reduction at various permeability (K) values and various thickness (h) layers of porous are presented. It is shown that the drag reduction depends on the values of the permeability parameter and the thickness of the porous layer. When the permeability decreases and the thickness increases, an increase in drag reduction is predicted. Future work will study the drag reduction of the turbulent boundary layer *via* the porous media.

Keywords: Drag reduction, Darcy-Brinkman Equation, Navier-Stokes equation, Permeability, Porous layer.

Abstract No: 212 ***ICT, Mathematics & Statistics***

RELATIONSHIP BETWEEN VARIATIONS OF WATER QUALITY AND ABUNDANCE OF BENTHIC INVERTEBRATES IN THE SAN DIEGO COASTAL AREA

W.M.P.N.Wijesundara* and S.G.J.Senarathne

Department of Statistics and Computer Science, University of Peradeniya, Peradeniya, Sri Lanka
**nethmiwijesundara962@gmail.com*

The quality of water has a significant impact on the distribution and growth of some species in an aquatic system. As the abundance of benthic invertebrates is sensitive to pollution and contaminants in their environment, they are commonly used as indicators of the quality of water bodies. In this study, we developed methods to quantify the relationships between the abundance of different benthic invertebrates and the physical and chemical properties of water bodies where they live. This was assessed by considering the water quality and abundance data collected from the San Diego coastal area in the United States of America. The study analyzed secondary data collected from 27 sampling stations during the winter (January and March) and summer (July) seasons from 1999 to 2014. Given the complexity of the data in the dataset, cluster analysis is used to obtain two-cluster solutions and then convert the water quality data from continuous to binary to facilitate data manipulation. The sampling stations were divided into two groups using the two-cluster solution of each water quality parameter. Alternatively, the sampling stations were divided into two groups using the abundance data of each benthic invertebrate, with one group having stations with above-average abundance values. The significance of the relationship between each water quality parameter and each benthic invertebrate was tested using Fisher's exact test. Furthermore, logistic regression models were fitted to predict selected water quality parameters based on abundance data. The prediction accuracy of the fitted models revealed that the water quality parameters, including density, dissolved oxygen concentration, and pH value, have a significant relationship with the abundance of selected benthic invertebrates. These findings enable future research to explore more accurate models to predict water quality based on abundance data of benthic invertebrates and provide insight into how such hidden relationships can be identified using statistical techniques.

Keywords: Cluster Analysis, Fisher's Exact Test, Logistics Regression, Species Abundance

Abstract No: 220 ***ICT, Mathematics and Statistics***

DIMENSION OF JOINT KERNEL OF PURE p-ISOPAIRS IN TERMS OF UNITARIES REPRESENTING p FOR $p(z,w) = z^n - w^2$

R.A.S.R. Rajapaksha* and U.D. Wijesooriya

Department of Mathematics, University of Peradeniya, Peradeniya, Sri Lanka
**supunr@sci.pdn.ac.lk*

An inner toral polynomial is a polynomial in two complex variables whose zero set is contained in $\mathbb{D}^2 \cup \mathbb{T}^2 \cup \mathbb{E}^2$, where $\mathbb{D}, \mathbb{T}$ and $\mathbb{E}$ represent the open unit disk, the unit circle and the exterior of the closed unit disk, respectively. Given an inner toral polynomial, there exists a minimal version p where p is minimal in the sense that p divides any polynomial with the same zero set as itself. A zero of a polynomial $p(z,w)$ is called a regular point for p, if p has a non-zero gradient evaluation. For a minimal inner toral polynomial $p(z,w)$ of bidegree (n,m), there exists a unitary matrix $U = \begin{pmatrix} A & B \\ C & D \end{pmatrix}$ of size $(m+n) \times (m+n)$ representing p such that $p(z,w)$ is a constant multiple of $\det \begin{pmatrix} A - wI & zB \\ C & zD - I \end{pmatrix}$. A pure isometry is an isometry defined on a Hilbert space that behaves like a shift operator. Given a pair of pure isometries (S,T), its bimultiplicity is defined as $(\dim(\ker(s^*)), \dim(\ker(T^*)))$, where $*$ denotes the adjoint operator. A pair of pure isometries (S,T) satisfying the algebraic relationship $p(S,T) = 0$, where p is a polynomial, is called a pure p-isopair. It was proven that, for a fixed minimal inner toral polynomial p with bidegree (n,m), and a unitary matrix U representing p, there exists a Hilbert space H such that the pair (M_z, M_w) on H is a pure p-isopair. Further, for a pure p-isopair (S,T) with finite bimultiplicity (m,n), $\dim[\ker(S-\lambda I)^* \cap \ker(T-\mu I)^*] = 1$ whenever $(\lambda,\mu) \in \mathbb{D}^2$ is a regular point for p. It can be observed that at a non-regular point (λ,μ), the above dimension of the joint kernel could be one or higher. In this work, we proved that for minimal inner toral polynomials of the form $p(z,w) = z^n - w^2$ where $n \geq 2$, if the unitary matrix representing p has a zero diagonal and a non-zero block matrix A, then there exists a pure p-isopair (S,T) such that dimension of $\ker((S-\lambda I)^*) \cap \ker((T-\mu I)^*)$ at the non-regular point $(0,0)$ is one.

Keywords: Algebraic isopairs, Distinguished varieties, Isometries

Abstract No: 221 ***ICT, Mathematics & Statistics***

IDENTIFYING THE BEST CUT-OFF VALUES FOR RENAL BIOMARKERS TO DIFFERENTIATE CKDu PATIENTS AND ENDEMIC CONTROLS

D.K. Herath[1*] and H.T.K. Abeysundara[2]

[1]Centre for research, National Hospital, Kandy, Sri Lanka
[2]Department of Statistics and Computer Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]dulanjalikh@gmail.com

Chronic Kidney Disease of uncertain aetiology (CKDu) is a major health issue that mainly affects agricultural communities in the North Central Province of Sri Lanka. The disease was first identified in the North Central Province in the mid-1990s, and by now, many people across the country have been infected with the disease. The most common CKDu victims are adult male farmers in rural areas. CKDu does not show any early symptoms, and the patients will be in the end-stage when they are referred for treatments. The aim of this study is to identify the best cut-off values for significant renal biomarkers to differentiate the CKDu patients from the endemic control (EC) group. A cross-sectional study was conducted on the above-mentioned two groups where the patient group included 75 cases of definite CKDu while the control group was 79 dipstick-negative individuals from the endemic area. Eight biomarkers (measurement unit – ng/g-Cr) were considered along with other clinical factors to identify the significant biomarkers that differentiate CKDu from EC. According to mean comparison tests, there were significant differences in mean biomarker levels between the two groups ($p < 0.001$). Cystatin C (CTS3), Osteopontin (OPN), and Retinol Binding Protein 4 (RBP4) were identified as significant biomarkers from the binary logistic model (Accuracy = 95.8%). Receiver Operator Characteristic curves were fitted for the identified biomarkers, and candidate cut-off values were derived based on Specificity, Sensitivity, Youden's Index and Closest Top left criteria. The best cut-off values were 236.499, 2.107, and 85.53 for RBP4, CTS3, and OPN, respectively. These cut-off values can be used to identify the possible patients at risk of CKDu at early stages where conventional biomarkers and symptoms are not yet visible. Early detection of the disease will help to manage treatments and hence better intervention of CKDu in endemic areas.

Financial assistance from University Research Grants (URG2021/38/S) is acknowledged.

Keywords: Best cut-off value, Chronic Kidney Disease, Renal biomarkers, ROC curve

Abstract No: 225 ***ICT, Mathematics & Statistics***

A NOVEL CRYPTOGRAPHIC SCHEME BASED ON THE COLLATZ CONJECTURE

R.M.V.V. Bandara* and P.G.R.S. Ranasinghe

Department of Mathematics, University of Peradeniya, Peradeniya, Sri Lanka
**s16322@sci.pdn.ac.lk*

The Collatz conjecture is one of the most famous unsolved problems in mathematics, which is named after the mathematician Lothar Collatz, who introduced the idea in 1937. The Collatz function is defined for any positive integer n; if n is even, then divide it by two; else, multiply it by three and add one. We can modify this function by writing the even number of the form $k \cdot 2^m$ for an odd number k and some positive integer m. The Collatz sequence is generated using this function, and the next term of the sequence is obtained by applying the function to the previous term. In the present cryptographic scheme, we use the Collatz sequence to encrypt a plaintext symmetrically. We have proposed a new cryptosystem in which the sender and the receiver hold the secret key pair (k, n); for some large, odd numbers k and some positive integer n. The key pair has been chosen randomly, and plaintext is encrypted using the Collatz sequence generated starting with k and n number of iterations in the generated sequence. The Collatz sequence is a chaos-based sequence, and for every positive integer, there is a unique mapping, and a slight change in the number makes a huge difference in the generated sequence. Thus, the chaotic nature makes it more secure. Furthermore, this cryptosystem has uncomplicated transformations, which are very simple to analyse and efficient because the only operations involved are multiplication and addition. The present cryptosystem suggests only encrypting the plaintext once, but we can encrypt the plaintext a finite number of times to make it more secure. Also, we can combine this method with some known cryptosystems to implement novel cryptosystems.

Keywords: Chaotic Nature, Collatz Sequence**,** Cryptography

Abstract No: 235 ***ICT, Mathematics and Statistics***

MATHEMATICAL MODELING OF CELL-FREE PROTEIN SYNTHESIS SYSTEMS

M.A.A. Aqeel and S.P. Rajapaksha*

Department of Chemistry, Faculty of Applied Sciences, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
**suneth@sjp.ac.lk*

Exploiting microbial cultures through gene manipulation techniques to synthesize the target proteins is popular among pharmaceutical industries. However, the changes in the nutritional and environmental conditions of the culture medium can perturb the protein production rate. Extracting the background machinery of gene expression from cells and assembling them into a reaction vessel to conduct DNA programs in a cell-free format can circumvent many problems associated with cell-dependent norms. In this work, a mathematical model for cell-free protein synthesis (CFPS) was developed. The model encompasses the mechanics of protein synthesis, extract methodology, consumption of biological nutrients, the active duration of protein synthesis, and the DNA template loading capacity, which are lacking in previous CFPS models. In CFPS, the concentrations of molecular components engaged in protein synthesis are within limits to apply continuum hypotheses and mass action-based formalisms. Therefore, by formulating ordinary differential equations for each component, the performance of the system under a particular setting can be evaluated. Further, plugging in the kinetic parameters available in the literature to simulate the model can be justified because it is not biosystem specific and can be treated as independent entities. Simulating the CFPS pipeline using the literature values showed that the maximum concentration of reporter protein yield obtainable is 21.0 pM. Testing for increased resources showed that the maximum concentration of protein obtainable reaches up to 0.4 nM. Testing the DNA template loading capacity indicated that the protein product increases linearly and plateaus after a critical DNA concentration of 2.0 nM. The model developed in this research is not entangled with the fundamental assumptions of Michaelis-Menten kinetics. Therefore, it can be used as a scaffold to formulate more complex and practical CFPS models with nuance parameters appropriate for pharmaceutics and biomanufacturing.

Code availability: The necessary codes to reproduce the key findings of this work are available at GitHub (https://github.com/zachariah-ibrahim/cell-free-protein-expression).

Financial assistance from the University of Sri Jayewardenepura (Grant No. ASP/01/RE/SCI/2021/07) is acknowledged.

Keywords: Cell-free protein synthesis, Mathematical modeling, Proteins, Simulations

Abstract No: 239 ***ICT, Mathematics and Statistics***

A BATSMAN'S SURVIVAL IN CRICKET: A STATISTICAL PERSPECTIVE

Jaishieka*, S.P. Abeysundara, and M. Dehideniya

Department of Statistics and Computer Science, University of Peradeniya, Peradeniya, Sri Lanka
**jaishieak@gmail.com*

Cricket is the most popular sport among the Sri Lankan audience. Even though each player is essential in cricket, the batsman plays a crucial role. Therefore, the primary objective of this study is to compare the survival of a player on the field in different innings, venues, and batting positions, and the secondary objective is to find the variables, i.e., runs, singles, doubles, boundaries and dot balls, that are associated with the survival rate of each player for the different criteria mentioned above. For this study, the ball-by-ball data of Sri Lankan innings in One-Day International matches contested between the time range of 01/01/2016 and 30/06/2021 was used. According to the exploratory data analysis, nine players who have played enough matches for different innings, venues, and batting positions are chosen for this study. The primary objective of the study is met by comparing the area under the adjusted survival curve formed using the cox proportional hazard models for each player and for each criterion such that the area is proportional to the survival probability. The predictor variables used in this model are the cumulative number of runs, singles, doubles, and boundaries scored, and the cumulative number of dot balls faced. The cox model is fitted with a right censoring technique by taking the survival time as the number of balls faced until the player gets out. Aalen model is fitted to attain the secondary objective, which provides a graphical method to check on the time dependence of covariate effects. For example, the probability of getting out increases for A.D. Mathews when more fours were scored in the fifth batting position after facing more than 75 balls. The results of this research may help in team selection because the strength of a player is identified. Also, this can help a player survive more on-field by identifying the variables that affect their survival and improving them by practising. This research will be a helpful tool to improve the performance of the Sri Lankan team, which will result in a higher success rate.

Keywords: Aalen's additive hazard model, Cricket, Cox Proportional Hazard, Survival Analysis

Abstract No: 247 ***ICT, Mathematics and Statistics***

NUMERICAL STUDY OF THERMODIFFUSION EFFECTS ON BOUNDARY LAYER FLOW OF NANOFLUIDS OVER A POWER LAW STRETCHING SHEET WITH SLIP CONDITIONS AND MAGNETIC FIELDS

R.M.S.D. Madushanka* and M.T.M. Dewasurendra

Department of Mathematics, University of Peradeniya, Peradeniya, Sri Lanka
**s16410@sci.pdn.ac.lk*

In the study, boundary layer flow over a moving flat plate with velocity slip and applied magnetic field is analyzed. The governing partial differential equations are converted into a nonlinear ordinary differential equation through an appropriate similarity transformation. Recently, Liao invented a Directly Defining Inverse Mapping Method (MDDiM) for nonlinear differential equations. Further, it is guaranteed that this novel method can be used to obtain convergent series solutions for boundary layer flow problems when the inverse linear mapping satisfies the properties of linearity, injectivity and finiteness. In this present work, the effect of the magnetic field and the second-order slip on the boundary layer flow is investigated using the MDDiM and found in excellent agreement with the numerical results obtained by the Runge–Kutta method for some special cases. The novelty of this study is this is the first time that someone has studied the effect of second-order slip on boundary layer flow of nanofluids over a *power law* starching under the presence of the magnetic field, but for *linear* and *quadratic* stretching. Further, this is the first time MDDiM has been used to solve a system of four nonlinear coupled systems, but for systems of three equations. Also, the results obtained with minimum errors are presented graphically and discussed.

Keywords: Boundary-layer, Directly Defining Inverse Mapping, Second-order slip, Stretching surface

Abstract No: 267 ***ICT, Mathematics and Statistics***

ANALYSIS OF SOCIAL MEDIA CONTENT ON COVID CONTROL AND PREVENTION IN SRI LANKA

J.M. Hettiarachchi*

Department of Computing and Information Systems, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka
**madarajayani@gmail.com*

Due to travel restrictions and stay-at-home orders brought about by the COVID-19 epidemic, social media platforms like Twitter have become an outlet for people to voice their worries, opinions, and feelings. Twitter is used by people, medical organizations, and governments to communicate about COVID-19. The goal of this study was to determine the effectiveness of COVID control and prevention in Sri Lanka by identifying the most discussed topics about COVID control and prevention among social media users and analyzing the sentiments of discussions on Twitter. The *Tweepy python library* and *Postman* with the Twitter *API* were used to collect English tweets related to COVID-19 control and prevention between January 1, 2020, and February 28, 2022. The analysis included topic modeling to identify topics and sentiment analysis to identify the emotions of Twitter users. The proposed methodology for topic modeling was based on the *coherence score*, which was used as the quality measurement for topic modeling. An *unsupervised machine learning algorithm (the Latent Dirichlet allocation algorithm)* was used to identify topics. For starting topic modeling, a combination of *unigram* and *bigram* was created to better understand key terms for identifying topics. For selecting better text feature vectors from the preprocessing dataset, both *BOW (Bag of Words)* and *TF-IDF (Term Frequency-Inverse Document Frequency)* were used for extracting features. The base model was trained with *TF-IDF* and with *BOW* and compared for the *coherence score*. The *hyperparameters* (number of topics, *alpha*) of a chosen *LDA* model were tuned to find the best combination of *hyperparameters* that results in the optimal number of topics. This study trained the final *LDA* model with the best *hyperparameter* combination and got the identified topics. *VADER (Valence Aware Dictionary and Sentiment Reasoner)* was used to identify the sentiments of each tweet. Each tweet was classified as positive, negative, or neutral based on the *compound score*. The results showed that the *coherence score* of the *LDA* model was increased through the proposed methodology. The increments in *coherence score* happened in three steps: the feature vector using *TF-IDF*, the optimal number of topics (k) = 21, and *alpha = "auto"*. Further, 21 topics were identified by combining *unigram* and *bigram* key terms, which resulted from topic modeling. Then, the results of sentiment analysis indicate 41% of tweets are negative, 33% positive, and 26% neutral. The main finding of this study is that Sri Lankans have negative feelings towards COVID control and prevention in Sri Lanka, as results of sentiment analysis indicate a higher percentage of total tweets are negative, and results of topic modeling indicate there are many negative topics being discussed by Twitter users. The *coherence score* is one quality measurement that can be used to evaluate topic modeling, and the combination of *unigram* and *bigram* provides better interpretability. Social media platforms such as Twitter are robust communication platforms that can be used to express public thoughts. The findings of the studies assist governments, the health sector, and the general public in raising awareness about the effectiveness of COVID control and in improving their strategies and plans for future health pandemics.

Keywords: Coherence score, Covid control and prevention, Sentiment analysis, Topic modeling, Tweets

Abstract No: 272 ***ICT, Mathematics & Statistics***

FACTORS AFFECTING CUSTOMER RETENTION IN INSURANCE: A CASE STUDY

M.A.S. Sandakalani*, and L.P.N.D. Premarathna

Department of Mathematics, University of Kelaniya, Kelaniya, Sri Lanka
**sanjanasandakalani0903@gmail.com*

Customers play a vital role in business because they bring revenue to the company. Businesses cannot continue to exist without customers. Further, it is a challenge for the company to attract new customers and retain existing customers. Retaining customers is cheaper than acquiring new customers in any type of business. Insurance companies frequently update and initiate new strategies to retain their customers due to the competition in the insurance industry. Therefore, the purpose of this study is to analyze the behaviour of policyholders and to examine how to increase the profitability level by increasing the number of customers retained in the company. The policyholders of one of the leading insurance companies in Sri Lanka have been selected. Appropriate regression and machine learning models are used to analyze customer retention. Secondary data was collected by the company database, and primary data was collected through a questionnaire and telephone conversations with customers of the relevant organization. Data was collected from 1,162 policyholders from January to December 2021. The preliminary analysis identified a significant association between the predictor variables and customer retention. Logistic Regression (LR), Decision Tree (DT), and Support Vector Machine (SVM) were used in the study to predict customer retention rate. The random sampling method was used to avoid the problem of class imbalance in the datasets considered in the study. Business party, reason (or purpose), customer retention ratio, no claims bonus, and education level were identified as the most influential factors for customer retention by using LR final model. The models mentioned above can be considered suitable models for predicting customer retention in general insurance. This study identifies the best model as the DT model, and it classifies customer retention rate with an accuracy of 66%. Therefore, the models developed in this study can be used to manage customer retention, hence increasing the profitability level.

Keywords: Decision Tree, Logistic Regression, Probabilistic Neural Network, Regression, Support Vector Machine

Abstract No: 278 ***ICT, Mathematics and Statistics***

MATHEMATICAL MODEL FOR THE SPREAD OF COVID-19 IN AN OPEN POPULATION WITH ENVIRONMENTAL TRANSMISSION OF CORONAVIRUS

D.M.N.K. Dissanayaka and T.H.K.R. de Silva*

Department of Mathematics, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
**rkokum@gmail.com*

COVID-19 is an infectious disease readily spread by a pathogen called the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) through direct contact with an infected person or contact with pathogens that have survived in the environment. In this study, we developed a compartmental model to study the dynamics of the spread of COVID-19 in a small open population for a short period. To develop the mathematical model, we considered a population in an office environment which consists of staff members and customers. We considered these two groups separately and categorized each group according to the stage of the disease: The staff members (N_w) is divided into three groups as Susceptible staff members (S_w), Exposed staff members (E_w) and Infected staff members (T_w). The customers (N_c) is divided into three groups Susceptible customers (S_c), Exposed customers (E_c) and Infected customers (I_c). Here, the dynamics of the COVID-19 prevalence were analyzed by taking the direct and environmental transmissions into account with the threshold for infection of COVID-19. Simulation results were obtained for two situations using the *odint* function in Python 3 software. First, when there are both infected staff members and infected customers in the open population, and next, when there are only infected customers in the open population. The results show that the risk of the staff members becoming exposed is greater when there are both infected staff members and infected customers in the open population than when there are only infected customers in the open population.

Financial assistance from the PGIS Research Grant 2020 (Grant No PGIS/2020/04) is acknowledged.

Keywords: COVID-19, Environmental transmission, Open population, SARS-CoV-2, Threshold level

Abstract No: 279 ***ICT, Mathematics and Statistics***

DEEP LEARNING-BASED DETECTION AND ANALYSIS OF ALZHEIMER'S ON STRUCTURAL CONNECTOMES

S. Subaramya[1,2*], R. Nagulan[2], T. Kokul[3] and U.A.J. Pinidiyaarachchi[4]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Physical Science, Faculty of Applied Science, University of Vavuniya, Vavuniya, Sri Lanka
[3]Department of Computer Science, Faculty of Science, University of Jaffna, Jaffna, Sri Lanka
[4]Department of Statistics and Computer Science, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]subaramya87@gmail.com

Early detection of Alzheimer's disease (AD) is crucial for delaying or minimizing the disease's progression because AD is a chronic and degenerative disorder. An important AD diagnostic technique is diffusion MR imaging-based structural connectomes, which provide a wealth of knowledge about the anatomy of the brain. Deep learning techniques have received much interest recently for automatically identifying AD using various neuroimaging techniques. In order to classify AD patients and healthy controls (HC), an effective convolutional neural network (CNN) architecture is presented here. The analysis of Alzheimer's disease's structural white matter connection changes is then performed using CNN's classification decisions. The discriminative alterations in white matter connectivity associated with Alzheimer's disease were identified using the Gradient-weighted Class Activation Mapping (Grad-CAM) algorithm. The Alzheimer's Disease Neuroimaging Initiative (ADNI) research dataset is used to test the classification and identify discriminative patterns of structural changes in the brain. The proposed architecture provides a reliable Alzheimer's detection classifier and effectively demonstrates discriminative brain network properties. The CNN model, designed from scratch, is more consistent and precise than the prior methods, as evidenced by the proposed approach's prediction accuracy of 95%. Specific patterns of white matter damage in AD were discovered using the Grad-CAM-based CNN decision visualization since the Grad-CAM technique uses the gradients of the classification score. Our research not only examines the advantages of CNN-based deep learning by categorizing high-dimensional clinical data and can aid in the early detection and prevention of AD but also has the potential to thoroughly analyze the discriminative structural connectivity differences in AD and HC. Our approach provides an automated AD diagnostic tool and supports clinicians in better understanding the anatomical alterations that occur in AD.

Financial assistance from the Postgraduate Institute of Science (Grant No 06) is acknowledged.

Keywords: Alzheimer's Disease, Class Activation Map, CNN, Deep Learning, Structural Connectome

Abstract No: 287 ***ICT, Mathematics and Statistics***

POWER CURVE MODELLING FOR WIND TURBINES

D.D. Kiriella[1*] and G.W.R.M.R. Palamakumbura[2]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Engineering Mathematics, University of Peradeniya, Peradeniya, Sri Lanka
[*]ddkiriella@gmail.com

The energy crisis is a major problem in the world, and as a solution to the problem, wind energy plays a strategic role. Wind energy-based plants grow expeditiously among the energy plants due to sustainability and emission reduction requirements and cost-effectiveness. The uncertain nature of wind makes considerable challenges to the reliability and stability of wind power plant projects. Therefore, to overcome these challenges, power curve models are designed to predict power output with respect to wind speed. Accurate models of power curves can play an essential role in improving the performance of wind energy-based systems. Modeling methods usually use data from manufacturers' specifications and actual data from wind farms. In this regard, various modeling techniques are available, and in our work, existing polynomial function approximation is adopted. This research paper discusses modelling an effective power curve for wind turbines, which are located in the Puttalam District. The power curves have been developed for actual data using SPSS statistical analytical package and Python programming language for each wind turbine. Then, a quadratic model and a cubic model were developed for each wind turbine. Furthermore, a comparison of developed quadratic and cubic power curve models with respect to actual power output data was performed. The errors were calculated for quadratic and cubic developed models using the root mean square error method, and it indicated 156.70 and 160.18, respectively. Through these comparisons, it was detected that the gradient of both models should increase to minimize the errors of these models. Accordingly, the quadratic and the cubic model were differentiated, and modifications to both models were performed using the trial and error method under several conditions to reduce the root mean square error. This novel heuristic approach resulted in effective models on comparison of the graphs of the modified models with the actual data. Further, the errors were calculated for these modified power curve models with respect to actual power output data and indicated 28.48 and 63.43, respectively, thus depicting an accurate fitting for the actual data.

Keywords: Power curve modeling, Root mean square error, Wind Energy

Abstract No: 292 ***ICT, Mathematics and Statistics***

E-SUPER VERTEX MAGIC LABELING FOR CATERPILLAR GRAPH

M.W.S. Randunu* and A.M.C.U.M. Athapattu

Department of Mathematics, University of Peradeniya, Peradeniya, Sri Lanka
**randunuwellalage@gmail.com*

Graph labeling has been an exciting area of research in graph theory. Most graph labeling origins can be traced back to the mid-1960s. Over the last 60 years, more than 100 graph-labelling techniques have been studied. E-super vertex magic labeling is a type of modern concept when compared with other popular labeling patterns such as graceful labeling, harmonious labeling, lucky labeling, anti-magic labeling, etc. It is one of the most challenging and interesting labeling techniques with various applications. For a finite simple graph G, the set of vertices and edges are denoted by $V(G)$ and $E(G)$, respectively. If G is a simple undirected graph with p vertices and q edges, then vertex magic total labeling is a bijective map f from $V(G) \cup E(G)$ onto the set $\{ 1, 2, \ldots, p+q, \}$ with the property that, for every vertex u in $V(G)$, $f(u) + \sum_{V \in N(u)} f(uv) = k$, where k is a constant and set $N(u)$ denotes the vertices adjacent to the vertex u. The labeling is called E-super vertex magic if $f(E(G)) = \{1, 2, \ldots, q\}$. A graph G is called E-super vertex magic if it admits an E-super vertex magic labeling. Intending to answer the open problem, every tree is E-super vertex magic to some extent; we focus on the E-super vertex magic labeling for the caterpillar graph. In this study, we can prove that E-super vertex magic labeling does not exist for the star graphs S_n with $n \geq 4$. Consequently, we proved that the caterpillar graph, which has a star graph as a subgraph, is not an E-super vertex graph for order; $n \geq 7$.

Keywords: Caterpillar graph, E-super vertex magic labeling, Star graph

Abstract No: 310 ***ICT, Mathematics and Statistics***

PADDY LEAF DISEASE DETECTION USING DEEP NEURAL NETWORK AND GLCM ALGORITHMS

N. Venuja[1], T. Rajeetha[2] and V. Senthooran[1]

[1]Department of Information and Communication Technology, University of Vavuniya, Sri Lanka
[2]Department of Computer Science and Informatics, Uva Wellassa University of Sri Lanka, Sri Lanka

Paddy leaf diseases have been increasing significantly due to environmental pollution, climate change, and globalization, thus affecting the country's economy. The conventional way of detecting paddy leaf diseases is time-consuming. In the present world, many technological solutions are provided to detect diseases for sustainable agriculture. A number of research studies on the detection of paddy leaf diseases using digital technologies are facilitating the development of artificial intelligence techniques that can examine the paddy leaf data automatically to localize the affected area and detect the types of disease. Those numerous techniques are still competing with accuracy due to the complication of algorithms and features of the data set. The research paper proposes a novel idea for creating an autonomous system to identify paddy diseases such as paddy blast, brown spot, and narrow brown spot disease using image processing techniques for improving image resolution and the Deep Neural Network (DNN) for diagnosing paddy diseases. The proposed system inputs the collected paddy leaf images and use canny edge detection, multilayer thresholding, and region-growing algorithms for image segmentation and GLCM (grey level co-occurrence matrix) techniques to extract texture data, as well as colour and shape features to increase the framework's accuracy, and DNN for classification. The overall segmentation accuracy of 88.5%, the sensitivity of 86.1%, and the specificity of 90.5% in the experiments, and the results compete and significant improvements with existing segmentation algorithms.

Keywords: Deep Neural Network (DNN), Grey Level Co-Occurrence Matrix (GLCM), Canny Edge Detection, Multilayer Thresholding, and Region-Growing Algorithm.

Abstract No: 311 ***ICT, Mathematics and Statistics***

CLUSTERING ENGLISH NEWS ARTICLES BASED ON RELEVANT DOMAINS: COMPARATIVE STUDY USING THREE CLUSTERING ALGORITHMS

N. Disayiram[1] and R.A.H.M. Rupasingha[2*]

[1]Department of Computing and Information Systems, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka
[2]Department of Economics and Statistics, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka

The news tells us about what happens around us. Nowadays, people use news sites to read exciting news. News has many categories. The preferable choice of the news category differs for each newsreader. In the end, every news category is important. Every day lots of news is published on news websites. Typically, news sites categorize the news, but all the categories are not included on that site. Most news sites prioritise some categories, and other categories get lower media coverage. It is, therefore, difficult to find the relevant types of news. These problems give complexity to the newsreaders and relevant content seekers to find the relevant section on the news sites. The clustering of English news based on the relative category gives solutions to overcome those problems. This study aims to cluster news articles based on the relevant domain using machine-learning algorithms. We consider five domains: politics, sports, health, technology, and business. The online collected data was converted into vector format by using the term frequency-inverse document frequency vectorization. Then, the three clustering algorithms: Expectation Maximization, Simple Kmeans, and Hierarchical Clustering based on agglomerative technique, were separately applied to the body of the news and the news headline. The accuracy is calculated through the classes to clusters evaluation model in the WEKA tool. The results show that the Expectation Maximization algorithm achieved the highest accuracy of 87.9%, while it was 83.8% for the Simple Kmeans algorithm. Further, the Hierarchical Clustering method achieved the minimum accuracy results. The comparison results between the heading of news and the body of news show that the body of news performed better than the heading of news to cluster the news articles.

Keywords: Clustering, Domain, Machine learning, News article

Abstract No: 312 ***ICT, Mathematics and Statistics***

OBESITY LEVEL PREDICTION BASED ON APRIORI ALGORITHM ASSOCIATION RULE MINING

S.A.H.S. Sudasinghe

Department of Information Systems, Faculty of Management Studies, Rajarata University of Sri Lanka, Mihintale

Being overweight and obesity are ongoing severe health problems in the world. According to health experts, people who maintain a normal BMI index can live healthy life. However, the obese population is considered a vulnerable group to COVID-19. Using association rule mining with Weka software tried out to define some rules for the major causes of obesity and overweight. The dataset used here was the "Estimation of obesity levels based on eating habits and physical condition", which has been collected from Mexico, Peru and Colombia. This dataset contains 17 attributes and 2,111 records. Here, data preprocessing was done first, and for the data discretization part, numeric attributes were converted to nominal. Then used Apriori Algorithm for mining association rules and tested with different parameter settings. After going through each of the separate rules, some common rules that caused type III obesity can be identified, where females have a higher risk of causing obesity rather than males. A woman with an overweight history in her family has a higher probability of having Type III obesity. Moreover, if such a person has a habit of frequently eating high-caloric foods, she has a high risk of getting obese. Moreover, if a person eats high-caloric foods and eats any food between meals, it is advisable to monitor calorie consumption. Furthermore, if a person uses public transport daily, that person is living under the threat of obesity because of a lack of exercise. Finally, these obesity level prediction rules can apply to modern-day life to avoid obesity and have a healthy life.

Keywords: Apriori, Association, Covid, Obesity, Overweight

Abstract No: 4 ***Life Sciences***

RAPID MICROPROPAGATION OF A TROPICAL FOREST SPECIES, *MADHUCA LONGIFOLIA* VAR. *LONGIFOLIA* USING APICAL AND NODAL EXPLANTS

H.G.M.K. Karunarathna[1], J.P. Eeswara[2] and M.C.M. Iqbal[1*]

[1]National Institute of Fundamental Studies, Kandy, Sri Lanka
[2]Postgraduate Institute of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka
[*]iqbal.mo@nifs.ac.lk

Madhuca longifolia (Koenig) J.F. Macb. var. *longifolia* is a tropical tree belonging to the family Sapotaceae with a high reforestation potential, and immense benefits economically and in traditional medicine. Overexploitation and rapid deforestation combined with the problems in seed propagation due to viability and survivability in the soil increased species vulnerability in natural forests. These drawbacks can be overcome by the development of a rapid regeneration technique for *M. longifolia*. In the present study, a successful in vitro propagation protocol from sterilization to hardening was developed by direct organogenesis through apical shoots and nodal cutting explants. The combined effect of 10% (v/v) sodium hypochlorite (NaOCl) for 10 min following 0.1% (w/v) mercuric chloride ($HgCl_2$) for 5 min increased the survival rate of all explants (83.9%) compared to using NaOCl alone. Culture initiation was influenced by the type of explants, where apical shoots showed a higher response (90.0%) than nodal explants (77.7%) in bud break. Both explants indicated the highest bud break percentage in the shortest duration (approximately 6 and 15 days, respectively) with 1.0 mg l^{-1} 6-benzyl amino purine (BAP). A higher multiplication rate of micro shoots (7.93) from a single node was observed with 1.0 mg l^{-1} BAP combined with 3.0 mg l^{-1} Zeatin (ZEA). A culture medium with ZEA was more efficient for shoot multiplication than indole-3- acetic acid (IAA) or gibberellic acid (GA_3), where shoot elongation was enhanced under a low concentration of BAP (0.2 mg l^{-1}). The application of kinetin has no significant effect on shoot multiplication. *In vitro* grown shoots can be successfully rooted within 9 days by pulsing with IAA (0.5 g l^{-1}) for 2 h (64.7%). After 12 weeks, 88.9% of plants survived after keeping in a soil-less ¼ MS media for four weeks before transferring into the sand: compost (1:1) media under greenhouse conditions.

Keywords: *Madhuca longifolia*, Micropropagation, Rooting, Shoot, Tropical forest

Abstract No: 13 ***Life Sciences***

GLYCEMIC INDICES OF FIVE COMMERCIALLY AVAILABLE BREAKFAST CEREAL-BASED PRODUCTS

G.C.P. Kumari[1*] and J.G.S. Ranasinghe[2]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Biochemistry, Faculty of Medicine, University of Peradeniya, Peradeniya, Sri Lanka
[*]chandimam91@gmail.com

The glycemic index (GI) of a particular type of carbohydrate affects the rate of change in blood glucose concentration or glucose metabolism in the body. For healthy eating, foods with a low GI are recommended. This study aimed to determine the GI of five commercially available cereal products. The GI was determined using measured portions of food containing 50 g of carbohydrates given to the six healthy volunteers. Blood glucose curves were constructed based on the blood glucose concentrations at times 0, 30, 60, 90 and 120 min following the meal. The GI was calculated by dividing the Incremental Area Under the Curve (IAUC) for the tested food by that of the Incremental Area Under the Curve of Standard food (IAUCS). After the meal, the average of the respective blood glucose concentrations was used to draw a blood glucose response curve for the two hours. The individual IAUC values for each test food in each subject are expressed as a percentage of the mean IAUC value for the repeated reference food tests taken by the same subject. The mean of the resulting values for each food is the GI value. The Glycemic Load (GL) of a specific serving of each food was calculated using the following equation: GL = (GI of test food × available carbohydrate in a serving of test food [g])/100. MS Excel 2013 and Minitab 2017 were used to analyze the data. The mean values of GI for products 1 to 5 (PRO 1 - PRO 5) were 58.6, 53.5, 82.9, 76.3 and 55.4%, respectively. There was no difference in GI *vs.* GL. The study concludes a significant difference in GI among tested cereal products ($p<0.05$).

Keywords: Cereal products, Glycemic index, Glycemic load

Abstract No: 18 ***Life Sciences***

IN VITRO CYTOTOXICITY OF *PHYLLANTHUS EMBLICA* LEAF EXTRACT

M.O. Galappaththi[1*], A.M.S.B. Abeykoon[1] and F. Noordeen[1]

[1]Department of Microbiology, Faculty of Medicine, University of Peradeniya, Peradeniya, Sri Lanka
[*]mogalappaththi91@gmail.com

Phyllanthus emblica (*nelli*) is a traditional medicinal plant used to treat many diseases. Here we tested the toxicity of the *P. emblica* on mammalian (Vero) cells as part of an antiviral screening of plant products against dengue using the CytoTox-96® Non-Radioactive Cytotoxicity Assay. This colourimetric assay quantitatively measures lactate dehydrogenase released upon cell lysis. *P. emblica* leaves were ground, and two-fold dilution series was prepared using fresh, neat extract. Two 96-well plates were prepared with Vero cells, and an assay was set up with an analytical system based on negative control (without Vero cells), vehicle control (untreated cells) and positive control (lysis solution) with four replicates. Leaf extract was added to the test wells at different concentrations: one plate was incubated for 5 h (LDH has a half-life of approximately 9 h), and the next plate was incubated for 24 h (cell exposure time in antiviral treatment) at 37 ^{o}C. The absorbance data were measured using a standard 96-well plate reader (LabtechLT-4500, Singapore), and the percentage cytotoxicity was calculated for each concentration. The colour intensity and absorbance values decreased with the decreasing concentrations of *P. emblica* leaf extract. The percentage cytotoxicity for dilutions of 1/4, 1/8, 1/16, 1/32, 1/64, 1/128, 1/256, 1/512 and 1/1024 were 95.6, 71.53, 74.77, 82.16, 79.91, 40.25, 7.37, 0.16 and -1.24, respectively, for the 5 h of incubation. The percentage cytotoxicity for dilutions of 1/4, 1/8, 1/16, 1/32, 1/64, 1/128, 1/256, 1/512 and 1/1024 were 141.61, 133.24, 127.78, 121.88, 109.79, 106.67, 30.64, 22.67 and 25.39, respectively for the 24 h of incubation. High concentrations of *P. emblica* extract resulted in high cell lysis. High concentrations of *P. emblica* leaf extracts were cytotoxic to Vero cells. Cytotoxicity data of *P. emblica* leaf extracts help select the minimum toxic concentrations (<1/256) for testing the inhibitory activity of *P. emblica* leaf extract against dengue viral infections.

Financial assistance from the University of Peradeniya (Grant No. URG/2016/47/M) is acknowledged.

Keywords: Cell lysis, Colour intensity, Cytotoxicity, *Phyllanthus emblica* leaf extract

Abstract No: 21 ***Life Sciences***

DIROFILARIASIS IN DOGS BROUGHT TO THE VETERINARY TEACHING HOSPITAL, PERADENIYA, SRI LANKA

S.S. Thilakarathne[1,2], N. Wijayawardhane[3], P.K. Perera[2], C. Mallawa[3] and R.S. Rajakaruna[2*]

[1] Department of Parasitology, Faculty of Medicine, University of Ruhuna, Galle, Sri Lanka
[2]Department of Zoology, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[3]Department of Veterinary Clinical Sciences, Faculty of Veterinary Medicine and Animal Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]rupika.rajakaruna@sci.pdn.ac.lk

In 2016, Sri Lanka was acknowledged by the World Health Organization for having eliminated human lymphatic filariasis as a public health problem. However, human dirofilariasis caused by zoonotic *Dirofilaria repens* has shown an upward trend in incidence in recent years all over the country, particularly in the Central and Western Provinces. Dogs are the main natural host of the infection. The objective of this study was to study *Dirofilaria* infections and evaluate the phylogenetic relationship of *Dirofilaria* species in dogs brought to the Veterinary Teaching Hospital at the University of Peradeniya clinic for either vaccination or a regular checkup. Blood samples were collected from dogs and were morphologically analyzed by Modified Knott's Technique, followed by molecular characterization using pan-filarial primer and phylogenetic analysis by the Neighbor-Joining method. Among the dogs examined, 28% (24/87) were positive for *D. repens.* Dirofilariasis infection in males (39%) was significantly higher than females (15%; Chi-square test, χ^2 =0.447, p=0.011). There was no significant difference in the infection among dog age groups or breeds (χ^2=3.711, p=0.054). Moreover, the intensity of infection (mf/ml) among sex, age or breed did not significantly differ. Sequencing results of the *5.8S-ITS2-28S rDNA* showed that the nucleotide sequences were 63% identical to those of *D. repens* reported from South India, and sequences obtained in the present work show greater similarity between each other. The high number of *Dirofilaria* cases, with more than one-fourth of dogs, could increase the risk for human dirofilariasis in Sri Lanka. Thus, an assessment of the social and eco-epidemiological factors that influence the distribution dynamics of this zoonotic disease is needed for reliable prediction and the potential emergence of new areas of endemicity.

Financial assistance from the National Research Council, Sri Lanka (Grant No. 20-083) and the University of Peradeniya Research Grants (Grant No. URG/2018/39/S) are acknowledged.

Keywords: Dog, Domestic, Dirofilariasis, *Dirofilaria repens*, Sri Lanka

Abstract No: 24 ***Life Sciences***

PHYSICOCHEMICAL AND NUTRITIONAL PROPERTIES OF TENDER COCONUT (*Cocos nucifera*) WATER OBTAINED FROM DIFFERENT COCONUT VARIETIES

S. Shayanthavi[1, 2*], R. Kapilan[2] and I. Wickramasinghe[1]

[1]*Department of Food Science and Technology, Faculty of Applied Sciences, University of Sri Jayewardenepura, Nugegoda, Sri Lanka*
[2]*Department of Botany, Faculty of Science, University of Jaffna, Jaffna, Sri Lanka*
[*]*shayanth1995@gmail.com*

The liquid endosperm of tender coconut (*Cocos nucifera*) makes a refreshing drink during summer. It is also prescribed for cases of diarrhoea and vomiting against dehydration of the body. Global use and demand for tender coconut water have increased due to its nutritional and medicinal benefits. The nutritional composition and phytochemical profiles of young coconut water are influenced by variety, location, and environmental factors. This study aimed to compare the physicochemical and nutritional properties of tender coconut water (5-7 months mature) obtained from eight varieties of *Cocos nucifera* cultivated in Jaffna, Sri Lanka. Six local varieties *viz.*, *Ran thambili*, *Nawasi*, Green dwarf, Yellow dwarf, Brown dwarf, King coconut, and two hybrid varieties (CRIC 60 and CRIC 65), were tested. Nutritional and physicochemical parameters of the tender coconut water of eight palm varieties were analyzed in triplicates (3 from each palm) using standard assay methods. Based on the study, significantly higher levels of total soluble solids (5.0±0.6 ^{o}Brix) and total protein (0.59±0.15 mg BSA/ml) were found in the King Coconut (Aurantiaca variety). Total sugar content was significantly higher in the King Coconut (63.575±0.28 mg/ml) and CRIC 65 (64.47±2.4 mg/ml) than the other varieties tested. *Nawasi* (43.9±2.42 mg/ml), *Ran thambili* (43.8±3.6 mg/ml), Green dwarf (44.22±1.47 mg/ml), and Yellow dwarf (43.38±3.01 mg/ml) showed significantly higher levels of reducing sugar than other varieties. Total phenolic content was significantly higher in the King Coconut (26.25±1.9 µg GAE/ml) and *Ran thambili* (28.12±2.12 µg GAE/ml) than the others. Total antioxidant capacity was significantly higher in the King Coconut (403.73±13.42 mg GAE/ml), *Ran thambili* (410.21±15.3 mg GAE/ml), and Green dwarf (420.99±9.6 mg GAE/ml) than the other varieties tested. High transmittance percentage (98.8%) and less turbidity were found in *Nawasi* (typical variety) and Green dwarf. These biochemical characteristics of various popular Sri Lankan coconut varieties could be considered when choosing them for commercial products.

Keywords: *Cocos nucifera*, Nutritional properties, Physicochemical, Tender coconut water

Abstract No: 25 ***Life Sciences***

GREEN SYNTHESIS OF SILVER NANOPARTICLES USING WATER EXTRACT OF *PANCHAVALKALA* AND ITS ANTIMICROBIAL ACTIVITY *IN - VITRO*

A.M.A. Fernando[1*] and J.A.M.S. Jayatilake[2]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Oral Medicine and Periodontology, Faculty of Dental Sciences, University of Peradeniya, Peradeniya, Sri Lanka
[*]anumaheshamila@gmail.com

'Panchavalkala' is a combination of water extracts of five barks of medicinal plants widely used for treating wounds in ayurvedic medicine. Three different combinations are commonly used as *Panchavalkala* in Sri Lanka. Recently, the synthesis of silver nanoparticles (Ag-NPs) using various plant extracts has become popular due to their cost-effectiveness, affordability, effectiveness, and eco-friendliness. Therefore, the objective of this study was to synthesize silver nanoparticles using the three different combinations of *Panchavalkala* and to assess their antimicrobial activity (AMA) against some common wound pathogens. Three different *Panchavalkala* combinations were prepared using barks of each plant concentrating into 8:1 by boiling; named as A (*F. bengalensis*, *F. racemosa*, *F. religinosa*, *F. arnottiana*, *G. quaesita*), B (*F. bengalensis*, *F. racemosa*, *F. religinosa*, *T. populnea*, *A. indicum*) and C (*F. bengalensis*, *F. racemosa*, *F. religinosa*, *C. cainito*, *G. quaesita*). Ag -NPs were synthesized by mixing 10 ml of each filtered extract with 90 ml of 1 mM aqueous silver nitrate. Synthesis of Ag-NPs was confirmed by the colour change, UV-visible absorbance and scanning electron microscopy (SEM). Screening of AMA was carried out using the agar well diffusion assay on standard isolates of *Escherichia coli*, *Pseudomonas auregenosa*, *Staphylococcus aureus*, methicillin-resistant *Staphylococcus aureus* and *Candida albicans* as well as clinical isolates of methicillin-sensitive *S. aureus* (MSSA) and methicillin-resistant *S. aureus* (MRSA). Ag-NPs synthesized from each combination of *Panchavalkala* showed antimicrobial effects against all the tested microorganisms. Ag-NPs synthesized from samples B and C showed significantly higher effects than sample A against clinical isolates and standard of MRSA and *C. albicans* ($p<0.0001$). Sample B showed significantly higher effects against clinical isolates and standard MSSA ($p<0.0001$) than samples A and C. In conclusion, Ag-NPs synthesized from the above three combinations of *Panchavalkala* were effective against all the tested microorganisms. Further studies are recommended to explore the molecular-level interactions such as drug antagonism, additivism, and synergy of *Panchavalkala* and Ag-NPs.

Keywords: Antimicrobial activity, Green synthesis, Panchavalkala, Silver nanoparticles, Wound pathogens.

Abstract No: 36 ***Life Sciences***

COMPARATIVE ASSESSMENT OF ACUTE TOXICITY OF SILVER NANOPARTICLES AND *RAJATHA BHASMA* ON BRINE SHRIMP

K.G.C.P. Gamage[1], S.S.S. de S. Jagoda[2], S.K.M.K. Herapathdeniya[3] and B.R. Fernando[4*]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Veterinary Pathobiology, Faculty of Veterinary and Animal Science, University of Peradeniya, Peradeniya, Sri Lanka
[3]Department of Dravyaguna Vignana, Institute of Indigenous Medicine, University of Colombo, Rajagiriya, Sri Lanka
[4]Department of Veterinary Public Health and Pharmacology, Faculty of Veterinary and Animal Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]ruchika@vet.pdn.ac.lk

Nanoparticles provide a promising prospective in future medical applications, especially in fighting against microbial diseases while mitigating the development of acquired resistance in bacteria. Several studies have investigated the potential of using silver nanoparticles to treat infectious diseases, cancers and wounds, although silver may cause toxicities. The ancient Rasa Shastra (Indian Alchemy) and Ayurveda inherit a unique set of herbo-mineral-metallic drugs (Rasa Aushadha), which consist of fine particles believed to be in the nanoscale (e.g. Bhasma). Rajatha Bhasma (RB), made out of fine silver particles, is used to treat neurological, respiratory, digestive, skin and infectious diseases in Ayurveda medicine. However, to date, only a handful of studies have investigated the potential toxicities of these herbo-mineral-metallic drugs used in Ayurveda. The objective of this study was to investigate the acute toxicity of RB in comparison with modern silver nanoparticles (SNP) using brine shrimp lethality bioassay (BSLB). One preparation of RB (RB1) was made by the researchers following the recommended authentic procedures. Two other RB products in the market were purchased (RB2 and RB3). SNP were prepared using the Turkevich method. In order to conduct the BSLB, artificial seawater was prepared in the laboratory. Nauplii of brine shrimp (24 h old) were exposed to different concentrations of RB and SNP (674.00 µg ml^{-1}, 337.00 µg ml^{-1}, 167.00 µg ml^{-1}, 83.50 µg ml^{-1}, 41.75 µg ml^{-1}, 20.88 µg ml^{-1}, 10.44 µg ml^{-1}, 5.21 µg ml^{-1}, 2.60 µg ml^{-1}, 1.30 µg ml^{-1} and 0.65 µg ml^{-1}) in triplicates in 12 well cell culture plates. De-ionized water was used as the control. After 24 h, the number of dead nauplii was counted, and the percentage of deaths was calculated. The lethal concentration required to kill 50% of the population (LC_{50}) was calculated using the software Minitab 14. SNP, RB1, RB2 and RB3, in respective order, had LC_{50} values of 32.75 (±8.50) µg ml^{-1}, 326.17 (±94.40) µg ml^{-1}, 340.03 (±158.50) µg ml^{-1} and 149.52 (±85.85) µg ml^{-1}. The study reveals that the RB preparations were relatively non-toxic compared to SNPs at the concentrations used. However, acute and chronic toxicities associated with RB treatments need to be further assessed in higher animal models.

Keywords: Acute toxicity, Brine shrimp lethality, *Rajata bhasma*, Silver, Silver nanoparticles

Abstract No: 37 ***Life Sciences***

SAME-SEX SEXUAL BEHAVIOUR (SSB) IN FREE-RANGING TOQUE MACAQUES (*Macaca sinica aurifrons*) IN THE LOWER HANTHANA REGION, SRI LANKA

W.M.L.S. Weerasekara[1,2*], W.M.K.B. Wijesooriya[3] and K.B. Ranawana[3]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Zoology, Faculty of Science, Eastern University, Trincomalee, Sri Lanka
[3]Department of Zoology, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]lakshaniw@esn.ac.lk

Same-sex sexual behaviour (SSB) is common in animals, including primates and is often viewed as an "evolutionary paradox" as unlike different-sex sexual behaviour (DSB), it persists without any obvious contribution to reproductive success. While SSB has been documented in many primate species, SBS in *Macaca sinica* has not been reported in previous studies. We conducted a behavioural study in free-ranging *M. sinica* as a part of a long-term study to document the occurrences of sexual encounters and to provide a qualitative description of SSB. Data were collected from August 2020 to August 2021 in lower Hanthana (7°15′24″ N 80°36′08″ E) from two groups of macaques A (n=37-53) and B (n=20-24). The adult male/female ratio in A and B ranged from 0.6-0.8 and 0.5-0.6, respectively. Scan sampling was carried out for 3-5 days/month from 0700 to 1700 h resulting in a total of 1,123 observational hours. Sexual behaviours were observed for the bout, kiss, masturbation, ventral hug, clutching reaction, mount position, partial mount, sideway mount, mount refusal, genital manipulation and mount rhythm. In troop A, 162 DSB and 163 SSB encounters were documented, while 64 DSB and 51 SSB occurrences were recorded for troop B. Mounting was the most frequently recorded SSB and DSB activity for both groups. Similar to *M. fuscata*, the fundamental factor of homosexual mounting is challenging to examine with no physiological information available. Adult male–adult female DSB encounters were higher in troop B (81%) compared to A (54%). Female-female SSB in troop A was recorded as 1%, whereas in troop B, it was 10%. Adult male–adult male SSB was higher in troop B (37%) compared to A (18%). There was no significant association between sexual behaviour and the troop size (χ^2=1.146, df =1, p=0.284), depicting that when the number of individuals in a troop is high, the sexual encounters were also high and individuals can involve in both SSB and DSB. The unusual SSB among free-ranging adult and sub-adult males of *M. sinica* could be serving as a practice for DSB, avoiding/managing stress or simply pleasure-seeking.

This work was supported by Idea Wild under the research equipment grant [501c(3)].

Keywords: Different-sex sexual behaviour, *Macaca sinica*, Same-sex sexual behaviour

Abstract No: 44 ***Life Sciences***

INSECTICIDE RESISTANCE IN SELECTED *CULEX* MOSQUITO SPECIES IN SRI LANKA

S.N. Palliyaguru[1,2], T.C. Weeraratne[1], W.G.D. Chathuranga[3] and W.A. de Silva[1*]

[1]Department of Zoology, University of Peradeniya, Peradeniya, Sri Lanka
[2]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[3]Department of Zoology, University of Ruhuna, Matara, Sri Lanka
[*]depriyanka@yahoo.com

Culex mosquitoes are widely distributed with a broader host range and are possible vectors of emerging infectious diseases. Thus, continuous assessment of their responses to mosquito control approaches is essential. This study aimed to determine the insecticide resistance mechanisms of *Culex quinquefasciatus*, *Cx nigropunctatus* and *Cx sitiens* in Sri Lanka. Mosquito samples were collected from Kandy, Kurunegala and Puttalam districts. Collected samples were tested to determine the activity levels of detoxifying enzymes and Acetylcholinesterase insensitivity to Organophosphates and Carbamates. Biochemical assays were conducted according to the procedures outlined by the World Health Organization. From each population >200 mosquitoes were subjected to Protein, Esterase (ES), Glutathione-S-transferase (GST), Monooxygenase (MO), and Acetylcholinesterase (ACE) assays. Relatively high specific activity levels of ES (1.01±0.2 μmol mg^{-1} min^{-1}) and remaining activity levels of ACE (87.05±15.12%) were reported from *Cx quinquefasciatus* from Kurunegala. Specific activity levels of GST for *Cx quinquefasciatus* populations from Kurunegala and Peradeniya were 0.63±0.09 and 0.6±0.11 μmol mg^{-1} min^{-1}, respectively. A relatively high activity level of MO (0.23±0.12 μmol mg^{-1} min^{-1}) was reported from *Cx quinquefasciatus* from Peradeniya. *Cx sitiens* population, which was collected from forested habitats, showed relatively less activity levels for ACE (67.63±18.72%), GST (0.44±0.14 μmol mg^{-1} min^{-1}) and ES (0.72±0.26 μmol mg^{-1} min^{-1}). *Cx nigropunctatus* populations reported moderate activities for all tested enzymes. A significantly high enzyme activity levels of *Cx quinquefasciatus* ($p<0.05$) populations suggested the relatively high resistance developed by these mosquito populations to all insecticide groups.

Financial assistance from University Research Grant (Grant No URG-2021-33/S) is acknowledged.

Keywords: Acetylcholinesterase, Chemical assay, Esterase, Glutathione-S-Transferase, Monooxygenase

Abstract No: 45 ***Life Sciences***

GENOME AND RESISTOME OF DRUG-RESISTANT *ENTEROBACTER* SPECIES ISOLATED FROM LIVESTOCK WASTE USING NANOPORE SEQUENCING

L.R.L.S. Kumari[1], H.R.N. Jinadasa[3] and W.R.P. Wijesinghe[1,2*]

[1]Department of Botany, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[3]Department of Veterinary Pathology, Faculty of Veterinary Medicine & Animal Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]priyangaw@sci.pdn.ac.lk

Antibiotic resistance (ABR) is a major global health issue. *Enterobacter* species are common nosocomial pathogens that acquire multiple drug resistance (MDR) in addition to the intrinsic β lactam resistance. The study determined the whole genome and the antibiotic resistome of selected bacterial isolates from livestock farms in the Kandy District using Oxford Nanopore sequencing. Collected cow dung samples were screened for the presence of β-lactam resistant bacteria using a 96-well plate-based assay. The DNA from the selected antibiotic-resistant bacteria (ARB) was extracted using QIAamp DNA mini kit. The whole genome was sequenced using Oxford Nanopore® MinION Rapid Barcoding Sequencing (SQK-RBK004). Generated FastQ files from MinKNOW software were analyzed using EPI2ME with WIMP. In the Galaxy platform, generated genomes were assembled using Flye, visualized using Bandage image, evaluated using QUAST, and assessed MDR using ABRicate in the CARD database. Plasmids were detected using PlasFlow/Staramr tools and annotated using Prokka. According to the WIMP analysis (threshold = 750,000 score), one strain of ARB was identified as *Enterobacter cloacae* (strain 1) with 100% read count, while three isolates were identified as *Enterobacter hormaechei*. All genomes generated circularized chromosomes ranging from 4.8–4.9 Mb, while circularized plasmids were present in strains 2, 3, and 4 ranging from 53 - 225 kb. A list of MDR of *E. cloacae* carried carbapenem, cephalosporin, cephamycin, fluoroquinolone, glycylcycline, monobactam, penam, penem, phenicol, rifamycin, tetracycline, and triclosan resistance genes of ramA (efflux pump) and blaCHM-1 genes. Three *E. hormaechei* isolates contained 13 different ABR genes, which were common to all three isolates. The Oxford Nanopore sequencing coupled with Galaxy bioinformatics tools were successfully used to determine the whole genomes, taxonomy, and the genomic and plasmid resistomes in *Enterobacter* spp.

Financial assistance from the Postgraduate Institute of Science, University of Peradeniya (Grant No. PGIS/2020/17) is acknowledged.

Keywords: Enterobacteriaceae, Galaxy, Multidrug resistance bacteria, Oxford Nanopore sequencing

Abstract No: 46 ***Life Sciences***

COMPUTER-AIDED DRUG DESIGN WITH KNIME PLATFORM TO DISCOVER DNMT INHIBITORS FROM PHYTOCHEMICALS

L.R.L.S. Kumari[1] and W.R.P. Wijesinghe[1,2*]

[1]Department of Botany, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]priyangaw@sci.pdn.ac.lk

High throughput screening of drug candidates is an expensive and time-consuming process with a high rate of failure. In this regard, computational approaches using quantitative structure-activity relationship (QSAR) are a significant aid, enabling biological activity prediction using theoretically calculated physicochemical properties of candidate molecules. When coupled with machine learning (ML), QSAR approaches to create an ideal platform for discovering potential drug candidates. DNA methyltransferases (DNMTs) are epigenetic target enzymes responsible for adding the methyl group to the fifth position of the DNA base cytosine. Other than a few available drugs, several natural products have been discovered as inhibitors of DNMTs due to their availability and less toxicity. In this study, we combined a QSAR approach with ML using TeachOpenCADD KNIME workflows and applied it to identify plant molecules structurally similar to the active pharmaceuticals of current DNMT inhibitors. KNIME v4.5.2 was used with the KNIME cheminformatics extension. Simplified Molecular Input Line Entry System (SMILES) notations of 295 drug molecules were retrieved from the ChEMBL database, where 27 molecules are known DNMT inhibitor drugs, 229 molecules are phytochemicals, and the rest are used to treat other diseases. FeatMorgan molecular fingerprints were used to prepare the dataset for ML using the RDkit fingerprint. The dataset was cross-validated at 15% by train-to-test ratio. Random forest, Support Vector Machine and Artificial Neural Network were used to train the model to accurately classify DNMT inhibitor medications from candidate phytochemicals with an accuracy of 92.9, 92.2, and 91.9%, respectively. Predicted molecules were filtered with Lipinski's rules of 5 to determine the drug-likeliness. Totally nine phytochemicals were predicted as DNMT inhibitors. These results suggest that the predicted phytochemicals can be studied as potential inhibitors against DNMT. However, further *in-vitro* and *in-vivo* efficacy studies need to be conducted on these phytochemicals.

The authors would like to thank Prof. Dayajan S. Wijesinghe, Department of Pharmacotherapy and Outcomes Sciences, Virginia Commonwealth University, School of Pharmacy, VA, USA, for introducing us to KNIME.

Keywords: DNMT inhibitors, KNIME, Machine learning, Phytochemicals

Abstract No: 50 ***Life Sciences***

ANTIBACTERIAL PROPERTIES OF FOLIAR FUNGAL ENDOPHYTES ASSOCIATED WITH SRI LANKAN MANGROVES

R. Baskaran[1], K. Rajan[1], K.K. Uthpala[1], R.J.K.D.R.H. Ranathunga[1], C.D. Costa[1] and D.M.S.U. Dissanayaka[1,2*]

[1]School of Science, Business Management School, Colombo, Sri Lanka
[2]Edith Cowan University, Australia
[*]udeshinis@gmail.com

Recent researchers have steered their attention towards plant-based antimicrobial agents to overcome antibiotic resistance and the adverse effects of synthetic antibiotics. Hence, mangrove fungal endophytes, the occupiers of internal plant tissues, and their secondary metabolites are being vastly studied. However, the antimicrobial properties of Sri Lankan mangrove fungal endophytes are relatively unexplored. The current investigation aims to detect the inhibitory potential of the foliar fungal endophytes isolated from seven mangrove species from the Western Province of Sri Lanka, *viz.*, *Avicennia marina*, *Bruguiera gymnorrhiza*, *Nypa fruiticans*, *Rhizophora mucronata*, *Rhizophora mangle*, *Sonneratia alba* and *Sonneratia caseolaris*. Pure fungal isolates obtained by the culture-dependent method were subjected to solvent extraction using ethyl acetate. The antimicrobial screening was performed using the well diffusion assay against two microorganisms: *Escherichia coli* (ATCC 25922), a Gram-negative bacterium and *Staphylococcus aureus* (ATCC 25923), a Gram-positive bacterium, and diameters of the inhibition zones were measured. The highest number of isolates (3) were obtained from *S. alba* and *S. caseolaris*. *Aspergillus tamarii, Aspergillus terreus, Aspergillus flavus, Aspergillus niger, Penicillium citrinum, Penicillium notatum* and *Penicillium verruculosum* were isolated from certain mangroves and categorised based on their macroscopic and microscopic characteristics. Most of the isolates were inhibitory against both the test organisms except *A. flavus* isolated from *R. mangle*. The highest inhibitory action was exhibited by *P. notatum* of *N. fruiticans* against *S. aureus* (22$\pm$2.5 mm) and *E. coli* (19.5$\pm$2.5 mm). The least potency was exhibited by *A. terreus* (7$\pm$1.1 mm) isolated from *S. alba* against both test organisms. A greater inhibitory action was exhibited towards *S. aureus* than *E. coli* except for the positive control, *P. citrinum* isolated from *R. mucronata* and *S. alba*. Other isolates exhibited low to moderate activities. Hence, it is evident that the foliar endophytes are capable of eliciting bacteriostatic action against certain bacterium and will aid in the discovery of non-synthetic antibiotics.

Keywords: Antimicrobial agents, Ethyl acetate extraction, Well diffusion

Abstract No: 58 ***Life Sciences***

INSECTICIDE RESISTANCE OF *SITOPHILS ORYZAE* AND *CALLOSOBRUCHUS MACULATUS*, TWO MAJOR COLEOPTERAN PESTS OF STORED GRAINS IN SRI LANKA

G.N.P.V. Anuradha[1,2], W.A.P.P. de Silva[1] and T.C. Weeraratne[1*]

[1]Department of Zoology, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]thiliniw@sci.pdn.ac.lk

Post-harvest loss of stored grains due to insect pests is a major problem in Sri Lanka. Control of these pests has become challenging due to the development of insecticide resistance. This study aimed to investigate insecticide resistance of two major stored product pests: rice weevil, *Sitophils oryzae* and cowpea weevil, *Callosobruchus maculatus*, against commonly used pesticides, malathion and deltamethrin. Five concentrations of each insecticide were selected based on preliminary results. Healthy adults (25-30), obtained from the stock cultures were exposed to each concentration (replicates were conducted to test >100 individuals per concentration) for 1 h using the insecticide-impregnated paper method. Mortalities were recorded after a 24-h recovery period. Log-probit curves were constructed, and the lethal doses needed to kill 50% and 90% (LD_{50} and LD_{90}) of the established population were obtained by regression analysis. For both species, lethal dosages for deltamethrin were lower than that for malathion, indicating susceptibility to deltamethrin. The LD_{50} of *Ca. maculatus* for deltamethrin (LD_{50}=200 mg/l) was 12.5 times lower than that of malathion (2,500 mg/l). The LD_{90} (2,600 mg/l) of *Ca. maculatus* for deltamethrin was closer to the LD_{50} of malathion (2,500 mg/l). For *Si. oryzae*, the LD_{50} and LD_{90} for deltamethrin were 2,400 and 9,700 mg/l, respectively. Both these values are noticeably higher than the values obtained for *Ca. maculatus*. The lethal dosages for malathion for *Si. oryzae* was slightly higher (LD_{50}=2,400 mg/l, LD_{90}=9,500 mg/l) than that of *Ca. maculatus* (LD_{50}=2,500 mg/l, LD_{90}= 8,500 mg/l). Overall, these results indicated a higher level of resistance in *Si. oryzae* to both insecticides. The susceptibility to deltamethrin suggests it could be more effective in controlling both pest species. Studies continue to determine the underlying resistance mechanisms these species show to tested insecticides.

Financial assistance from PGIS Research Grant Programme 2020 (Grant No. PGIS/2020/12) is acknowledged.

Keywords: Insecticides, Insect pests, Mortalities, Resistance

Abstract No: 65 ***Life Sciences***

AWARENESS AND PERCEPTIONS ON MICROPLASTICS: A CASE STUDY FROM SRI LANKA

W.M.K.N. Premarathna[1*], H.M.S.P. Madawala[1], A.M.T.A. Gunaratne[1] and S.P. Abeysundara[2]

[1]Department of Botany, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Statistics and Computer Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]kumudinp@gmail.com

Microplastic (MP), derived from the long-term degradation of plastics, pollution has become a major global issue, and its impacts on natural ecosystems and organisms are largely unknown. As the impacts of MPs are relatively less visible in the short term, people pay less attention to the usage and disposal of plastics. The lack of awareness of MPs and their negative consequences can be a major drawback in introducing effective control measures to minimize their impacts. Thus, the current study investigates the level of awareness of MPs among a representative population of the general public and their perceptions of using plastics. The convenience sampling method was employed to select the study population representing rural and urban residents. A questionnaire was distributed among 166 respondents belonging to the age group of 20 - 40 years through different means and collected responses for a period of six months in 2021. A majority of the respondents were females (70%) and students (58%). Approximately 67 and 68% of respondents were aware of MPs and their harmful impacts, respectively. Nevertheless, a majority of respondents (66%) were not aware of the regulatory measures introduced by the authorities to control the usage of plastic items and to dispose of them without harming the environment. About 66% of respondents discard plastic items daily or weekly, suggesting extensive use. A majority (85%) of respondents were not aware that burning plastics is a prohibited action. The results also revealed that the awareness of MPs and their impacts were significantly related to the gender, level of education, and occupation of the respondents. However, their awareness of regulatory measures of plastics did not show any relationship with the aforementioned demographic characteristics. Their positive perceptions in relation to plastics were significantly associated with the education level and occupation of the respondents. As an example, unemployed respondents were more mindful (98.4%) of the non-biodegradable nature of plastics than that of students and employed respondents. In contrast, students were more aware of the impacts of MPs on plant growth than that of unemployed and employed respondents. Overall, the respondents were generally mindful of MPs and their environmental impacts; thus, they showed a willingness to use eco-friendly substitutes to reduce plastic usage in the future. The study highlights the need for effective measures to enhance the awareness of regulatory measures regarding the usage and disposal of plastics among the public to curb adverse consequences of MP pollution.

Keywords: Awareness, Microplastic pollution, Perceptions, Regulations, Sri Lankan community

Abstract No: 68 ***Life Sciences***

KNOWLEDGE AND ATTITUDES TOWARDS RUBELLA VACCINATION AMONG WOMEN AGED 18 - 45 YEARS IN COLOMBO DISTRICT

J.A.J.D. Jayakodi[1], S.S. Wettasinghe[1], A.S.G. Kosgolla[1], Y.T.D.M. Yapa[1], A.M.F. Faheema[1], J.D.K. Dunukara[1*] and J. Perera[2]

[1]Department of Biomedical Science, KIU, Koswaththa, Sri Lanka
[2]Department of Microbiology, University of Colombo, Colombo, Sri Lanka
[*]jayani@kiu.ac.lk

Rubella is considered a common cause of congenital disabilities worldwide and still rising in developing countries despite widespread vaccination campaigns. This descriptive cross-sectional study was conducted among 412 females between 18 - 45 years in the most densely populated district of Colombo in Sri Lanka to assess the knowledge and attitudes regarding the rubella vaccine. The data were collected using the pre-tested online survey with the ERC approval of KIU (KIU/ERC/21/182) and analyzed using SPSS 25 software. The mean population age was 27 years, and the majority were between 22-25 years (33.7%). 27.9% of participants knew that Sri Lanka was now a rubella-free country. 84.7% of participants accepted the need for rubella vaccination before pregnancy. 70.9% of participants had thought that the rubella vaccination was safe, and 25.2% had assumed the vaccine had serious side effects. 71.4% of participants stated that the rubella vaccine should be given to society even after eliminating rubella disease from Sri Lanka. 46.6% of the population had good knowledge about rubella vaccination, and 31.0% had moderate knowledge. 17.9% of the population had a good attitude towards rubella vaccination, and 43.6% had a moderate attitude. Significant positive associations were found between knowledge and attitudes regarding vaccination ($p<0.05$) and the willingness to vaccinate their children with the rubella vaccine ($p<0.0001$) using chi-square test in descriptive statistics. Females between 18-45 years in the Colombo District had commendable knowledge and moderate attitudes about rubella vaccination, which is essential in maintaining rubella eradication in Sri Lanka. However, it is necessary to increase the awareness of rubella vaccination in Sri Lanka.

Keywords: Females, Rubella, Sri Lanka, Vaccination

Abstract No: 73 ***Life Sciences***

COMPARATIVE GENOMIC ANALYSIS OF *PECTOBACTERIUM CAROTOVORUM* PHAGE P15_PC2B6 ISOLATED FROM CARROT FIELD SOIL

K.N. Naligama[1] and A.P. Halmillawewa[1*]

[1]Department of Microbiology, Faculty of Science, University of Kelaniya, Kelaniya, Sri Lanka
[*]anupama@kln.ac.lk

Phylogenetic relationships play a significant role in the taxonomic identification of organisms. The classification helps in revealing the shared genomic and biological characteristics of an organism in comparison to its close relatives. Due to the recent advancement in next-generation sequencing technologies, the number of genomes deposited into public databases has dramatically increased. Among them, the taxonomic classification of bacterial viruses has reached a new level, where nucleotide and protein homologies are utilized to determine their phylogenetic relationships. In this study, the taxonomic relationship of *Pectobacterium carotovorum* phage P15_PC2B6, isolated from carrot field soils in the Badulla District, Sri Lanka, was determined using bioinformatic tools. In the VICTOR-generated phylogram of the annotated whole genome of P15_PC2B6 (Genbank Accession No: ON995367) with other known phage genomes of subfamily *Studiervirinae*, P15_PC2B6 clustered with the members of the genus *Unyawovirus*. Further, the phylogenetic reconstruction generated with the maximum-likelihood method using the amino acid sequences of RNA polymerase of the subfamily *Studiervirinae* demonstrated that the P15_PC2B6 grouped well with the known members of the genus *Unyawovirus*. Additionally, genome-wide comparisons employing TBLASTX homology of the P15_PC2B6 genome with the genomes of two members of the *Unyawovirus* genus, *Pectobacterium phages* phiPccP-1 and DU_PP_II, revealed that they shared a similar gene structure, indicating a closer relationship between them. Also, these phages shared closer average nucleotide identities (~91%) with the phage P15_PC2B6. The results of these comparative genomic analyses provide sufficient evidence for the placement of P15_PC2B6 within the genus *Unyawovirus* of the subfamily *Studiervirinae.*

Financial assistance from 'The World Academy of Science' (Grant ID: 17-446 RG/BIO/AS_I-FR3240297764) and the National Science Foundation of Sri Lanka (Grant ID: RG/2019/AG/01) is acknowledged.

Keywords: Comparative genomics, Genus *Unyawovirus,* Phylogenetic relationship

Abstract No: 76 ***Life Sciences***

BIOLOGICAL CONTROL OF *PODOSPHAERA* SP., THE CAUSAL AGENT OF EGGPLANT POWDERY MILDEW DISEASE BY *ILLEIS CINCTA* (COLEOPTERA: COCCINELLIDAE)

E.M.D. Ekanayake[1], W.A.I.P. Karunaratne[*1], K.M.G.G. Jayasuriya[2], K.S. Hemachandra[3], A.K. Karunarathne[4], A.D.S.N.P. Athukorala[2] and E.S.M. Edirisinghe[2]

[1]Department of Zoology, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Botany, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[3]Department of Agricultural Biology, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka
[4]Department of Agricultural Engineering, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka
[*]inokap@sci.pdn.ac.lk

Eggplant, *Solanum melongena* L. is infected by many diseases, including powdery mildew caused by *Podosphaera* spp. (Family: Erysiphaceae), which seriously affects yield. The mycophagous coccinellids play an important role as biocontrol agents in controlling powdery mildew disease. The present study investigates the efficacy of the coccinellid beetle, *Illeis cincta* (Fabricius), in controlling powdery mildew disease in eggplant. The study was conducted at Meewathura farm, Peradeniya, Sri Lanka from December 2021 to April 2022. The 100 m^2 cultivation area had 76 one-square-meter plots, each with an eggplant. As symptoms of powdery mildew disease appeared on leaves, a survey was conducted to determine the abundance of associated coccinellid beetles. Randomly selected 16 plots were sampled twice a week for five weeks; both sides of all leaves from top to bottom of each plant were observed for symptoms. The number of infected and healthy leaves per plant per plot was also recorded. Plant disease incidence was determined using a disease index and severity scale. The abundance of *I. cincta* larvae and adults was quantified per plot. Identification revealed *Podosphaera* sp. as the causal agent of powdery mildew. During the flowering stage, *I. cincta* population density positively correlated to disease severity while disease incidence negatively correlated with *I. cincta* population density. *Illeis cincta* abundance is significantly higher ($p < 0.05$) in the voracious larval stage than in the adult stage and the larvae had more negative impact on the disease. Initially, the total abundance of *I. cincta* increased with time but started decreasing by the second week with decreasing disease severity. The present study revealed that *I. cincta* abundance was positively related to the damage severity of powdery mildew. Increase in *I. cincta* abundance with disease severity may lower further spread of the disease. Overall, *I. cincta* is a vital biocontrol agent to control powdery mildew disease on eggplants. Biodiversity enhancement within agroecosystems by conserving natural enemies will be an effective alternative for pesticide usage and managing pests/diseases in eco-friendly cropping systems.

Financial assistance from National Research Council (Grant No 20:010) is acknowledged.

Keywords: Biological control, Coccinellidae, Eggplant, *Illeis cincta*, Powdery mildew

Abstract No: 80 ***Life Sciences***

IN VITRO ANTIMICROBIAL ACTIVITY OF TRADITIONAL MOUTHWASH PREPARATIONS: A PRELIMINARY STUDY

P. Rohini[1*] and G.J. Panagoda[2]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Oral medicine and Periodontology, Faculty of Dental Sciences, University of Peradeniya, Peradeniya, Sri Lanka
[*]prohini165@gmail.com

Antimicrobial agents administered systemically or locally can help to suppress periodontal pathogens. In *Siddha* medicine, *Padikkaraneer (PN)*, *Panchathuvarpikasayam (PT)* and *Mayakaaineer (MN)* are used as mouthwashes in treating oral diseases. In this study, the herbal mouthwash preparations (HMP) were tested for their antimicrobial activity (AMA) against oral ulcer-causing pathogens *viz, Candida albicans*, *Escherichia coli*, *Pseudomonas aeruginosa* (Gram-negative) and *Staphylococcus aureus* (Gram-positive). Recommended guidelines in the *Siddha* texts were used to prepare the mouthwashes. AMA of each HMP was checked using the agar well diffusion method. Each experiment was carried out in duplicate and repeated thrice. Significant differences among HMP were analyzed using one-way ANOVA. HMPs showed significant antimicrobial activity ($p<0.001$) against tested strains. It was observed that *PN* was the most effective among the three HMPs. The inhibitory effect of the three HMPs and the positive control on the standard organisms and clinical isolates demonstrated that *PN* contains higher antimicrobial activity. *MN* showed a zone of inhibition against *E.coli*, *P.aeruginosa* and *S.aureus.* No activity was reported against the fungi. *PT* was less effective against both Gram-negative and Gram-positive bacteria and fungi. This study revealed a potent *in vitro* activity of HMP on certain oral ulcer- causing pathogens. Results scientifically validate the inhibitory capacities of *PN* and *MN* in Siddha medicine, and the findings contribute towards developing new treatment options based on herbal mouthwashes.

Keywords: Antimicrobial activity, Gram-negative, Gram-positive, Herbal mouthwash preparations, Siddha

Abstract No: 87 ***Life Sciences***

PLANT–POLLINATOR INTERACTIONS IN RESIDENTIAL GARDENS IN THE KANDY MUNICIPAL COUNCIL AREA

H.M.D.N. Herath[1], K. Yakandawala[1*] and E.S. Minor[2]

[1]Department of Horticulture and Landscape Gardening, Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, Sri Lanka
[2]Department of Biological Sciences, Institute for Environment Science and Policy, University of Illinois at Chicago, Chicago, IL, USA
[*]kapilay@wyb.ac.lk

Residential gardens provide a significant component of urban landscapes, but their relative contribution to pollination remains largely un-quantified. Vegetation in these gardens plays a vital role in conserving pollinators. Hence, the present study aimed to investigate the contribution of garden flora to insect pollinator conservation. Six Grama Niladhari Divisions (GND) were randomly selected in the Kandy Municipal Council area, and a cluster of 10 adjacent residential gardens was selected in each GND (n=60). In each front garden, vegetation was identified. The gardens were visited once a month for three months to quantify floral resources and pollinator visitations. Pearson's correlation analysis was used to investigate the relationship between the abundance of floral resources and pollinators. Data were analyzed using R-studio software. The garden flora belonged to 92 families represented by 321 species. The majority of species belonged to the family Arecaceae (7%), followed by Fabaceae (6%), Poaceae and Asteraceae (5%). Overall, we recorded 3,153 pollinator visits. Among them, bees were dominated (54%), followed by flies (22%) and butterflies (15%). Arecaceae recorded the highest number of plant-pollinator interactions, followed by Asteraceae and Fabaceae. A significant moderate correlation was observed between floral abundance and pollinator abundance ($p<0.05$; Correlation coefficient[r]=0.36), suggesting that increasing floral abundance could support the attraction of pollinators. Hence, we recommend maintaining residential garden flora with abundant floral resources to support the pollinators. Based on the study, planting designs of the residential gardens could be enriched with the members of the families Arecaceae, Asteraceae and Fabaceae.

Keywords: Floral resources, Garden flora, Plant–pollinator interactions, Pollinator conservation, Residential gardens

Abstract No: 94 ***Life Sciences***

TOXICITY OF *TERMINALIA ARJUNA* (COMBRETACEAE) USING BRINE SHRIMP ASSAY

H.D.T. Madhuranga*, M.R.K. Farween, J.I.M.K. Ilangage, W.H.Y.P.S. Rupasena and D.N.A.W. Samarakoon

Department of Biomedical Science, Faculty of Health Sciences, KIU, Battaramulla, Sri Lanka
**kiu.b56365@kiu.ac.lk*

Terminalia arjuna (*Kumbuk*) is a herbaceous, ever-green tree, standing 20 - 30 m above ground level, in the Family *Combretaceae*. The plant has shown many medicinal and antimicrobial properties in previous studies. Even though the medicinal value of *T. arjuna* has been extensively studied, there are no toxicity assays. The objective was to identify the minimum toxic concentration of the crude extract of *T. arjuna* using a brine shrimp assay. The brine shrimp lethality assay of the aqueous extracts of the *T. arjuna* plant was used to determine the toxicity of the *T. arjuna* bark aqueous extract. The air-dried plant material was powdered and extracted into distilled water in a 1:3 ratio using the laceration technique. The dilution series was prepared with two-fold dilution, one gram of bark aqueous extract powder dissolved in 4 ml of distilled water, starting from 1g/ml to 1.9×10^{-3} g/ml concentration. Their ability to kill a cultured larva (nauplii) was observed. Ten larvae were exposed to plant extract for 24 h. The number of live larvae was observed using the naked eye, and the mortality percentage and LC_{50} (the median lethal concentration) were calculated using *GraphPad Prism* software. The study was triplicated. The mortality percentage and LC_{50} were calculated using *GraphPad Prism* according to a log concentration and percentage mortality graph and compared with *Meyer's* or *Clarkson's* toxicity scale (if LC_{50} < 1,000 µg/ml is considered toxic if LC_{50} > 1,000µg/ml is considered as non-toxic). The resulting LC_{50} was = 0.0083 g/ml for the aqueous extract. The results confirmed that the plant extract is nontoxic, and the minimum toxic concentration of *T. arjuna* in the brine shrimp assay was 0.0083 g/ml.

Keywords: Brine shrimp assay, *Terminalia arjuna*, *T*oxicity

Abstract No: 105 ***Life Sciences***

QUANTITATIVE ESTIMATION OF EXTRACELLULAR ENZYME ACTIVITIES OF BACTERIAL STRAINS ISOLATED FROM MANGROVE SEDIMENTS IN PUTTALAM LAGOON, SRI LANKA

D.A. Narampanawa, K.E. Weerasinghe and A.P. Halmillawewa*

Department of Microbiology, University of Kelaniya, Kelaniya, Sri Lanka
**anupama@kln.ac.lk*

Mangrove ecosystems provide habitats for diverse bacterial populations with extensive abilities to produce various secondary metabolites and extracellular enzymes such as amylases, proteases, cellulases, and lipases. These secondary metabolites and extracellular enzymes are known to harbour great biotechnological potential making them good candidates for various industrial applications. The present study was focused on the quantitative estimation of extracellular enzyme production capabilities of eight bacterial strains isolated from mangrove habitats located in the Puttalam lagoon, Sri Lanka. In a previous study, these bacterial isolates were screened qualitatively for the production of amylase, protease, and cellulase enzymes, and isolates positive for each of the selected enzyme production were quantitatively analyzed using the spectrophotometric methods. Out of the four amylase-positive bacterial isolates, the highest amylase activity was observed with PUTS1_2 (1.397 ± 0.055 U/ ml), whereas the minimum amylase activity was given by the PUTS2_10 (0.573 ± 0.032 U/ ml). According to the qualitative screening, seven isolates produced protease, while the highest and the lowest protease activities were detected with PUTS1_1 (1.743 ± 0.010 U/ ml), and PUTS2_12 (0.093 ± 0.011 U/ ml), respectively. The highest cellulase activity was given by the PUTS2_6 (3.229 ± 0.081 U/ ml), whereas PUTS2_5 had the lowest activity (0.792 ± 0.042 U/ml) among the five cellulase-positive isolates. Isolate PUTS2_2 exhibited comparatively higher activities for all the three enzymes quantified. Further studies are needed to understand the potential use of these extracellular enzymes in various large-scale industrial applications.

Financial assistance from the University of Kelaniya, Sri Lanka (Grant No: RP/03/02/03/01/2019) and TWAS (Grant No: 17-446 RG/BIO/AS_I-FR3240297764) is acknowledged.

Keywords: Amylase activity, Bacterial extracellular enzymes, Cellulase activity, Protease activity

Abstract No: 112 ***Life Sciences***

BIOSYNTHESIS OF SILVER NANOPARTICLES USING *LACTOBACILLUS FERMENTUM*, AND CHARACTERIZATION AND *IN-VITRO* ANTIBACTERIAL EFFECT AGAINST *SALMONELLA TYPHI*

A. Mudalige[1*], D. Gunasena[1], P.A.S.R. Wickramarachchi[2] and C. de Silva[3]

[1]Department of Microbiology, University of Kelaniya, Kelaniya, Sri Lanka
[2]Department of Chemistry, University of Kelaniya, Kelaniya, Sri Lanka
[3]Western California University, USA
[*]ayanka96mudalige@gmail.com

The biological synthesis of silver nanoparticles (AgNPs) is a novel and alternative approach to antibiotics. This study was designed to biosynthesize and characterize AgNPs and evaluate the *in-vitro* toxicity of AgNPs against *Salmonella typhi* (ATCC14028). Cell-free supernatant of 16s-rRNA sequenced *Lactobacillus fermentum* (L_{12}) was provided as the reducing and stabilizing agent during the synthesis of AgNPs when supplied with Ag^{+}. Formation of AgNPs was indicated by the absorption peak at 410 nm in the UV-Vis spectrum. Transmission and Scanning Electron Microscopy revealed the size of AgNPs in the range of 5-20 nm. Further, AgNPs exhibited a peak at 3.0 keV in Energy Dispersive X-ray analysis. *In-vitro* antibacterial activity was evaluated by the agar well-diffusion method (in triplicates) using Muller-Hinton Agar, and the average diameter of inhibition of 15.3 mm was obtained. The characterization of nanoparticles revealed the synthesis of stable AgNPs. The application of these AgNPs as an effective *in-vitro* antibacterial agent against ATCC14028 was verified.

Keywords: Antibacterial activity, *Lactobacillus fermentum*, Nanoparticles, *Salmonella typhi*

Abstract No: 118 ***Life Sciences***

CONTROL OF *AEDES* LARVAE USING CRUDE EXTRACTS OF PLANT MIXTURES OF *CAPSICUM FRUTESCENS*, *ALLIUM SATIVUM* AND *PSOPHOCARPUS TETRAGONOLOBUS*

M.W.M.P. Nawarathne[1], J.M.S. Jayasinghe[1,2*] and W.A.P.P. de Silva[1,3]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[1,2]Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka
[1,3]Department of Zoology, University of Peradeniya, Peradeniya, Sri Lanka
[*]susanthij@sci.pdn.ac.lk

Dengue is a vector-borne viral disease transmitted by mosquito species *Aedes aegypti* and *Ae. albopictus*. Control of the vector mosquito population is challenging due to human-influenced breeding sites. Larval control is one of the most effective methods compared to other mosquito control methods. In this study, larvicidal activities of hot water, cold water and water:acetone extracts of plant mixtures of *Capsicum frutescens* (king chilli/ "Naimiris"), *Allium sativum* (garlic) and *Psophocarpus tetragonolobus* (winged beans) were tested against third instar larvae of mosquitoes of genus *Aedes*. Also, red and green *C. frutescens* were separately added to the plant mixtures to investigate the significant difference in larval mortalities. Stock solutions were prepared using each solvent extract; final concentrations of test solutions were set as 1,000, 2,000, 5,000, and 10,000 mg $L^{-1,}$ while distilled water was used as the control. Larval mortalities were observed after 24 and 48 h exposure periods. Cold water and water:acetone extracts showed 90 and 100% mortality after 24 h, respectively, and 100% larvae mortality after a 48 h exposure period at 10,000 mg L^{-1}. Larval mortalities increased with increasing concentrations and exposure time. The hot water extracts did not show any significant larval mortalities. LD_{50} values of the mixture, which includes green *C. frutescens* was relatively low (LD_{50}=2,460.29 mg L^{-1}) compared to that of red *C. frutescens* (LD_{50} = 2,577.86 mg L^{-1}). Water:acetone extracts had the highest efficacy against larvae (100% larval mortality). Larvicidal effect of water:acetone extracts of *P. tetragonolobus* (leaves and pods) alone and a mixture of green *C. frutescens* and *A. sativum* showed that the mixture of green *C. frutescens* and *A. sativum* has the highest efficacy (100% larval mortality within 9 h). *Psophocarpus tetragonolobus* pods and leaves showed 30 and 25% mortality after 24 h exposure, respectively, and 70 and 35% mortality after 48 h exposure, respectively. These results revealed that the water:acetone extract of green *C. frutescens* and *A. sativum* mixture showed relatively high larvicidal activities against *Aedes* larvae with the lowest LD_{50} values (2,051.01 and 1,097.69 mg L^{-1} for 24 and 48 h exposure periods, respectively). The results of the study suggest that the plant mixture of green *C. frutescens* and *A. sativum* could be used as an environmentally friendly alternative to chemical insecticides.

Keywords: *Aedes* larvae, Dengue, Larvicidal activity, Plant extracts

Abstract No: 137 ***Life Sciences***

SYNERGISTIC EFFECT OF WATER HARDNESS AND FLUORIDE ON ZEBRAFISH (*DANIO RERIO*) EMBRYONIC DEVELOPMENT

K.P.A. Imanthi[1,3], M.M. Pathmalal[1,3*] and J.K.P. Wanigasuriya[2]

[1]Centre for Water Quality and Algae Research, Department of Zoology, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
[2]Centre for Kidney Research, Department of Medicine, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
[3]Faculty of Graduate Studies, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
[*]pathmalal@sjp.ac.lk

Among water quality parameters, hardness and fluoride play a vital role in hatchability, larval growth and survival of fish eggs. Fluoride is mainly derived from the solvent action of water on rocks. Water hardness measures the calcium (Ca^{2+}) and magnesium (Mg^{2+}) in water. Excessive water hardness levels and fluoride can be toxic and cause oxidative stress in fish. The present study evaluated the synergistic effect of water hardness and fluoride on zebrafish embryonic development. Zebrafish (*Danio rerio*) is an ideal model for studying toxicological and environmental effects on early embryonic development due to its small size, short life cycle, ex-utero development and transparency of the embryo. Following the Sri Lanka standards for potable water, maximum permissible levels of hardness (600 mg/l) and fluoride (1.5 mg/l) were used for the experiment, and the control was filter-sterilized distilled water. Solutions were added into 30 embryos at 2 h post-fertilization (hpf) and retained up to 96 hpf. The experiment was repeated three times using three different batches simultaneously. Variations in hatching rate, hatching time and mortality rate were observed and recorded for the experimental solutions compared to the control. Embryos exposed to the hardness of 600 mg/l, fluoride of 1.5 mg/l and synergistic solution (hardness + fluoride) have recorded a 0% mortality rate and 100% hatching rate. Embryonic hatching time in the three solutions was 60±1.15, 57±3.05 and 78 ±1.15 hpf, respectively, while in the control solution, it was 54±1.15 hpf. No morphological abnormalities were observed other than the hatching delay compared to the control. Thus, the results of the study suggest that hardness and fluoride have a synergistic effect on the hatching time of zebrafish embryos and no critical effects from single exposure under laboratory conditions.

Financial assistance from grant ASP/01/RE/SCI/2022/16, Centre for Water Quality and Algae Research, University of Sri Jayewardenepura is acknowledged.

Keywords: Embryonic development, Fluoride, Hardness, Synergistic effect, Zebrafish

Abstract No: 139 ***Life Sciences***

RAMAN SPECTROSCOPY CHARACTERIZATION OF SERUM-DERIVED EXTRACELLULAR VESICLES FROM TUBERCULOSIS PATIENTS

W.R.U.A. Bandara[1], D. Madegedara[2], W.A.I.P. Karunaratne[3] and D.N. Magana-Arachchi[1*]

[1]Molecular Microbiology & Human Diseases project, National Institute of Fundamental Studies, Kandy, Sri Lanka
[2]Respiratory Disease Treatment Unit, General Teaching Hospital, Kandy, Sri Lanka
[3]Department of Zoology, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]dhammika.ma@nifs.ac.lk

Raman spectroscopy has been increasingly applied in disease diagnosis and appears to be a promising tool. Tuberculosis (TB) continues to be a chaotic infectious disease that needs urgent medical attention upon diagnosis. According to our knowledge, no studies to date have investigated the diagnostic use of Raman spectroscopic analysis of serum-derived extracellular vesicles (EVs) concerning tuberculosis. In this study, a total of 46 serum-derived EV samples (Active tuberculosis (ATB, n=14), latent tuberculosis (LTB, n=15), household contacts (CT, n=10), and healthy controls (HC, n=7)) were isolated from patients attending the chest clinic in Kandy. These samples were biochemically investigated using Raman spectroscopy with a laser wavelength of 785 nm. Raman spectra were collected from 100 to 3,200 cm^{-1} wavelengths for all patient samples. Spectra were normalized using the WiRE 3.4 software. The mean spectra, peak analysis, and principal component analysis (PCA) were performed using Origin Pro V10.5.88. The results show intensity variations in five main Raman peak positions from 756-1425, 1440-1740, 1750-2400, 2400-2800, and 2900-3100 cm^{-1}, and may play a major role in TB detection. In addition, higher Raman intensities in these regions are mainly assigned to lipids (Region 2, 3, and 4), proteins (Amide bands 1 and 2), and carbohydrates (Region 2, 3, 4, and 5). The highest Raman peak was observed around 2127-2135 cm^{-1}. The mean peak intensities (Arbitrary unit: a.u.) of the highest Raman peak showed a gradual decrease from ATB to HC (Mean Raman peak intensities for ATB: 3909.71, LTB: 3294.75, CT: 2733.27 and HC: 1963.14 a.u.). The PCA results from this study confirmed that the first three principle components (PC1, PC2, and PC3) contribute more than 99.5% to the variance of the four clinical groups. According to the score plot, all four clinical groups showed a clear differentiation among groups. Furthermore, each clinical cohort showed characteristic Raman peaks that need further analysis and validation to investigate the contribution towards biochemical pathways involved in TB pathogenesis. Overall, our preliminary results demonstrate that Raman spectroscopy could be used to differentiate between serum-derived EVs from ATB, LTB, CT, and healthy individuals.

Keywords: Extracellular vesicles, Raman spectroscopy, Serum, Tuberculosis.

Abstract No: 143 ***Life Sciences***

DIET AND FEEDING PREFERENCES OF THE SRI LANKAN JACKAL (*CANIS AUREUS NARIYA*)

U. Jayaweera and S.S. Seneviratne*

Laboratory for Molecular Ecology and Evolution, Department of Zoology and Environment Sciences, University of Colombo, Colombo, Sri Lanka
**sam@sci.cmb.ac.lk*

The Sri Lankan jackal (*Canis aureus nariya*) is the only wild canid species and the third largest carnivore on the island. However, no dietary analysis has been reported from Sri Lanka. The main aim of this study is to fill this research gap. A total of 32 likely jackal faecal samples were collected across the country. Two road-killed carcasses were dissected, and the stomach, foregut, hindgut and rectum were separately extracted. Microscopic hair analysis was conducted to identify mammalian prey species in the diet. The gut compartments and faecal matter were examined under a dissecting microscope at the laboratory. The frequency of occurrence and percentage of biomass consumed from different food items were calculated for dissected guts and known faecal (n=8) samples. Four food types were identified in the jackal diet: small mammals (e.g. Rodents such as *Rattus* sp.), plant materials (e.g. jackfruit, banana peels and cooked rice), birds (e.g. Munias such as *Lonchura* sp.), and invertebrates (e.g. beetles and insect larvae/maggots). The main food type in terms of percentage biomass consumed was small mammals (64.1%) followed by plant material (32.9%), birds (2.4%), and invertebrates (0.6%). In terms of percentage frequency of occurrence, the most important food item in the diet was plant material (60.0%), followed by small mammals (26.7%), birds (6.7%), and invertebrates (6.7%). The majority of the plant material in the food consisted of plant-derived human food. A dichotomous key was constructed to identify jackal faecal samples from that of other sympatric carnivores of Sri Lanka. Despite the small sample size, our results suggest that the Sri Lankan jackal is an omnivorous opportunistic forager that relies on a diverse diet consisting of invertebrates, birds, small mammals, fruits and other edible plant-based foods. Our results further indicate that they frequent human habitations in search of food. The knowledge generated through this study on feeding preferences and diet will help future conservation planning of Sri Lankan jackals.

Financial assistance from the Department of Zoology and Environment Sciences, Faculty of Science, University of Colombo, is acknowledged.

Keywords: Canidae, Carnivore, Faeces, Feeding Ecology, Nariya

Abstract No: 145 ***Life Sciences***

SECONDARY METABOLITES FROM AN ENDOPHYTIC FUNGUS ASSOCIATED WITH *CENTELLA ASIATICA* AND THEIR PHYTOTOXICITY

K. Samarakoon[1], D. Dissanayake[1], N.R. Amarasinghe[2], D. Yakandawala[3], N.S. Kumar[1], N.K.B. Adikaram[1], L. Jayasinghe[1*], H. Araya[4] and Y. Fujimoto[1,4]

[1]National Institute of Fundamental Studies, Kandy, Sri Lanka
[2]Faculty of Allied Health Sciences, University of Peradeniya, Peradeniya, Sri Lanka
[3]Department of Botany, University of Peradeniya, Peradeniya, Sri Lanka
[4]School of Agriculture, Meiji University, Kawasaki, Japan
[*]lalith.ja@nifs.ac.lk

Weeds are a growing problem in agriculture, and synthetic weedicides negatively impact environmental health. Endophytic fungi are studied as an alternative source of bioactive metabolites. *Centella asiatica* (*Gotukola*) of Family Apiaceae is an important medicinal herb known to produce many bioactive compounds. This study was conducted to isolate and investigate the phytotoxicity of secondary metabolites of an endophytic fungus associated with *C. asiatica*. Endophytic fungi were isolated from triple sterilized leaves of *C. asiatica,* collected from the Central Province of Sri Lanka. The pure fungus was cultured on a large scale in Potato Dextrose Broth for five weeks with shaking at room temperature. The broth was then filtered and extracted in Ethyl acetate (EtOAc). Mycelium was extracted in EtOAc and Methanol. Chromatographic separation of combined EtOAc extract of broth and mycelium furnished four compounds austdiol (KCCA-3), 4-(hydroxymethyl)-3-methoxy-5-methylcyclopent-2-enone (KCCA-4), eugentine (KCCA-6), 6-methoxy methyl eugenol (KCCA-8) and their structures were elucidated by detail analysis of Nuclear Magnetic Resonance (NMR). The endophytic fungus was tentatively identified as *Muyocopron laterale* by amplification of ITS regions of rDNA gene. Further, confirmation of the identity of endophytes by other gene regions is in progress. Pure compounds were screened for phytotoxicity by lettuce (*Lactuca sativa*) seed germination inhibition assay and leaf puncture assay using two-week-old cucumber (*Cucumis sativus*) leaves. Compound KCAA-3 showed root and shoot inhibition at IC_{50} 5.38 mg l^{-1} and IC_{50} 805.19 mg l^{-1}, respectively. KCCA-4 and KCCA-8 were found to be with low activity. In leaf puncture assay, KCCA-3 and KCAA-4 resulted in necrotic symptoms after 48 h of treatment and increased by 72 h in 1,000 mg l^{-1} to 31.25 mg l^{-1} concentrations, where necrosis was higher in KCCA-3 in all concentrations than KCCA-4. Results suggest that this endophyte is a source of phytotoxic compounds which could further be tested on weeds to identify their potential for developing eco-friendly weedicides.

Financial assistance from the National Research Council (Grant No: NRC-EWC 18-03) is acknowledged.

Keywords: *Centella asiatica,* Eco-friendly weedicides, Endophytic fungi, Phytotoxicity

Abstract No: 151 ***Life Sciences***

EFFECT OF AQUEOUS EXTRACT OF GREEN SEAWEED, *Ulva fasciata* ON PADDY AND OKRA SEED GERMINATION

R.M.R.D.M. Rathnayaka[1], B.V.A.S. Bambaranda[1] and R.A.I.S. Ariyarathna[1,2*]

[1]*Department of Animal Science, Uva Wellassa University, Badulla, Sri Lanka*
[2]*Seed Certification Service, Department of Agriculture, Sri Lanka*
[*]*rasanjalidil23@gmail.com*

Seeds having good germinability lead to successful crop production and higher yields. As some crop seeds show poor germination, different chemical and biological methods are used to enhance the germination power. Applying seaweed extractions has been used in many parts of the world to enhance the germinability of seeds. Seaweeds contain phytochemical characteristics, including macro-, micro-nutrients, and plant growth hormones, enhancing seed germination. The present study was conducted to evaluate the possibility of using an aqueous extract of *Ulva fasciata* on the germination of paddy (*Oryza sativa)* and okra (*Abelmoschus esculentus)* seeds. The experiment was arranged in a Complete Randomized Design (CRD) with three concentrations (4, 8, and 12%) of *Ulva* extract. All experiments were conducted in triplicate, and data were analyzed using one-way ANOVA at a 95% significance level ($p<0.05$). The results revealed that with Paddy seeds, 8% aqueous seaweed extract showed the highest germination percentage (86.0±1.7%) and Vigor Index II (0.6±0.2), while application of seaweed extract with 12% strength resulted in the highest root length (14.1±0.7 cm) and dry weight (0.007±0.002 g). Seaweed aqueous extract of 4% showed the highest leaf area (3.57±0.18 cm^2), Vigor Index - I (1,391.4±60.9), and Vigor Index – III (1,405.3±60.9). With okra seeds, application of 12% extract gave the highest growth with increased shoot length (12.42±0.32 cm), leaf area (9.26±0.40 cm^2), and dry weight (0.020±0.001 g), Vigor Index – I (1,040.0±70.3), Vigor Index – II (1.7±0.1) and Vigor Index III (1,052.0±70.3). However, the highest germination percentage (84.67±1.45%) was noted with 8% extract, while the lowest germination percentage (57.67±7.31%) The results suggest that 8% aqueous extract enhances seed germination and initial growth of Paddy and Okra.

Keywords: Okra, Paddy, Seaweed aqueous extract, Seed germination, *Ulva fasciata*

Abstract No: 152 ***Life Sciences***

ENZYME INHIBITORY ACTIVITY OF ISOLATED COMPOUNDS FROM AN ENDOPHYTIC FUNGUS ASSOCIATED WITH *ZINGIBER OFFICINALE*

U. Siriwardhane[1], K. Samarakoon[1], E.A.I.A. Perera[1], D. Yakandawala[2], N.S. Kumar[1], N.K.B. Adikaram[1], L. Jayasinghe[1*], H. Araya[3] and Y. Fujimoto[1,3]

[1]National Institute of Fundamental Studies, Kandy, Sri Lanka
[2]Department of Botany, University of Peradeniya, Peradeniya, Peradeniya, Sri Lanka
[3]School of Agriculture, Meiji University, Kawasaki, Japan
[*]lalith.ja@nifs.ac.lk

Endophytic fungi live inside plant tissues and are capable of producing bioactive compounds. *Zingiber officinale* (Ginger) is widely used in medicine, and many studies have investigated its bioactivities. However, there are few studies related to its endophytic fungi. This study was carried out to investigate the bioactivities of compounds produced by an endophytic fungus associated with *Z. officinale*, in which the crude extracts have shown enzyme inhibitory, phytotoxic and cytotoxic activities from our previous studies. Triple sterilized rhizome segments were incubated at room temperature on potato dextrose agar. Emerged Fungus was inoculated in potato dextrose broth medium and incubated for 21 days. After incubation, the broth was filtered and extracted with ethyl acetate (EtOAc). Mycelium was extracted into EtOAc and methanol using sonication. Then, solvents were rotary-evaporated to obtain crude extracts. The extracts were subjected to chromatographic separations using gravity columns, sephadex LH-20 columns, high-performance liquid chromatography using reverse phase C-18 columns, and preparative thin layer chromatography to obtain four pure compounds: adenosine, glycerol, uracil and tyrosol which were identified using NMR data. The compounds were subjected to enzyme inhibitory assays against α-amylase, α-glucosidase, acetylcholineesterase and lipase. According to the results, none of the compounds showed α-amylase inhibitory activity. Adenosine showed α-glucosidase inhibitory activity (IC_{50}=36.04±4.87 mg l^{-1}), which was higher than the positive control acarbose (IC_{50}= 74.44±10.04 mg l^{-1}). Compared to the positive control donepezil (0.76±0.11 mg l^{-1}), adenosine and tyrosol (IC_{50}=27.50±0.67 mg l^{-1}, 52.14±6.75 mg l^{-1}) showed lower acetylcholineesterase inhibitory activity. Lipase enzyme inhibitory activity was exhibited by adenosine (IC_{50}= 134.83±0.87 mg l^{-1}), which was lower compared to the positive control orlistat (IC_{50}= 2.73±1.37 mg l^{-1}). These results suggest that this endophytic fungus could produce potential enzyme inhibitors which can be used as leads for therapeutics.

Financial assistance from National Science Foundation Research Grant RG/2017/BS/06 is acknowledged.

Keywords: Bioactivity, Endophytic fungi, Enzyme inhibition

Abstract No: 153 ***Life Sciences***

SELECTED BIOACTIVITIES OF PLANT EXTRACTS FROM WATER LETTUCE, *PISTIA STRATIOTES*

T.M.K.P. Thennakoon[1], D. Yakandawala[2], J.M.N. Marikkar[1], N.K.B. Adikaram[1] and L. Jayasinghe[1*]

[1]National Institute of Fundamental Studies, Kandy, Sri Lanka
[2]Department of Botany, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]lalith.ja@nifs.ac.lk

Pistia stratiotes is a free-floating aquatic plant commonly known as water lettuce (*Diyaparadel*) of the family Araceae. Benefits derived from *P. stratiotes* include biogas and biofuel production, medicinal properties including wound healing, and treatment for eczema, leprosy, ulcers, piles, stomach disorders, and throat and mouth inflammation. The objective of this study was to determine antifungal activity against *Cladosporium cladosporioides*, antioxidant activity against DPPH (2,2-diphenyl-1-picrylhydrazyl), cytotoxic activity against brine shrimps, phytotoxic activity against lettuce seed germination, α-amylase and lipase inhibitory activity of shoot (SH) and root (RT) crude extracts obtained from *P. stratiotes* plant by using solvents with different polarities. Plants collected from Mahawewa Lake in the Puttalam District, North Western Province of Sri Lanka, were shade dried and ground to a fine powder, extracted to solvents and subjected to bioassays in triplicate per each test. There was a significant antioxidant activity with IC_{50} values for *P. stratiotes* SH extracts 78.04 mg l^{-1}, 251.11 mg l^{-1}, and 24.57 mg l^{-1}. In comparison, RT extracts possess 551.30 mg l^{-1}, 37.41 mg l^{-1}, and 50.96 mg l^{-1} for hexane, ethyl acetate and methanol extracts, respectively, compared to the standard IC_{50} value of ascorbic acid (1.84 mg l^{-1}). Hexane, ethyl acetate, and methanol extracts of *P. stratiotes* SH assessed for cytotoxic properties revealed 93.3, 23.3, and 60.0% cell death, while RT revealed 76.7, 56.7, and 26.7% lethality, respectively. Potassium dichromate was used as the positive control (IC_{50}=24.21 mg l^{-1}). Further, the study revealed the lack of antifungal properties, α-amylase and lipase inhibitory activity in any of the crude extracts tested. Results demonstrate that RT extracts of the plant show better antioxidant, cytotoxic and phytotoxic properties than that of SH. Root extracts of *P. stratiotes* need further studies due to the presence of the aforementioned bioactivities.

Keywords: *α*- Amylase, Antioxidant, Cytotoxicity, Lipase, Phytotoxicity

Abstract No: 155 ***Life Sciences***

ENZYME INHIBITORY ACTIVITY OF COMPOUNDS ISOLATED FROM AN ENDOPHYTIC FUNGUS ASSOCIATED WITH *CURCUMA LONGA*

J. Kalinga[1], K. Samarakoon[1], E.A.I.A. Perera[1], D. Yakandawala[2], N.S. Kumar[1], N.K.B. Adikaram[1], L. Jayasinghe[1*], H. Araya[3] and Y. Fujimoto[1,3]

[1]National Institute of Fundamental Studies, Kandy, Sri Lanka
[2]Department of Botany, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[3]School of Agriculture, Meiji University, Kawasaki, Japan
[*]lalith.ja@nifs.ac.lk

Endophytic fungi are known as treasure houses of natural bioactive compounds. The objectives of this study are to isolate endophytic fungi from *Curcuma longa* L. (Zingiberaceae), known as turmeric, isolate their compounds, elucidate the structures and determine the bioactivities. After triple sterilisation, small rhizome pieces of *C. longa* were placed on Potato Dextrose Agar (PDA). The isolated fungus was tentatively identified as *Fusarium oxyporum* by analysis of ITS1 and ITS4 regions of the rDNA gene. Identification will be confirmed by using other specific gene regions. The fungus was grown on a large scale on Potato Dextrose Broth (PDB). After 4 weeks, the broth and the mycelium were extracted separately into ethyl acetate. After observing the similarities in their Thin Layer Chromatography (TLC), the two extracts were combined. The crude extract was subjected to chromatographic separation (silica gel column chromatography followed by Sephadex LH 20, HPLC and PTLC). This resulted in two pure compounds, and their structures were elucidated using spectral data as fusaric acid (1) and 9,10-dehydrofusaric acid (2). They were subjected to α-amylase, α-glucosidase, lipase and acetylcholinesterase enzyme inhibitory assays. The results revealed that Compound 2 has a strong potential to inhibit α-amylase enzyme activity (IC_{50} of 22.23±4.63 mg l^{-1}) while the positive control acarbose showed IC_{50} of 1.3±0.57 mg l^{-1}. Acetylcholinesterase enzyme activity was strongly inhibited by Compound 1 (IC_{50} of 23.6±5.2 mg l^{-1}) and moderately inhibited by Compound 2 (IC_{50} of 85.8±6.91 mg l^{-1}), whereas the positive control donepezil showed IC_{50} of 0.1±0.01 mg l^{-1}. Both these compounds showed no inhibition of the activities of α-glucosidase and lipase enzymes. Based on these findings, both Compound 1 and Compound 2 have the potential to be used as natural enzyme inhibitors.

Financial assistance from National Science Foundation Research Grant RG/2017/BS/06 is gratefully acknowledged.

Keywords: Acetylcholinesterase, α-Amylase, *Curcuma longa,* Endophytic fungi

Abstract No: 157 ***Life Sciences***

ANTIFUNGAL, ANTIOXIDANT, CYTOTOXIC, PHYTOTOXIC ACTIVITIES AND α-AMYLASE INHIBITION OF *MIKANIA CORDATA* AND *PLUMERIA OBTUSA*

T.D.A.D.K. Kulathunge, J.M.N. Marikkar, N.K.B. Adikaram and L. Jayasinghe*

Natural Products Project, National Institute of Fundamental Studies, Kandy, Sri Lanka
**lalith.ja@nifs.ac.lk*

For thousands of years, natural products obtained from earthly sources have engaged a vital role in medicine, agriculture, cosmetics and the food industry. Various new chemical compounds can be extracted from crude extracts of microorganisms, plants, or animals. *Mikania cordata* (MC) and *Plumeria obtusa* (PO) are plants used to treat numerous diseases in traditional medicine. This study was designed to determine the bioactivities of the leaves of MC and flowers of PO. The plant parts were collected from home gardens, Kandy of Sri Lanka washed, air dried, grounded and prepared the powdered material. Extractions were obtained using *n*-hexane, ethyl acetate (EtoAc) and methanol (MeOH). Phytotoxicity against germination of lettuce seeds, cytotoxicity against brine shrimp, antifungal activity against *Cladosporium cladosporioides*, 2,2-Diphenyl-1-picrylhydrazyl radical scavenging antioxidant activity, α-amylase inhibitory activity and lipase enzyme inhibitory activity were assessed for dilution series of each crude extracts ranging from 1000 mg l^{-1} to 31.25 mg l^{-1}. None of the crude extracts had any considerable inhibitory activity of lipase enzyme. MeOH extract of PO (POM) showed α- amylase enzyme inhibitory activity (IC_{50} 582 mg l^{-1}). MeOH extract of MC (MCM) showed the highest (IC_{50} 97.45 mg l^{-1}) antioxidant activity. EtOAc extract of PO (POE) also showed antioxidant activity (IC_{50} 832 mg l^{-1}). POE and POM showed considerable toxicity, and hexane extract of MC (MCH) showed a captivating lethality against brine shrimp (LD_{50} 1.54 mg l^{-1}). EtOAc extract of MC (MCE) showed inhibitory properties against root and shoot elongation of lettuce seeds. POM displayed an inhibition zone around a spot of a separated compound from MC on the TLC plate against *C. cladosporioides*. Since positive results were obtained for almost all the assays, the pure compounds included in the extracts of MC and PO may have these fascinating properties. Therefore, future studies can be directed towards isolating the responsible bioactive compounds.

Keywords: Bioactivity, Brine shrimp, Lettuce seeds, *Mikania cordata*, *Plumeria obtusa*

Abstract No: 162 ***Life Sciences***

DISTRIBUTION OF *CABOMBA FURCATA*, AN AQUATIC ALIEN INVASIVE IN THE WET ZONE OF SRI LANKA

I. Madola[1*], K. Yakandawala[1], D.M.D. Yakandawala[2] and S. Karunaratne[3]

[1]Department of Horticulture & Landscape Gardening, Faculty of Agriculture & Plantation Management, Wayamba University of Sri Lanka, Sri Lanka
[2]Department of Botany, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[3]Commonwealth Scientific and Industrial Research Organisation, Melbourne, Victoria, Australia
[*]indrakheela@wyb.ac.lk

Cabomba furcata (Cabombaceae), an aquatic plant native to tropical and subtropical Central and South America and the Caribbean, is a popular aquarium plant worldwide. Currently, the plant is recorded from outside its natural range in countries such as India, Peninsular Malaysia and Sri Lanka, indicating its potential to expand the range. In 2021, it was first recorded from natural habitats in the Neboda area in the Kalutara District in the Western Province of Sri Lanka. Further, its ability to extend its territory in the wet zone of the country has also been recognized. Hence, the objectives of the present study were to identify potential areas of occurrence using the species distribution model and to validate it. Field visits were conducted in the wet zone of the country in order to explore new locations in addition to its first recorded location, and GPS locations of the identified populations were logged. The species distribution modelling was carried out with presence-only data and environmental variables covariates (Bio2, Bio3, Bio4, Bio6, Bio7, Bio13, Bio15, Bio17, Bio18, Bio19) to build species' niche and potential geographical distribution model, using the principle of maximum entropy. The model identified parts of the Colombo and Galle districts, in addition to areas in Kaluthara, as the potential areas of occurrence of *C. furcata*. As predicted in the model, field excursions revealed eight new locations, further validating the model used in the study. The results suggest that habitat modelling can provide accurate information to predict areas where the invader could extend its territory. This study suggests the importance of using habitat modelling in predicting invasion. Further, this information would be an eye-opener for the authorities to initiate controlling and eradicating measures immediately for this potential invasive species. If not, this plant will extend its territory and invade other watercourses of the wet zone facilitated by frequent floods. Therefore, monitoring the most probable areas of occurrence predicted by the model is recommended.

Keywords: Alien invasive plant, Aquarium plants, *Cabomba furcata*, Species distribution modelling

Abstract No: 164 ***Life Sciences***

PHYTOTOXIC EFFECT OF ZnO NANOPARTICLES ON *RAPHANUS SATIVUS* L.

P.S. Samuditha[1*], N.M. Adassooriya[2] and N. Salim[1]

[1]Department of Botany, Faculty of Applied Sciences, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
[2]Department of Chemical and Process Engineering, Faculty of Engineering, University of Peradeniya, Peradeniya, Sri Lanka
[*]psahansamuditha@gmail.com

Zinc oxide nanoparticles (ZnO NPs) have been used as a promising micronutrient fertilizer for various crops. However, elevated levels of Zn in the soil might lead to hyperaccumulation in plant tissues causing phytotoxicity. In this study, the effect of ZnO NPs on *Raphanus sativus* L. was evaluated based on plant growth and variations in selected plant metabolites. ZnO NPs were synthesized by the wet chemical method, and the successful synthesis of NPs was confirmed using Powder X-Ray Diffraction (PXRD), Fourier Transform Infrared Spectroscopy (FTIR), and Scanning Electron Microscopy (SEM). SEM images showed that ZnO NPs have a spherical-shaped morphology with an average particle diameter of 70 nm. *R. sativus* did not show any significant toxic effect up to 100 mg/l at the seed germination stage, but at higher concentrations (300 - 1,000 mg/l), root and shoot lengths were significantly reduced. However, the percentage of seed germination was not affected even at 1,000 mg/l. Seedlings grown in acid-washed sand showed that ZnO NPs increased shoot, root lengths and shoot dry mass by 21.5, 50.9, and 52.9%, respectively, even at the highest concentration tested (10,000 mg/l). A dose of 1,000 mg/l ZnO NPs increased the soluble protein content, carbohydrates, chlorophyll a, chlorophyll b, total chlorophylls, carotenoids, and antioxidants by 24.7, 58.5, 38.0, 42.2, 39.9, 11.2 and 7.7%, respectively without affecting the indole acetic acid content. The Zn internalization was confirmed by Atomic Absorption Spectroscopy (AAS), indicating that *R. sativus* can hyper-accumulate Zn at high concentrations (0.36 mg g^{-1} and 1.76 mg g^{-1} at 0 and 10,000 mg/l, respectively), showing insights on health issues regarding Zn toxicity in consumers. Accordingly, treatments below 1,000 mg/l seem to show nontoxic effects on *R. sativus*.

Financial assistance from the Department of Botany, University of Sri Jayewardenepura, is acknowledged.

Keywords: Micronutrients, Nano fertilizer, Phytotoxicity, ZnO Nanoparticles

Abstract No: 168 ***Life Sciences***

EFFECTIVENESS OF A SEED COATING FORMULATION FOR THE SURVIVAL OF *BRADYRHIZOBIUM JAPONICUM* ON SOYBEAN (*GLYCINE MAX*) SEEDS IN STORAGE

D.M.G.I. Dissanayake, T.W.M.M. Wijayasinghe and P.N. Yapa*

Department of Biological Sciences, Faculty of Applied Sciences, Rajarata University of Sri Lanka, Mihintale, Sri Lanka

**pnyapa40@yahoo.co.uk*

Seed coating technology can be used as a potential delivery method for biofertilizers. However, maintenance of the viability of microorganisms in coated seeds is challenging during storage. The current study aimed to develop a potential seed coating mixture and evaluate its effectiveness in maintaining the viability of *Bradyrhizobium japonicum* on soybean (*Glycine max*) seeds in storage. The coating mixture was formulated using xanthan gum as the binder and biochar as the filler. Based on the applicability of the coating mixture on the seed, the xanthan gum to biochar ratio was selected as 80:20 (w/w g). This ratio was modified with different concentrations of xanthan gum mixtures (0.25, 0.50 and 1.00%) and each mixture with and without sucrose (1% W/V) and primed with *Bradyrhizobium japonicum* (3×10^8 CFU ml^{-1}). The viability of the coated seeds and the survivability of the inoculum in the seed coat were tested after 15 days of storage (4 ℃ and 30 ℃). The study revealed that the germinability of coated and non-coated seeds stored at 4 ℃ was significantly higher ($p < 0.05$) compared to coated and non-coated seeds stored at 30 ℃. However, the germinability of non-coated seeds was higher than the coated seeds at both temperatures. The viability of the inoculum was around 1×10^7 CFU ml^{-1} on day 1 after the coating application but drastically decreased after day 3 in both temperatures. Inoculum viability on the seed coat was over 0.7×10^6 CFU ml^{-1} after 15 days of storage under 4 ℃. The seed coating formulation used in this study can hold the viability of *Bradyrhizobium japonicum* only for short-term storage at lower temperatures.

Keywords: Biochar, Biofertilizers, Seed coat, Seed germination, Xanthan gum

Abstract No: 172 ***Life Sciences***

KNOWLEDGE, PRACTICES AND ATTITUDES IN REUSING HOUSEHOLD PLASTIC CONTAINERS AMONG UNDERGRADUATES

M.K.F. Nusla[1], W.A.N.L. Wickrama Arachchi[1], K.L.S.H. Perera[1], H.C.K. Mendis[1], K.P.H.D. Wickramashinghe[1], A.W.M.K.K. Bandara[2*] and Y.P. Nandapala[1*]

[1]Department of Bio Medical Science, Faculty of Health Sciences, KIU, Sri Lanka
[2]Department of Basic Sciences, Faculty of Allied Health Sciences, General Sir John Kotelawala Defence University, Werahera, Sri Lanka
[*]awmkkbandara@gmail.com

Plastics are widely reused for household purposes. However, improper handling and lack of awareness lead to microbial contamination of reusable plastics. Therefore, this study aimed to evaluate the knowledge, practices and attitudes towards reusing disposable household plastic containers for food and beverages among a group of undergraduates. A descriptive, cross-sectional study was carried out with 354 undergraduates. A self-administered pretested questionnaire was used to gather data in five sections: socio-demographic data, practices on reusing household plastic containers, perceived hygiene scale on practices, knowledge and attitude. A score of 1 was given for each correct response. A score of more than 75% was considered good, 50-74% moderate and less than 50% poor for each category. Among 231 respondents, the majority had reused plastic containers such as water bottles, ice cream tubs and lunch boxes. In terms of overall knowledge, it was revealed that 43% of undergraduates had poor knowledge regarding the reuse of household plastic containers for storing food and beverages. On the other hand, only 26% of the participants had poor attitudes about reusing household plastic container usage with food and beverages. Female respondents had relatively higher attitudes compared to males. Moreover, 35% of participants were found to have poor practices in reusing plastic containers for food and beverages. The research findings revealed a poor level of knowledge among participants, attitudes and practices regarding disposable plastic containers used for food and beverages, which can lead to food or water-borne illnesses. Thus, the study highlights the need for further educational programs on reusing disposable plastics.

Financial assistance from KAATSU International University, Sri Lanka, is acknowledged.

Keywords: Food and beverages, Reusing household plastic containers, Undergraduates

Abstract No: 173 ***Life Sciences***

DEGRADATION OF ANTHRACENE BY PHYLLOSPHERE BACTERIUM *BACILLUS VELEZENSIS* AND ITS KINETIC ASPECTS

R.B.N. Dharmasiri[1,2], L.J.S. Undugoda[1*], A.H.L Nilmini[3], M.M. Pathmalal[2,4], N.N.R.N. Nugara[1] and D. Udayanga[1]

[1]Department of Bio-systems Technology, Faculty of Technology, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
[2]Faculty of Graduate Studies, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
[3]Department of Material and Mechanical Technology, Faculty of Technology, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
[4]Centre for water quality and algae research, Department of Zoology, Faculty of Applied Sciences, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
[*]lankaundugoda@sjp.ac.lk

Polycyclic aromatic hydrocarbons (PAHs) are hazardous pollutants, and among them, researchers have been focusing on anthracene due to its high persistence. PAHs released into the environment could be removed by several approaches. Microbial activity is one of the critical remediators of PAH degradation. Few studies have reported the growth kinetics of bacteria on PAHs. Understanding of growth kinetics of bacteria at different concentrations can help determine their applicability in bioremediation. This study aimed to understand the anthracene biodegradation kinetics of *Bacillus velezensis* in the presence of different concentrations of anthracene. *Bacillus velezensis* (Accession number MN190156) was isolated from the phyllosphere of urban areas in Colombo, Sri Lanka. The isolate was acclimatized in an anthracene-rich medium using anthracene-enriched Bacto Bushnell-Hass. Degradation percentages were analyzed using High-Performance Liquid Chromatography. The best degradation percentage was obtained in the 100 mg/l concentration. Cell growth rates and dry weight of cells under different anthracene concentrations were measured for the kinetic assay. The isolate produced by-product 9, 10-Anthracenedione during the degradation and was detected using Gas Chromatography-Mass Spectrometry. This intermediate was tested for phytotoxicity and was revealed to be not harmful to the phyllosphere. The batch tests were conducted to examine the interaction of anthracene for single components by a pure culture of *B. velezensis* under aerobic conditions. Anthracene degradation was fast with the bacterium, resulting in high biomass growth. The optimum anthracene concentration was 100 mg/l, while higher concentrations inhibit bacterial growth as well as being toxic to the phyllosphere. Michaelis-Menten mathematical equation gives a better fit with experimental kinetic data of anthracene. The results confirmed that the high correlation determination values in anthracene degradation convinced their degradation kinetics to fit the first-order kinetic model well. This model provided a suitable prediction of the *B. velezensis* growth kinetic constants and interactions between PAHs substrates.

Financial assistance from the University of Sri Jayewardenepura (Grant No. ASP/01/RE/TEC/2017/72) is acknowledged.

Keywords: Anthracene, *Bacillus velezensis*, Biodegradation, Michaelis-Menten, Phyllosphere

Abstract No: 175 ***Life Sciences***

RED PIGMENT ISOLATED FROM SOIL BACTERIUM KEGS1_1 AS A POTENTIAL BIOACTIVE AGENT: A PRELIMINARY STUDY

B.W.M.K.E. Weerasinghe[1], R.N. Attanayake[2], C.S.K. Rajapakse[3] and A.P. Halmillawewa[1*]

[1]Department of Microbiology, Faculty of Science, University of Kelaniya, Kelaniya, Sri Lanka
[2]Department of Plant and Molecular Biology, Faculty of Science, University of Kelaniya, Kelaniya, Sri Lanka
[3]Department of Chemistry, Faculty of Science, University of Kelaniya, Kelaniya, Sri Lanka
[*]anupama@kln.ac.lk

Prodigiosin, a bright red-coloured pigment of the alkaloid family, mainly produced by *Serratia* spp., is known to harbour antibacterial, antimalarial, and antitumor properties. The main goal of the present study was to characterize and identify bioactive potentials of the intracellular, red-coloured pigment extracted from the soil bacterium KEGS1_1. The pigment was extracted from the KEGS1_1 culture grown in nutrient broth, using solvent extraction with ethyl acetate, and purified by silica gel column chromatography. The colour of the extracted pigment changed into pink and yellow upon the concentrated HCl and concentrated NH_4OH treatments, respectively, indicating the positive presumptive test for prodigiosin. Preliminary characterization of the red pigment by UV-Visible spectrophotometry (λ_{max} = 536 nm) and thin layer chromatography (R_f, = 0.84, chloroform: methanol: acetone 4:2:4) further revealed prodigiosin as a main chemical constituent of the extracted pigment. Antimicrobial activity was determined using a standard disk-diffusion assay against six bacterial and three fungal strains at the concentration of 400 µg of pigment per disk. The pigment exhibited inhibitory effects against the tested bacterial strains *Staphylococcus aureus* (ATCC 25923, 20.11±0.42 mm), *Bacillus subtilis* (ATCC 6633, 32.89±0.87 mm), *Listeria monocytogenes* (NCTC 11994, 21.67±0.27 mm) and *Escherichia coli* (ATCC 25922, 18.44±0.16 mm). However, at the same concentration, no inhibition zones were observed for the tested fungal strains *Candida albicans* (ATCC 10231), *Aspergillus welwitschiae* and *Scelorotinia sclerotiorum.* The DPPH free radical scavenging activity of the pigment increased gradually with the concentration, and the IC_{50} value was 77.03±0.83 µg ml^{-1}. The *in vitro* Sun Protection Factor (SPF) of the pigment was determined using a UV-visible spectrophotometric method, and the pigment showed a moderate SPF value of 24.86±0.05 at the concentration of 2 mg ml^{-1}. The findings of the current study suggested the potential use of the red pigment as an antibacterial and a photoprotective agent.

Financial assistance from the National Research Council, Sri Lanka (Grant No. 20 – 051) is acknowledged.

Keywords: Antibacterial activity, Antioxidant activity, Pigment, Prodigiosin, Sun Protection Factor

Abstract No: 178 ***Life Sciences***

HIDDEN PAINS OF TURF GRASS - "PUTTING GREENS" CAUSED BY GREEN MICRO-ALGAE AND CYANOBACTERIA: A CASE STUDY

W.G.M. Lakmali[1*] and A.D.S.N.P. Athukorala[1,2]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Botany, University of Peradeniya, Peradeniya, Sri Lanka
[*]madushalakmali1992@gmail.com

Turf grass diseases are affecting the esthetic value of golf courses, causing severe economic losses to the management. Despite its economic significance, very few studies are reported worldwide on turf grass pathology and control remedies. Turf grass "putting greens" caused by green algae and cyanobacteria is one such problem occurring during wet seasons. In Sri Lanka, golf is not very popular and restricted to a particular social group. These are not scientifically researched despite their significance to the industry. The current study was conducted to evaluate the reasons for the sudden death of turf grass observed in one leading golf course resort in Kandy, Sri Lanka, which resembled the "putting green" disease. To understand the problem and the source of contamination, a pilot study was carried out to study the presence/absence and prevalence of green microalgae and cyanobacteria in affected and healthy areas. Overall, twenty soil samples were collected from three affected sites, two healthy regions neighbouring the golf course and two samples from sea-sand added areas with 3 replicates per site. A total of 32 species were recorded from affected sites; 15 cyanobacteria and 17 algal species belonging to five classes, Cyanophyceae, Chlorophyceae, Trebouxiophyceae, Klebsormidiophyceae, and Zygnematophyceae, while species number in healthy and sand samples were 2 and 18 respectively. *Chlamydomonas* sp. was common among samplings sites. Further, the species similarity determined by cluster analysis observed between sea-sand samples and affected areas but not with sampling sites neighbouring the golf course suggests that sand samples could be a source of contamination. The "putting green outbreak" seems to be caused by algae and cyanobacteria. However, it needs to be further investigated to confirm. Since most of the species belong to mucilage-producing taxa, this will highly affect the aesthetic value and will raise safety concerns, ultimately affecting their profit margins, highlighting the importance of developing control strategies for turf grass putting the green disease in Sri Lanka.

Keywords: Algae, Black spots, Cyanobacteria, Golf course, Turf grass

Abstract No: 179 ***Life Sciences***

ISOLATION AND IDENTIFICATION OF MICROORGANISMS IN FAECAL MATTER OF DAIRY CATTLE

R.I.S Karunathilaka[1], M.K.S Thilakarathna[1], P.P Jayasekara[2], S. Periyasami[3], P.T Jayasooriya[1] and G.A Gunawardana[2*]

[1]Faculty of Technology, Rajarata University of Sri Lanka, Mihintale, Sri Lanka
[2]Veterinary Research Institute, Gannoruwa, Peradeniya, Sri Lanka
[3]Animal husbandry school, Kundasale, Sri Lanka
[*]gnanavri@yahoo.com

The spreading of disease-causing microorganisms among animals has threatened livestock farming. Pathogenic microbes in the surrounding environment can be transmitted to animals directly or indirectly. Cattle faeces are of diverse bacterial populations with potential pathogens; thus, identifying them is crucial for disease prevention and food safety. The objective of the present study was to isolate and identify the predominant bacteria in dairy faecal matter. Freshly voided faecal samples were collected from ten cattle at a medium-scale dairy farm with different breeds in the Central Province of Sri Lanka. One gram of each sample was used to prepare dilution series in Phosphate Buffered Saline. Three dilutions (10^{-1}, 10^{-2}, 10^{-3}) from each sample were spread plated on Nutrient and Blood agar. Based on morphological characteristics, 35 different colonies were selected and identified by standard microbiological methods, including Gram staining and biochemical analysis. In the current investigation, the predominant bacterial type detected was *Bacillus* spp. (n=2, 62.9%). In addition, the following bacterial species were also recorded less frequently: *Staphylococcus aureus* (n=4, 11.4%), *Pseudomonas aeruginosa* (n=3, 8.6%) and *Enterobacteriaceae* spp. (n=3, 8.6%), *Escherichia coli* (n=2, 5.7%) while *Streptococcus* spp. (n=1, 2.9%) Among the *Bacillus* spp., the majority (n=15, 68.5%) was found to be *Bacillus subtillis*. Notably, from all seven crossbred born animals with combined characters of Fresian, Jersey, Sahiwal, and AFS and 100% Holstein Fresian and Khilari breed animals, *Bacillus* spp., which is known to have probiotic effects was recovered. Further studies on bacterial characterization are necessary for advanced management strategies.

Financial assistance from 292-02-02-02-2507(13) is acknowledged.

Keywords: Bacteria, Dairy cattle, Livestock, Pathogen, Sri Lanka

Abstract No: 181 ***Life Sciences***

RELATIONSHIP BETWEEN AGILITY AND BODY FAT PERCENTAGE OF RUGBY PLAYERS

K.P.I. Silva*, M.A.S. Udayanga, S. Weerasinghe, A.M.G.C.P. Adikari and L.H.M.P. de Silva

Department of Sports Science, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
**pasindusilva@sjp.ac.lk*

Agility is an essential skill in rugby. It is important to look at the factors affecting players' agility levels so that players can be better prepared for competition. However, the lack of bio-motor data is a hurdle in incorporating proper performance analysis in skill development and implementation of training systems by coaches. Hence, this study was designed to initiate a systematic collection of performance data and to assess the relationship between body fat levels and player agility levels using the data collected. The participants were subjected to an inclusion criterion and were given a familiarization session. The relevant body composition measurements (Bodivis Bio-impedance BMR Body Composition Analyzer BCA-2A) were taken. The participants underwent a structured warm-up session consisting of light treadmill running and mobility, and dynamic stretching. Finally, the Modified Change of Direction and Acceleration Test (M-CODAT) was administered. Twenty-five total participants (Forward =13, Back =12) took part in the study and had an average M-CODAT time of 5.46±0.40 s. Strong positive correlations were observed between M-CODAT test times and body fat percentages (r=0.644, p=0.001), left arm fat (r=0.581, p=0.002), right arm fat (r=0.619, p=0.001), trunk fat (r=0.606, p=0.001), left leg fat (r=0.569, p=0.003), and right leg fat (r=0.634, p=0.001). Additionally, a strong negative correlation was recorded between M-CODAT test times and fat-free mass percentage (r=-0.644, p=0.001). The findings indicated that upper body fat levels, along with trunk and lower body fat levels, significantly affect player agility. These findings suggest that player agility could be improved by maintaining lower fat levels in the entire body, which may result in improved rugby performance.

Keywords: Agility, Body composition, Fat levels, Performance, Rugby

Abstract No: 182 ***Life Sciences***

NUTRIENT ANALYSIS OF CULTIVARS OF *CUCURBITA* SPP. (PUMPKIN) GROWN IN THE DRY ZONE OF SRI LANKA

K.O.G.H. Ruwanthika[1*], M.L.A.M.S. Munasinghe[1] and R.A.U.J. Marapana[2]

[1]Department of Botany, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
[2]Department of Food Science and Technology, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
[*]hgamage1010@gmail.com

Different *Cucurbita* spp. generally recognized as pumpkin, is a commonly grown vegetable in dry and intermediate zones of Sri Lanka. *C. maxima* and *C. moschata* are popular cucurbits that include different types of open-pollinated, hybrid and imported varieties. This study aimed to conduct a nutrient analysis of seven pumpkin cultivars collected from Kudaoya in the Monaragala District to identify the differences in the nutrient composition among the selected cultivars. The study area comes under the dry zone low country 1b (DL1b) agro-ecological region. *Rajah, Leela, Malbaro, Batana, Bingha, Katana* and *Meemini* were the selected pumpkin cultivars, and out of these, *Rajah, Leela* and *Katana* were recognized as *C. maxima* varieties. In contrast, *Bingha, Meemini, Batana* and *Malbaro* were recognized as *C. moschata* varieties. All the selected cultivars were collected within a range of 5 km from the Kudaoya town and at their fullest harvestable maturity in the *Maha* season. The collected samples were stored under ambient temperature, and the flesh part of each cultivar was powdered before the nutrient analysis. In the nutrient analysis, the proximate composition, Fe, Mg and K compositions and the anti-oxidant (AO) activity in different pumpkin cultivars were evaluated using standard analytical methods (Protein-Bradford assay, Carbohydrate-Phenol sulphuric method, Lipid content-Bligh and Dyer method, Crude fibre-Weende method, Moisture level-Rapid moisture analyser, Minerals-Atomic absorption spectroscopy method, AO activity-Ferric reducing anti-oxidant power assay). The nutrient compositions among the cultivars were statistically compared through one-way ANOVA. In 100 g of powdered pumpkin flesh, the nutrient composition was reported as protein content in the range of 32.8-32.9 g, carbohydrate 57.8-57.9 g, lipid content 1.04-6.13 g, crude fibre 2.19-10.94 g, moisture level 8.24%-10.95%, Fe content 4.11-7.76 mg, K content 5,055-8,841 mg, Mg content 96.0-337.02 mg and AO activity 145.1-147.1 mg AAE (Ascorbic acid equivalent) in dry-weight basis. The three varieties of *C. maxima* have recorded significantly higher nutrient levels ($p<0.05$) than the *C. moschata* varieties. The overall nutrient composition was significantly higher in the cultivar type '*Rajah*', an imported hybrid variety, compared to the other cultivars analysed in the study.

Financial assistance from the Department of Botany of the University of Sri Jayewardenepura is acknowledged.

Keywords: *Cucurbita* spp., Low country dry zone, Nutrient analysis, Pumpkin cultivars, Sri Lanka

Abstract No: 183 ***Life Sciences***

ANTIOXIDANT ENCAPSULATION AND BIOACCESSIBILITY IMPROVEMENT OF SELECTED UNDERUTILIZED WILD EDIBLES

P.S. Peduruhewa[1,2], K.G.L.R. Jayathunge[1*], D.C. Manatunga[1], R. Liyanage[1], W.R.M. de Silva[3] and K.M.N. de Silva[3]

[1]Department of Biosystems Technology, Faculty of Technology, University of Sri Jayewardenepura, Homagama, Sri Lanka
[2]Faculty of Graduate Studies, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
[3]CAMD Research Laboratory, Department of Chemistry, Faculty of Science, University of Colombo, Colombo, Sri Lanka
[*]lasanthi@sjp.ac.lk

Underutilized wild edibles (UWE) such as *Commelina diffusa* (Girapala) and *Acrostichum aureum* (Kerenkoku) have extensively been reported for their nutritional and antioxidant activity. Nanoencapsulation is used to overcome antioxidant depletion due to chemical and mechanical barriers in the digestive process. This study aims to produce an encapsulated edible fibre mat. This includes ethanol extracts of tender leaves of *C. diffusa* and *A. aureum* (0.2%) as a natural source of antioxidants with a high bioaccessibility fraction. Antioxidant extracts from selected UWE were encapsulated in wall material, hydroxypropyl-β-cyclodextrin (70%) and poly (ethylene oxide) (30%) using the electrospinning technique. The nutritional and physical properties of encapsulated fibre mats were investigated. Physical properties were revealed by scanning electron microscopy, transmission electron microscopy and differential scanning calorimetry. Fibre mats were then assessed for total polyphenol content, ascorbic acid content and antioxidant capacity. Obtained fibre mats by *A. aureum* showed the highest antioxidant activity (DPPH: IC50 value of 0.192 mg/mL, ABTS:352.45 Trolox equivalent antioxidant capacity), total phenolic content [334 gallic acid equivalents (GAE) mg/100 g] and ascorbic acid content (1.52 mg/100 g) compared to the fiber mat by *C. diffusa*. The effect of *in vitro* digestion on the antioxidant-encapsulated fibre mats of selected UWE was evaluated, and the bioaccessibility fraction was calculated. Both antioxidants-encapsulated fibre mats showed an increment in their bioaccessibility fraction while it was 67.3% in *A. aureum* loaded fibre mat and 57.7% in *C. diffusa*-loaded fibre mat. In this study, electrospinning was identified as an effective method to improve antioxidant bioaccessibility fraction in ethanol extracts of tender leaves of *C. diffusa* and *A. aureum*.

Financial assistance from the Faculty of Graduate Studies, University of Sri Jayewardenepura (Grant No ASP/RE/01/FOT/2019/59) is acknowledged.

Keywords: Antioxidants, Bioaccessibility, Encapsulation, Electrospinning, Underutilized

Abstract No: 190 ***Life Sciences***

CORRELATION BETWEEN THE PREVALENCE OF VECTOR IMMATURE STAGES AND DENGUE CASES REPORTED FROM GOTHATUWA MOH AREA, COLOMBO

A.P.S. Perera*, M.M.S.M.B. Marasinghe, H.M.D. Maduranga, B.L. Hewagamage, S. Samaraweera and D.S.A.F. Dheerasinghe

National Dengue Control Unit, Sri Lanka
**paramikaperera90@gmail.com*

Aedes vector data utilized for vector control interventions are often correlated with reported dengue cases. This study analysed data on vector immature stages (VIS) with reported cases in the Gothatuwa Medical Officer of Health (MOH) area, Colombo, from January to August 2022 to assess their correlation to develop a timeline for efficient vector control strategies. VIS data were collected by larval vector surveillance conducted monthly, selecting 100 households systematically and placing 100 ovitraps representing indoors and outdoors equally in each sampling period. The disease surveillance system obtained monthly reported dengue cases for the MOH area. Monthly correlations between dengue cases and vector data (Number of positive premises for larvae-PP, number of positive containers for larvae-PC, number of ovitraps positive for eggs-OP and number of viable eggs-VE of *Aedes* vector) were analyzed using Pearson correlation coefficients. The same analysis was done considering one-month and two-month lag periods for cases. The *Aedes* egg strips collected from the ovitrap surveillances were reared in laboratory conditions to assess viability. Reported cases showed the best positive correlations with PP ($r = 0.57$, $p = 0.24$), PC ($r = 0.63$, $p = 0.08$) and VE ($r = 0.56$, $p = 0.25$) when the one-month lag period was considered. Correlations of the dengue cases with VE ($r = 0.72$, $p = 0.72$) and OP ($r = 0.39$, $p = 0.44$) were increased when the lag period was extended to two months. If the data were contemporary, reported cases showed moderate positive correlation only with PP ($r = 0.55$, $p = 0.25$) and PC ($r = 0.52$, $p = 0.27$). However, a statistical significance was not observed ($p>0.05$) for either of the correlations. Higher vector larval prevalence could best describe potential dengue outbreaks occurring after four weeks, while the availability of viable eggs could describe the same occurrence after four to eight weeks. Prevalence data on each VIS can be used as proactive indicators in predicting outbreaks of a particular area accordingly and planning the optimum time to execute vector control programs to strengthen the preventive aspect of dengue control. Reporting cases may depend on factors other than vector prevalence, although the cases showed some correlations with most VIS data.

Keywords: *Aedes*, Correlation, Dengue, Outbreak, Prevalence

Abstract No: 191 ***Life Sciences***

ENUMERATION AND ANTIBIOTIC SENSITIVITY OF *ESCHERICHIA COLI* AND A SOCIOLOGICAL SURVEY ON WATER QUALITY IN THE RIVER MAHAWELI, SRI LANKA

W.M.S.H. Weerakoon[1*], B.S. Nanayakkara[1], C.L. Abayasekara[1], H.T.K. Abeysundara[2] and L.R.I.S. Liyanage[1]

[1]Department of Botany, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Statistics and Computer Science, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]shashikaw@sci.pdn.ac.lk

While water quality affects health, in Sri Lanka, unlike in developed countries, recreational water quality is hardly assessed. Faecal contamination of recreational water poses health risks as faeces are sources of pathogens. The current study aimed to investigate *Escherichia coli* in recreational water by enumeration to assess antibiotic sensitivity and conduct a sociological survey. Water samples were collected from six bathing locations along the river Mahaweli during rainy and dry periods from 2020 - 2022. Samples were subjected to membrane filtration and typical blue colonies on m-FC agar were enumerated. Antibiotic sensitivity test was performed on *E. coli* isolates using Amikacin (30 µg), Amoxicillin-clavulanate (20/10 µg), Cefotaxime (30 µg), Ciprofloxacin (5 µg), Imipenem (10 µg), Meropenem (10 µg), and Ticarcillin-clavulanate (75/10 µg). A sociological survey was conducted at the bathing locations to infer possible sources of contamination. The *E. coli* counts in 95.0% of water samples exceeded the permissible limit of 235 CFU/100 ml (USEPA). In all locations except one, counts were significantly different between the rainy and dry periods ($p<0.05$). Counts were higher during the rainy period in four sites and lowered in two sites, compared to dry period. The *E. coli* isolates were resistant to Ciprofloxacin (56.5%), Cefotaxime (4.8%), Amoxicillin-clavulanate (4.2%), Amikacin (3.0%), and Ticarcillin-clavulanate (0.6%). None was resistant to Imipenem or Meropenem. In one site, the percentage of isolates that was resistant to at least one antibiotic was significantly higher ($p<0.05$) during the rainy period (92.9%) compared to the dry period (64.3%). According to the survey, the reasons for water contamination at these locations were inadequate sewage facilities, industrial effluents and urban runoff, augmented by water stagnation. The elevated *E. coli* counts and the presence of antibiotic-resistant *E. coli* render the water unsuitable for recreational purposes, emphasizing the need for proper monitoring and necessary action by relevant authorities.

Financial assistance from the University of Peradeniya (URG/2019/29/S) is acknowledged.

Keywords: Antibiotic resistance, Indicator organisms**,** Recreational water, River water

Abstract No: 197 ***Life Sciences***

RE-EVALUATION OF THE CONSERVATION STATUS OF THE GENUS *ELAEOCARPUS* IN SRI LANKA

G.G.N.D. Silva[1, 2*], D.M.D. Yakandawala[1, 2] and K. Yakandawala[3]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Botany, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[3]Department of Horticulture and Landscape Gardening, Wayamba University of Sri Lanka, Sri Lanka
[*]nilankadulanisilva@gmail.com

Elaeocarpaceae, a family with 12 genera, is represented in Sri Lanka by a single genus *Elaeocarpus*. The island harbours nine species, eight endemics, and five are listed under various threat categories in the National Red List 2020. However, extensive fieldwork on this genus has not been carried out after the revision of the genus in 1995. Hence, the study aimed to re-evaluate the conservation status of the genus *Elaeocarpus* employing recent field-collected data from 2019-2022. Forty-five sites were visited, and the GPS locations were recorded. The sites comprised Forest Reserves, Sanctuaries, Strict Nature Reserves and Wildlife Parks, which were selected by referring to literature, including any other possible locations of occurrence. The potential distribution maps were developed by plotting the GPS locations on a map using ArcGIS 10.4 and were used in calculating the Extent of Occurrence and Area of Occupancy. The species evaluations were based on either criterion B or C of the IUCN guidelines 2019. According to the results, the conservation status of six species; *E. ceylanicus* as Critically Endangered (CR); *E. coriaceus* and *E. hedyosmus* as Endangered (EN); *E. glandulifer* and *E. subvillosus* as Nearly Threatened (NT) and *E. serratus* as Least Concern (LC) remained unchanged as given in National Red list 2020. However, with the updated information on the distribution and threats, three endemic species were upgraded; *E. amoenus* from NT to CR, *E. montanus* from Vulnerable (VU) to EN and *E. taprobanicus* from EN to CR. The uplifted threat status would facilitate these taxa to gain priority in conservation plans as the Red List, and its assigned threat status provide baseline information on the healthiness of a country's biodiversity and convey the urgency of conservation issues to the public and policymakers. Furthermore, the study highlights the importance of recent field-based information in determining the threat categories, which is pivotal for all other conservation acts.

Financial assistance from the National Science Foundation, Sri Lanka (Research Grant: RG/2018/EB/01)) is gratefully acknowledged.

Keywords: Biodiversity, Conservation status, Elaeocarpaceae, Red list threat categories

Abstract No: 198 ***Life Sciences***

STEROID EFFECT OF TRIBUTYLTIN ON ZEBRAFISH

K.R.V. Bandara[1,2], S.D.M. Chinthaka[3] and M.M. Pathmalal[1,2*]

[1]Centre for Water Quality and Algae Research, Department of Zoology, Faculty of Applied Sciences, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
[2]Faculty of Graduate Studies, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
[3]Department of Chemistry, Faculty of Applied Sciences, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
[*]pathmalal@sjp.ac.lk.

Tributyltin (TBT) is an organometallic compound identified as a Persistent Organic Pollutant (POP) in the environment. TBT has widespread dispersion, high hydrophobicity, and long-term persistence in the environment and results in bioaccumulation, bio-magnification in food webs, and negative consequences on the ecosystem, including reproductive toxicity. The zebrafish model was used as a model organism in this study to reveal the reproductive hormonal effects of TBT that are predictive of similar outcomes in humans. Different TBT concentrations (1, 10 and 100 ng/l) were exposed to the zebrafish model for three months. Zebrafish, without being exposed to TBT, were used as the control (n=6). Steroid hormone measurements were performed using the Enzyme-Linked Immuno-Sorbent Assay (ELISA). TBT-treated fish at 10 and 100 ng/l reported significantly decreased 17β-estradiol levels, while 1 ng/l treated fish reported no significant changes compared to the control. In control and 1 ng/l TBT-treated fish, 17β-estradiol levels in plasma were recorded as 94.17±13.10 pg/ml and 78.75±7.70 pg/ml, respectively. On exposure to TBT (10 ng/l), 17β-estradiol levels were reduced to 30.42±10.94 pg/ml. However, at a higher concentration of TBT (100 ng/l), the 17β-estradiol levels decreased drastically in plasma at 12.92±8.60 pg/ml. Though Testosterone levels in fish exposed to 100 ng/l were significant ($p< 0.05$) with control, fish exposed to 1 and 10 ng/l were not substantial. Therefore, the results revealed that at a higher concentration of TBT (100 ng/l), 17β-estradiol levels drastically decreased, which was inverse for the testosterone in plasma. The changes in sex hormone levels would finally affect ovarian development and maturation in fish with the potential to induce masculinization effects. This hormonal balance between estradiol and testosterone appears to be crucial in the development of fish. It has been suggested that the reproductive toxicity of TBT compounds is due to the inhibition of the steroid pathways of animals. Therefore, an extended monitoring programme is needed to assess the toxic mechanisms of TBT and its long-term reproductive effect.

Financial assistance from the University of Sri Jayewardenepura (ASP/01/RE/SCI/2017/11) is acknowledged.

Keywords: Tributyltin; Toxicity; Zebrafish, ELISA, Testosterone

Abstract No: 199 ***Life Sciences***

FELINE URINARY BLADDER WORM *CAPILLARIA* (SYN. *PEARSONEMA*) IN SRI LANKA

T. K. de Silva[1], S. Wijeratne[2], P. K. Perera[1], K. Wijesundera[3], W. R. Jayaweera[3], V. Perera[2,4] and R. S. Rajakaruna[1*]

[1]Department of Zoology, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]"Suwana" Pet Care Animal Hospital, 4th Lane, Nagoda, Kalutara South, Sri Lanka
[3]Department of Veterinary Pathobiology, Faculty of Veterinary Medicine and Animal Science, University of Peradeniya, Peradeniya, Sri Lanka
[4]Postgradaute Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]rupika.rajakaruna@sci.pdn.ac.lk

The presence of nematodes in the urinary tract of companion animals, mainly cats and dogs, is considered a rare occurrence. Here, we report a case of urinary bladder capillaries in a cat from Sri Lanka. A three-year-old domestic male cat from the Kalutara District was brought to a private veterinary hospital due to a clinical complaint reporting frequent urination, vomiting, and loss of appetite for one month. The cat's physical examination reported severe emaciation, gasping, abdominal breathing, and retarded growth. Successive to urinary sedimentation, *Capillaria*-type eggs were detected in microscopic analysis. Blood urea nitrogen level (505 mg/dl) and serum creatinine level (7.6 mg/dl) were higher than the normal ranges. Necropsy revealed that the left kidney was enlarged with gross lesions of the oedematous renal parenchyma. Although no adult worms were recovered from the kidneys or bladder, the histopathological examination revealed multifocal areas of tubular degeneration and necrosis with multifocal fibroblast proliferation in the renal cortex, and the lungs showed diffuse pulmonary oedema and chronic interstitial pneumonia. Subsequent DNA extraction, PCR and DNA sequencing from *Capillaria*-type eggs in sedimented urine, an amplicon for *Capillaria* of the 563 bp *18S* rRNA (specifically to identify cardiopulmonary and urinary nematodes) was produced. The sequences were subjected to phylogenetic analysis along with reference sequences in the GenBank. The phylogenetic analysis revealed a 100% identity to *Pearsonema* collected from the urinary bladder of a raccoon from Japan. Cases of *Capillaria* in cats are rarely reported because most infected animals do not show clinical signs. Even though eggs of *Capillaria* were reported in Sri Lanka in the mid-1950s in cat faeces, this is the first case study to investigate this species and its infection in the veterinary medical aspects and identify the species using molecular tools.

Financial assistance from the University of Peradeniya Research Grants (Grant No. URG/2018/39/S) is acknowledged.

Keywords: Feline, Nematode, *Pearsonema*, Sri Lanka, Urinary bladder worm

Abstract No: 200 ***Life Sciences***

INVASION SUCCESS OF *CABOMBA FURCATA* IN THE WET ZONE OF SRI LANKA THROUGH VEGETATIVE REPRODUCTION STRATEGIES

H.M.R.U. Herath[1], K. Yakandawala[1*], D. Yakandawala[2], A.S.A. Salgadoe[1] and G.K.I.S. Madola[1]

[1]Department of Horticulture and Landscape Gardening, Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, Sri Lanka
[2]Department of Botany, University of Peradeniya, Peradeniya, Sri Lanka
[*]kapilay@wyb.ac.lk

Cabomba furcata Schult. & Schult. f., is a submerged aquatic plant with an ornamental value. It occurs naturally in the Kalutara District and is identified as a potentially invasive plant. Recent studies have recorded the plant in parts of the Colombo and Galle districts, indicating its ability to extend territory. The knowledge of the mode of propagation of invasive plants is important in managing their further invasions. Therefore, the study aimed to evaluate vegetative propagation in the spread and establishment of *C. furcata*. Nodal stem parts at different maturity stages (terminal, middle and basal) were laid out in a Completely Randomized Design (n=144) and investigated their ability to propagate. The terminal parts recorded the best growth and survival. Hence, terminal fragments with single to six nodes were used to investigate the ability to propagate. Data were subjected to ANOVA and Tukey Multiple Comparison analysis using R software. The highest survival rate was recorded in terminal fragments (98%), followed by the middle fragments (85%). The mean number of roots produced by the terminal fragments was significantly high ($p>0.05$) compared to other maturity stages. Hence, the terminal fragments could be considered as having the highest capability of contributing to invasion. In the second experiment, all the fragmented terminal stem parts increased their length and produced new shoots and roots, while the fragments with four nodes had the highest survival and growth parameters. Hence, four nodal terminal fragments performed better than other nodal fragments. The capability of fragments to regenerate into new plants could be a reason for the invasion success of *C. furcata*. In addition, as even a single nodal fragment is capable of regenerating, thus any attempts at mechanical control/removal should be carried out with utmost care to minimize fragmentation.

Keywords: *Cabomba furcata*, Invasive aquatic plant, Mechanical control, Propagation, Stem fragmentation

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Abstract No: 211 ***Life Sciences***

ACTIVITY OF '*TRIPHALA*' AGAINST DRUG-RESISTANT *ESCHERICHIA COLI*

S.K.K. Sylvester[1*], C.L. Abayasekara[1], B.S. Nanayakkara[1], A. Manoraj[2] and E.W.M.A. Ekanayake[3]

[1]Department of Botany, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Research Laboratory, Bandaranayake Memorial Ayurveda Research Institute, Nawinna, Maharagama, Sri Lanka
[3]Department of Microbiology, Faculty of Medicine, University of Peradeniya, Peradeniya, Sri Lanka
[*]s16140@sci.pdn.ac.lk

'*Triphala*' is a herbal product used in traditional medicine to treat wounds, coughs, heart disease, and others. It comprises fruits of *Terminalia chebula*, *Terminalia bellirica*, and *Phyllanthus emblica*. The objective of the present study was to assess the inhibitory effect of the combination and constituent dried fruit extracts of '*Triphala*' on antibiotic-resistant *Escherichia coli*. The antimicrobial activity was assessed using the agar dilution assay, with an aqueous extract of 100% (boiled down to 1/8th of the initial volume) and 50% strengths of '*Triphala*'. The combined extract and individual fruit extracts were assessed using one Multidrug Resistant (MDR- resistant to at least one agent in three or more antibiotic classes) and nine Drug-Resistant (DR-resistant to one antibiotic) isolates (all resistant to Ciprofloxacin), previously isolated from river water. Ciprofloxacin (8 µg/ml) was used as the positive control and sterile distilled water as the negative control. Further, aqueous extracts of the three fruits were assessed using X-Ray Fluorescence (XRF) to determine the elemental composition of the three extracts. The results revealed that the aqueous extract (100%) of '*Triphala*' and individual extracts (100%) of *T. chebula* and *P. emblica* exhibited strong antibacterial activity against the MDR *E. coli* isolate resistant to antibiotics Ciprofloxacin [Fluoroquinolone], Amikacin [Aminoglycoside] and Augmentin [β-lactam] and all nine DR *E. coli* isolates. The extract of *T. bellirica* did not exhibit inhibition against the isolates tested. The XRF analysis revealed differences in elemental composition between the three extracts, which could not be attributed to the differences in the activity of the extracts. In conclusion, the combined extract of '*Triphala*' and two of its constituents (*T. chebula* and *P. emblica*) showed activity against drug-resistant *E. coli*, exhibiting their potential to be used as antibacterial agents, particularly in the treatment of infections that are untreatable by synthetic antibiotics.

Keywords: Antibiotics, Ciprofloxacin, Drug-resistant *E. coli*, MDR *E. coli*, *Triphala*

Abstract No: 213 ***Life Sciences***

CANINE GEOHELMINTHS IN DIGANA AND PUSSELLAWA AREAS IN KANDY DISTRICT: INVESTIGATION WITH SPECIAL REFERENCE TO *ANCYLOSTOMA* SPP.

T.H.P.S. Amarasingha[1*], N.M.T. Anupama[2], R.P.V.J. Rajapakse[2] and P.K. Perera[1]

[1]Department of Zoology, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Veterinary Pathobiology, University of Peradeniya, Peradeniya, Sri Lanka
[*]sakuni.amarasingha@sci.pdn.ac.lk

Geohelminths are intestinal parasitic worms that infect humans and animals and are transmitted through contaminated soil. The prevalence of geohelminths is higher in tropical and sub-tropical regions due to favourable soil temperature and soil moisture conditions. Zoonotic geohelminths in domesticated animals like dogs and cats can cross the species barrier to infect humans by ingesting eggs or penetrating infective larvae. The objective of the present study was to investigate geohelminths in dog faeces contaminating the soil in Digana and Pussellawa areas in the Kandy District, with particular reference to *Ancylostoma* spp., taking soil temperature variations into account. Faecal samples collected from free-roaming dogs in Digana (n=22) and Pussellawa (n=22) town areas were analysed using the modified salt flotation technique followed by microscopy and molecular analysis. Soil temperature data from the sampling sites were also collected simultaneously during sample collection using a soil thermometer. Of all dogs sampled, 93.2% were positive for geohelminths. Eggs of *Ancylostoma* spp., *Strongyloides* spp., and *Toxocara canis* were identified from both locations. *Toxascaris* spp. and *Trichuris* spp. were only observed in Digana, whereas *Capillaria* spp. and *Uncinaria* spp. were observed only in Pussellawa. Prevalence and faecal egg counts (FECs) of geohelminths were considerably higher in Digana (28-31 °C) compared to that in Pussellawa (18-21 °C). *Strongyloides* spp. had a significantly high prevalence (40.9%, p=0.004) and FEC (8.015±20.2, p=0.006) in Digana compared to Pussellawa (prevalence=4.5%; EPG=0.455±2.1). *Ancylostoma* spp. reported the highest overall prevalence of 93.2% and the highest overall FECs (115.6±145.4). Amplicons (*ITS1-5.8S-ITS2*) of the expected size for *A. caninum* (427 bp), *A. tubaeforme* (170 bp) and *A. ceylanicum* (268 bp) were produced from five, seven and one of the samples analysed, respectively. This signifies the first molecular identification of *A. ceylanicum* and *A. tubaeforme* in dogs in Sri Lanka, although both species were detected in humans earlier. These findings suggest that free-roaming dogs in Digana and Pussellawa can be a source of zoonotic helminthiasis in urban communities. The low soil temperatures in Pussellawa may affect the development of infective larvae in the soil, thereby reducing the prevalence of zoonotic helminthiasis among free-roaming dogs.

Financial assistance from the University of Peradeniya Research Grants (Grant No: URG/2022/64/S) is acknowledged.

Keywords: *Ancylostoma*, Dog, Geohelminths, Sri Lanka, Zoonotic

Abstract No: 228 ***Life Sciences***

ANTIBACTERIAL ACTIVITY OF DIFFERENT PLANT EXTRACTS AND THEIR COMBINATIONS WITH TURMERIC EXTRACT AGAINST *STAPHYLOCOCCUS AUREUS* STRAINS

M.C.G. Silva[1], D.R. Uduwela[1*], J.M.S. Jayasinghe[1], W.S.S. Gunathilake[1], L.V.C. Liyanapathirana[2], E.W.M.A. Ekanayake[2], U.P.R.U. Dissanayake[2] and A. Wickramasinghe[1]

[1]Department of Chemistry, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Microbiology, Faculty of Medicine, University of Peradeniya, Peradeniya, Sri Lanka
[*]dimanthi.uduwela@sci.pdn.ac.lk

Drug resistance in bacteria has become a major concern in pharmaceutical research. Natural products have high structural diversity and potent antibacterial activity (AA). Hence, they can be a good source for antibacterial drug development. This study aimed to investigate the AA of *Coffea arabica* (Coffee- CF) leaves, *Murraya koenigii* leaves (Curry leaves- CL), *Tabernaemontana dichotoma* (Poison nut- PN) leaves and *Curcuma longa* (Turmeric-TR) rhizomes and their combinations. The crude extracts were prepared using dried, powdered plant parts where the leaves were extracted into water-acetone (v/v 1:1), and TR rhizomes were extracted into methanol-acetone (v/v 1:1) using a bottle shaker. The individual extracts and the nine combinations of three plant extracts with TR extract in 1:3, 1:1 and 3:1 ratios were assessed for AA by broth microdilution assay against five *Staphylococcus aureus* bacterial strains as they are involved in wound infections. Among the four individual extracts, TR showed the lowest Minimum Inhibitory Concentration (MIC) of 98 mg/l, for all five bacterial strains and the lowest Minimum Bactericidal Concentration (MBC) values ranging from 195 - 390 mg/l resulting in the highest AA. CL, CF and PN showed MICs ranging from 780 - 1,560 mg/l, 1560 - 3,125 mg/l and 780 - 6,250 mg/l, respectively and MBCs ranging from 1,560 - 6,250 mg/l, 6,250 - 12,500 mg/l and 1,560 - 12,500 mg/l, respectively. From the nine combinations, CL/TR with 3:1 ratio showed the highest AA (MIC- 48 mg/l, MBC- 98 mg/l). However, in CF/TR and PN/TR, 1:3 ratio showed the majority of low MIC and MBC values against the five bacterial strains. An enhanced AA for the three leaf extracts was observed when combined with TR extract. Amongst the four individual extracts and the nine combinations, CL/TR 3:1 combination exhibited the highest antibacterial properties. Though TR shows the highest AA among individual extracts, it increased the overall AA when present in the mixture of CL/TR in 3:1 ratio. The results revealed that using these plant extracts in combination with TR enhances the AA more than using them as individual plant extracts.

Grant No.: - (AHEAD/RA3/RIC/PDN/SCI/Wound Dressing/OVAA/04) is acknowledged.

Keywords: Antibacterial, Broth microdilution, MBC, MIC, Plant combinations

Abstract No: 238 ***Life Sciences***

PHYSICOCHEMICAL AND MICROBIOLOGICAL PARAMETERS OF SELECTED PLAIN-SET YOGHURT BRANDS IN COLOMBO, SRI LANKA

M.J. Nuzla* and G.G.W. Nandanee

Department of Botany, University of Sri Jayewardenepura, Gangodawilla, Sri Lanka
**nuzlajiffry1993@gmail.com*

Yoghurt is a popular dairy product produced by the lactic acid fermentation of milk. It is consumed worldwide for its nutritional and health benefits. The quality factors of yoghurt are essential to ensure that a safe and healthy product is supplied to the consumers. The lack of investigations into the quality parameters of yoghurt has a potential impact on the health and well-being of its consumer. Hence, this study aimed to investigate the quality characteristics of some high-demand plain-set yoghurts sold in Colombo, Sri Lanka, during refrigerated storage. Four different yoghurt brands were selected based on a preliminary survey. They were examined for their physicochemical (titratable acidity, pH, milk solids non-fat, moisture, syneresis, fat, and protein) and microbiological attributes (total aerobic count, lactic acid bacterial count, yeast and mould count, and detection of coliform bacteria). SLS-approved tests were followed for analysis on days 4, 7, 14, 21, and 28 of their refrigerated storage. The findings were compared against the control, meeting the SLS standard. Microbiological analysis, which was performed in a timely interval during cold storage, showed the parameters *viz.*, total aerobic count and lactic acid bacterial count were within acceptable limits for all yoghurts. However, the yeast and mould count of the test samples was high. Coliforms were undetected in all brands, which is a positive remark concerning the hygienic level of these yoghurt brands. A decrease in moisture content was observed during storage. The results showed a drop in pH and a rise in titratable acidity in yoghurt with no significant difference ($p<0.05$). All yoghurts examined for titratable acidity and syneresis resulted in higher values than the control. The syneresis effect of yoghurts showed a non-significant increase during storage ($p<0.05$). Protein (0.75367 ± 0.00702 - 0.78233 ± 0.01604) and fat content (2.320 ± 0.013 - 3.132 ± 0.281) differed from the values printed on yoghurt. These variations can lead to or cause off-flavours and unacceptable microbiological changes in yoghurts during storage. Therefore, this study emphasized the necessity of manufacturing quality yoghurts with defined physicochemical and microbiological properties highlighting the importance of quality control during storage to ensure the consumer is supplied with a safe product.

Keywords: Microbiological, Physicochemical, Quality evaluation, Yoghurt

Abstract No: 253 ***Life Sciences***

APPLICATION OF PURIFIED AND MODIFIED - PYROLYTIC CARBON CHAR IN RUBBER COMPOUNDING

D.M.D.A. de Zoysa, Y.C.Y. Sudusinghe, J.S. Hewage and A.S. Ranaweera*

Department of Chemistry, University of Ruhuna, Matara, Sri Lanka
**samanthran@chem.ruh.ac.lk*

The waste tire pyrolysis process has attracted considerable interest as a sustainable solution to manage the accumulation of waste tires worldwide. The process produces three main fractions: gas, liquid and solid. The gaseous and liquid fractions are useful in industry as fuels; however, the solid fraction rich in carbon black has no use in Sri Lanka due to the presence of many impurities. The present study describes an efficient and economical route to purify contaminated pyrolytic char to manufacture value-added products. The pyrolytic carbon char was first passed through a 200 µm mesh to separate small particles, followed by size reduction by ball milling. These particles were demineralized stepwise using dilute HCl acid and NaOH at 60 °C for 1.0 h. Treated and untreated samples were characterized by carbon, hydrogen and nitrogen analysis, X-Ray Diffraction analysis and iodine adsorption experiments. The purified carbon black samples were used as reinforcing fillers for preparing rubber compounds according to the American Chemical Society 1 (ACS 1) formula. The physicomechanical properties of rubber compounds of purified carbon black prepared were consistent with compounds prepared with commercial carbon black, N660 and N330. CHN analysis shows that crude pyrolytic char (C-PT) contains 69% carbon, which can be improved up to 90% after washing with 2 M HCl twice and 2 M NaOH once. The iodine number of the sample was improved after demineralization (C-PT 180 mg/g and demineralized sample have 215 mg/g and 188 mg/g, 240 mg/g N660 and N330). There is no significant difference between the abrasion, tensile, tear, and compression properties of controls and ball-milled-treated samples. The average of all compound hardness is similar to the controls. The efficiency and value of the purification protocol in the current study were confirmed by test results and showed high potential application in the industry.

Financial assistance from AHEAD RIC Round 2 No. 18 Grant is acknowledged.

Keywords: Demineralization, Pyrolysis process, Pyrolytic char, Rubber compounds

Abstract No: 256 ***Life Sciences***

EFFECT OF BISPHENOL A ON GROWTH-RELATED OUTCOMES AND SURVIVAL OF EARLY LIFE STAGES OF *POLYPEDATES CRUCIGER*

R.M.H.N. Rajapaksha[1], P. Dissanayaka[2] and R.P.G.K. Rajapaksha[1*]

[1]Department of Zoology and Environmental Management, University of Kelaniya, Kelaniya, Sri Lanka
[2]Department of Statistics and Computer Sciences, University of Kelaniya, Kelaniya, Sri Lanka
[*]gayani@kln.ac.lk

Bisphenol A is a widely used chemical in the plastic industry worldwide. Urban water sources are frequently polluted by bisphenol A leaching from plastic waste and industrial effluents, hence threatening aquatic species. Bisphenol A is an endocrine disruptor that perturbs natural hormone signalling pathways affecting living organisms' growth, development, and physiology. This study assessed the impact of long-term exposure to Bisphenol A on the early life stages of *Polypedates cruciger* (Common hourglass tree frog). Twenty tadpoles of Gosner stage 26 – 27 were assigned to triplicate tanks treated with environmentally relevant concentrations of bisphenol A (1, 10, 100 µg/l) and treatment control (1% v/v ethanol) for 80 days. The total body length, tail length, and body weight of tadpoles were observed weekly. The survival rate, tail length ratio and increments in body weight and length were calculated at the end of the treatment. The total body length of tadpoles increased with increasing concentrations of bisphenol A. Total body lengths of tadpoles in all bisphenol A treatments were significantly higher than those in control ($p<0.05$). The mean tail length ratio gradually increased with increasing concentrations of bisphenol A. Tail length ratio of those in control and 1 µg/l bisphenol A was significantly lower than those exposed to higher exposures ($p<0.05$). Body weight increment was not significantly different between treatment and controls ($p>0.05$). About 90% of all tadpoles survived in treatments and control, with no significant differences in survival between treatments and control ($p>0.05$). Accordingly, it can be concluded that environmentally relevant concentrations of bisphenol A do not affect survival but has significant negative impacts on growth-related parameters in *Polypedates cruciger*.

Keywords: Amphibians, Bisphenol A, Growth, *Polypedates cruciger*, Survival

Abstract No: 262 ***Life Sciences***

EFFECT OF JUVENILE EXPOSURE TO BISPHENOL-A AND BISPHENOL-S ON SEX RATIO AND SWIMMING SPEED OF ZEBRAFISH (*DANIO RERIO*)

M.L.Y. Dulanthi, H.P. Weerarathna and R.P.G.K. Rajapaksa*

Department of Zoology and Environment Management, University of Kelaniya, Kelaniya, Sri Lanka
**gayani@kln.ac.lk*

Bisphenol-A has become a universal environmental contaminant due to its heavy usage in the plastic manufacturing industry. It is a xenoestrogen which perturbs hormone signalling pathways affecting the growth and development of organisms. Bisphenol-S was introduced as a safe alternative to bisphenol-A. However, the relative safety of bisphenol-S has become questionable due to its endocrine disruption ability and environmental occurrence. Therefore, to comparatively assess the biological impact of bisphenol-A and bisphenol-S on freshwater organisms, zebrafish, a popular aquarium fish (*Danio rerio*) at the age of 67dpf (days post fertilization), were exposed to environmental concentrations (0.01 and 0.1 mg/l) of either bisphenol-S, bisphenol-A or treatment control (1%-v/v ethanol) in triplicate. After 35 days of exposure, the gender of adult zebrafish was identified by observing external morphology such as body shape and protruding belly. Female-biased sex ratios were observed in both concentrations of bisphenol-S and bisphenol-A treatments than in the control ($p<0.05$). However, the sex ratios between comparable concentrations of bisphenol-S and bisphenol-A were not significantly different ($p>0.05$). The maximum swimming speed of five random fish from each tank was measured using a swimming chamber. Swimming speed was significantly lower in fish exposed to bisphenol-S and bisphenol-A compared to the control ($p<0.05$). The maximum swimming speed of fish in comparable concentrations of bisphenol-S and bisphenol-A was not significantly different ($p>0.05$). Accordingly, the effects of bisphenol-S exposure on sex differentiation and the swimming speed of juvenile zebrafish were similar to that of bisphenol-A exposure in comparable concentrations. Therefore, based on the findings, bisphenol-S could not be recommended as a safe alternative to bisphenol-A. However, more comparative studies are recommended to comprehensively evaluate the relative safety of bisphenol-S on freshwater ecosystem health.

Keywords: Bisphenol-A, Bisphenol-S, Sex ratio, Swimming speed, Zebrafish (*Danio rerio)*

Abstract No: 281 ***Life Sciences***

SHELL MORPHOMETRY AND RADULAE ANALYSIS OF FRESHWATER GASTROPOD GENUS *PALUDOMUS*

P.H. Liyanagedara, N. Wathuliyadde and S. Kumburegama*

Department of Zoology, University of Peradeniya, Peradeniya, Sri Lanka
**shalikak@sci.pdn.ac.lk.*

Paludomus is the most common genus represented among freshwater gastropods in Sri Lanka. Of the 12 recorded *Paludomus* species, 10 are endemic to the country. Shell morphology is the major taxonomic feature that has been used for their identification. However, the identification of *Paludomus* species using shell features is ambiguous due to shell plasticity and homoplasy. One characteristic that can be reliably used in the systematic identification of gastropods is the radula, unique molluscs feeding structure. Five species of *Paludomus* were identified (*Paludomus chilinoides*, *P. bicinctus*, *P. decussatus*, *P. neritoides*, *P. sulcatus*) using shell morphology from 47 sampling sites spanning the Kandy, Matale and Nuwara Eliya districts. Different shell morphometries, i.e. Shell Height (SH), Shell Width (SW), Aperture Height (AH) and Aperture Width (AW), were measured using a digital Vernier calliper, and shell indices were calculated. A Principal Component Analysis (PCA) was conducted to check whether the species/morphotypes can be distinguished using shell morphometry. Furthermore, the median, lateral and marginal teeth of the dissected radulae were examined using Scanning Electron Microscopy for species characterization. According to the PCA, several of the *Paludom*us species clustered together (*P. chilinoides* and *P. sulcatus* together and *P. bicinctus* and *P. decussatus*), indicating that shell morphometry is not a reliable characteristic for species separation and identification. However, especially the pattern and shape of the cusps of the median teeth in the radulae varied and was unique to each of the species. Hence, the radulae teeth pattern can be used as a reliable character for identifying closely related *Paludomus* species.

Financial assistance from the Ministry of Mahaweli Development and Environment is acknowledged.

Keywords: Freshwater, Gastropods, Morphometry, Radulae, Taxonomy

Abstract No: 300 ***Life Sciences***

COMPARATIVE *IN VITRO* ANTIDIABETIC ACTIVITY OF TWO AMIDES FROM BLACK PEPPER SEEDS (*PIPER NIGRUM* L.) AGAINST POSTPRANDIAL GLUCOSE REGULATORY ENZYMES

S. N. T. I. Sampath[1*], J. M. S. Jayasinghe[2], A. P. Attanayake[3] and V. Karunaratne[2]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Chemistry, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[3]Department of Biochemistry, Faculty of Medicine, University of Ruhuna, Galle, Sri Lanka
[*]thusharaindikasampath@gmail.com

Postprandial high blood sugar could be a risk factor for diabetes mellitus, and this condition is one of the critical points in diabetic treatments. Medication of postprandial hyperglycemia could be attained by mainly inhibiting key regulatory enzymes such as α-amylase and α-glucosidase, which are involved in carbohydrate digestion. Herbal plants are an excellent source to treat this disease and improve the ease of health. *Piper nigrum* L. (black pepper) is a well-known herbal plant belonging to the Family Piperaceae, and it contains a higher number of bioactive compounds. The present study reports the anti-postprandial hyperglycemic activity of an amide (pipnoohine) isolated from the hexane extract of *P. nigrum* seeds and compares it with that of isolated piperine (an antidiabetic compound from *P. nigrum* plant) and commercially available acarbose (a standard antidiabetic drug). The piperine and pipnoohine have been previously isolated from the genus Piper (*P. nigrum*, *Piper longum*, *Piper chaba*). However, the comparison of *in vitro* anti-postprandial hyperglycemic activity of these two compounds is untapped up to date. The two compounds were isolated from hexane extract of *P. nigrum* seeds using chromatographic techniques (vacuum liquid chromatography and flash column chromatography), and they were identified as piperine and pipnoohine, using ^{1}H and ^{13}C NMR, liquid chromatography-mass spectrometry (LC-MS), UV, IR spectroscopy and melting point data. The *in vitro* anti-postprandial hyperglycemic activity of the isolated compounds was determined in terms of the 50% inhibitory potential of α-amylase and α-glucosidase enzymes. Both piperine and pipnoohine inhibited 50% of α-amylase enzyme activity at 37.04±0.94 and 62.22±2.06 mg l^{-1} concentrations, respectively. In the α-glucosidase assay, the piperine and pipnoohine inhibited 50% of the enzyme activity at 51.12±0.09 and 82.42±2.25 mg l^{-1} concentrations, respectively. The pipnoohine showed no significant difference between the above activities with the piperine ($p>0.05$). The acarbose inhibited 50% of the α-amylase and α-glucosidase enzymes at concentrations of 5.72±0.33 and 17.72±0.48 mg l^{-1}, and the activities, however, showed significant differences with the inhibition activities of piperine and pipnoohine ($p<0.05$). This is the first report of α-amylase and α-glucosidase inhibitory activities of pipnoohine and the comparison of *in vitro* anti-postprandial hyperglycemic activity of piperine and pipnoohine. Results concluded that pipnoohine exerted considerable α-amylase as well as α-glucosidase inhibitory activities that indicate that it also can be considered a drug lead for the treatment of diabetes mellitus.

Financial assistance from the National Research Council (Grant No NRC/17/033) is acknowledged.

Keywords: Diabetes mellitus, Enzyme inhibition assays, Piperine, *Piper nigrum*, Pipnoohine

Abstract No: 306 ***Life Sciences***

DENSITY, DISTRIBUTION AND POPULATION DYNAMICS OF RUFOUS WOODPECKER (*Micropternus brachyurus jerdonii*) OVER THREE DECADES IN SRI LANKA

V.R. Gunasekara and S.S. Seneviratne

Avian Sciences & Conservation, Department of Zoology and Environment Sciences, University of Colombo, Colombo, Sri Lanka

The Rufous Woodpecker (*Micropternus brachyurus jerdonii*) is arguably the rarest woodpecker and probably one of the rarest birds in Sri Lanka. Its population seems to be declining in the recent past. Its density, distribution, and population status were evaluated using various techniques. Variable line transects with a fixed 20 m distance for either side were taken in locations where Rufous Woodpecker had been reported over the past 30 years. The information from the Global Biodiversity Information Facility (www.GBIF.org), eBIRD (www.ebird.org), and Ceylon Bird Club notes (CBCN: www.ceylonbirdclub.org) were used to determine the extent of occurrence (EOO) and area of occupancy (AOO). The EOO and AOO are 42,609.84 km^2 and 180 km^2, respectively. The total population size of the species calculated using the line transect data from 2020 to 2022 in Sri Lanka was estimated to be about 32,744 individuals. Kernel density estimation in QGIS was used to produce a heatmap to understand its density and distribution from the past to the present using GBIF (n=139). The equation ($H\ opt = (2/3n)(1/4)\times\sigma$) was adopted to calculate the kernels using the mean centre and standard distance. This occurrence data resulted in 48,733.26 km^2 of EOO. The area of occupancy evaluated over the past three decades (1990-2020) represents over 15 generations of the species to determine whether there has been any shrinking of its range during this period. Our analysis showed that the range of the species had not changed during the past three decades. Further, it suggests that the Rufous Woodpecker has a patchy distribution with fluctuating population size.

Financial assistance from the Department of Zoology and Environmental Sciences, Faculty of Science, University of Colombo, is acknowledged.

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Keywords: Area of occupancy, Extent of occurrence, Kernel density, Population dynamics

Abstract No: 2 ***Physical Sciences***

EXPLORATION OF COSMECEUTICAL POTENTIAL OF LEAF EXTRACTS OF GUAVA (*Psidium guajava* L.)

D.D.D.H. Dewage[1*], S.H.S. Karunaratne[2] and C.S.K. Rajapakse[1]

[1]Department of Chemistry, University of Kelaniya, Kelaniya, Sri Lanka
[2]Industrial Technology Institute, Colombo 07, Sri Lanka
[*]dewagedarshani@gmail.com

Sunscreen formulations are widely used to prevent and minimize harmful UV-induced photodamage. Nowadays, sunscreen development using natural ingredients revolutionises the cosmetic industry as they are healthier and safer than synthetic chemicals. Therefore, this study was focused on the evaluation of the cosmeceutical potential of leaf extracts of Psidium guajava L. (collected from Padukka, Sri Lanka) by determining their photoprotective properties and antimicrobial activities. Chemical constituents of guava leaves were cold extracted to ethanol, ethyl acetate and distilled water separately. The in-vitro sun protection factor (SPF) of each extract was determined using a spectrophotometric method and the Mansur equation. As many natural antioxidants and antimicrobial agents are phenolic, and flavonoid compounds, the total phenolic content (TPC) and total flavonoid content (TFC) of each extract were determined by Folin-Ciocalteau method and AlCl3 colorimetric method, respectively. Antimicrobial activity was determined by Agar well diffusion method against the bacterial strains of Staphylococcus aureus (ATCC 25923), Pseudomonas aeruginosa (ATCC 9027), Escherichia coli (ATCC 25922) and a fungal strain of Candida albicans (ATCC 10231), the potential pathogens in cosmetics. The treatments were triplicated (n=3). All extracts exhibited UV B absorption. Among them, the ethyl acetate extract showed an SPF value of 43.77±0.16 at 2.0 mg/mL while the SPF of the reference sunscreen was 39.18±0.56 (sunscreens with SPF>30 provide high protection against sunburn). The highest TPC was found to be in ethyl acetate extract (544.06±4.81 mg of gallic acid equivalent/g of dry weight), while the highest TFC was observed in ethanol extract (13.84±0.89 mg of quercetin equivalent/g of dry weight). According to the results, all extracts showed antibacterial activity against tested bacterial strains, while only the ethanol extract showed antifungal activity. This study revealed that guava leaves could be considered a promising natural source for the cosmeceutical industry as it is rich in chemical constituents with photoprotective properties and antimicrobial activities.

Financial assistance from the University of Kelaniya (Grant No RP/03/02/06/01/2018) and the National Science Foundation, Sri Lanka (Grant No RG/2013/EQ/01) are acknowledged.

Keywords: Antimicrobial, SPF, TFC, TPC

Abstract No: 8 ***Physical Sciences***

FERROMAGNETIC THIN FILMS WITH FCC STRUCTURE AS DESCRIBED BY FOURTH ORDER PERTURBED HEISENBERG HAMILTONIAN WITH SEVEN MAGNETIC PARAMETERS

M.S.M. Farhan[1, 2*] and P. Samarasekara[3]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Physical Sciences, South Eastern University of Sri Lanka, Sammanthurai, Sri Lanka
[3]Department of Physics, University of Peradeniya, Peradeniya, Sri Lanka
[*]salyfarhan243@gmail.com

Magnetic properties of fcc structured ferromagnetic ultra-thin films with two spin layers were described using fourth-order perturbed Heisenberg Hamiltonian with all seven magnetic energy parameters. Spin exchange interaction, magnetic dipole interaction, second-order and fourth-order magnetic anisotropy constants, in-plane and out-plane, applied magnetic fields, demagnetization factor and stress-induced anisotropy were considered in the model. 3D plots of total magnetic energy versus angle and stress-induced anisotropy were plotted for different values of fourth-order magnetic anisotropy constants. All other magnetic energy parameters were fixed at constant values. All the peaks are closely packed in the graphs plotted using the fourth-order perturbed Heisenberg Hamiltonian compared to peaks in the graphs plotted using the second and third-order perturbed Heisenberg Hamiltonian. The maximum energy varies from 10^{51} to 10^{49} as the fourth-order magnetic anisotropy constants in the bottom ($D_1^{(4)}$) and top ($D_2^{(4)}$) spin layers are changed from $\frac{D_1^{(4)}}{\omega} = 5$ and $\frac{D_2^{(4)}}{\omega} = 10$ to $\frac{D_1^{(4)}}{\omega} = 10$ and $\frac{D_2^{(4)}}{\omega} = 5$, respectively. The order of magnetic energy changes when the values of fourth-order anisotropy constants of two spin layers are interchanged. The magnetic energy was higher when the value of the fourth-order anisotropy constant in the bottom spin layer was higher than that of the top spin layer. In addition, the graphs of energy *versus* angle were plotted to find the magnetic easy and hard directions. The angle between the magnetic easy and hard direction was not 90 degrees in all the cases. The orientation of the magnetic easy axis is important in the applications of magnetic recording media.

Keywords: Fourth-order perturbed Heisenberg Hamiltonian, Magnetic anisotropy constant, Magnetic thin films, Spin, Stress-induced anisotropy

Abstract No: 41 ***Physical Sciences***

PREPARATION OF SULFONATED POLYSTYRENE BLENDED POLYSTYRENE FILM AND ITS WATER ABSORPTION PROPERTY UNDER DIFFERENT pH ENVIRONMENTS

N. Kapilraj* and M. Koneswaran

Department of Chemistry, Faculty of Science, Eastern University Sri Lanka, Chenkalady, Sri Lanka
**nkapil27@gmail.com*

Polystyrene (PS) is one of the most widely used plastics. The hydrophobic nature of the PS film restricts its application in several fields. In this work, PS films were prepared with different formulations and their water absorption properties in acidic, alkaline, and neutral environments were studied. The sulfonated polystyrene (S-PS) was prepared by homogeneous sulfonation using acetyl sulfate as a sulfonating agent. S-PS was characterized using FTIR. The degree of sulfonation was 10 based on the calculation using NaOH titration. The films were made by independently mixing S-PS at mass ratios of 0, 5 and 10% with PS. The films were prepared by solvent–casting method. The mass percentage of the polymer in the solvent (ethyl acetate 80% + chloroform 20%) was 20, and the same method was adopted to prepare the films with a plasticizer (diethyl phthalate). The viscosity of the polymer solution was measured with Brookfield digital viscometer. The addition of S-PS and plasticizer change the viscosity. The average thickness of the films was 0.33 mm. A water droplet on the film's surface was captured using a digital camera with a macro lens. The contact angle was measured using the image-processing program Image j. The contact angle for the pure polystyrene film was increased by the addition of a plasticizer. However, the contact angle decreased with the addition of a plasticizer for the film blended with a higher percentage of sulfonated polystyrene. The water absorption test was performed according to ASTM D570. From each film, $30 \cdot 25$ mm^2 specimens were cut, and samples were dried in an oven for 24 h at 50 °C. It was promptly weighed after cooling in a desiccator. The samples were then submerged individually in distilled water (pH 7), acidic water (pH 2), and basic water (pH 12), and the water absorption characteristics of the films were determined by weighing the specimens every two days. The overall analysis shows that the mass of S-PS in the film and the addition of plasticizer have an impact on the water absorption capacity of the film. The plasticizer increases the hydrophobic nature of the pure polystyrene film. However, the addition of plasticizer increased the hydrophilic nature of the film blended with S-PS. The film blended with S-PS at a higher ratio exhibits higher water absorption capacity in acidic and neutral environments than in the alkaline environment.

Financial assistance from the Accelerating Higher Education Expansion and Development (AHEAD) under the DOR Grant (Grant No 27) is acknowledged.

Keywords: Contact angle, Hydrophobicity, Polymer film, Plasticizer, Water absorption

Abstract No: 47 ***Physical Sciences***

MILK PROTEIN COMPOSITION IN DIFFERENT LACTATION STAGES OF DAIRY CATTLE GRAZING ON SALTMARSH PASTURES IN MANNAR, SRI LANKA

G.M.M. Kumari[1*], A.N. Navaratne [1, 2] and K.B Ranawana[3]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Chemistry, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[3]Department of Zoology, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]gmadushikamk@gmail.com

Cow milk is a nutrient-rich dairy product which has high demand worldwide. Improving local dairy production is essential to overcome malnutrition in the Sri Lankan population hit by the current food crisis. Cow milk is a vital source of high-quality proteins consisting of all nine essential amino acids required for humans. Considering the solubility factor, milk proteins belong to two main fractions that are casein (approximately 80% of total protein content) and whey protein (about 20% of total protein content). The composition of raw cow milk depends upon the stage of lactation, the feeding source, the cow's health and genetic factors. The study aimed to investigate the differences in total milk protein composition of cow milk within the lactation curve of cattle grazing on two types of pastures in Sri Lanka. The samples were collected during early, mid and late lactation stages from two cattle groups grazing on saltmarsh pastures in Mannar and dry pastures in Medawachchiya. The milk samples were tested for total protein composition (%w/w) by the ultrasonic Lactoscan MCC milk analyzer. Considering the results, the total milk protein composition of saltmarsh pasture feeding cattle was significantly higher ($p<0.05$) during the mid (3.48%) and late (3.54%) lactation stages than the dry pasture-feeding cattle. During the early lactation stage, the mean total protein composition (n=30, 3.38 %) of saltmarsh pasture feeding cattle was high compared to the mean total protein composition (n=25, 3.28%) of dry pasture feeding cattle, though statistically not significant ($p>0.05$). Since the milk protein yield is relatively proportional to the energy content of the diet in dairy cattle, this indicates that the saltmarsh pasture-based diet gives high energy to cattle. This study concludes that the protein composition of raw cow milk depends on the feeding pasture and the stage of the lactation period of dairy cattle.

Financial assistance from The National Science Foundation, Sri Lanka (NSF/SCH/2019/09) and Instrument assistance from The Dairy Technology Unit of Veterinary Research Institute, Gannoruwa, are acknowledged.

Keywords: Lactation, Milk, Pasture, Protein

Abstract No: 49 ***Physical Sciences***

COMMIPHORA WIGHTII GUM EXTRACT MEDIATED SYNTHESIS OF SILVER NANOPARTICLES AND THEIR BACTERICIDAL EFFICACY

C. Wickramarathne[1], S. Rajapakse [2*] and V.N. Seneviratne[3]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Molecular Biology and Biotechnology, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[3]Department of Chemistry, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]sanathr@pdn.ac.lk

Nanobiotechnology is an important division in nanotechnology that involves various biological entities for nano-synthesis. Silver nanoparticles (AgNPs) received tremendous attention owing to their versatile and promising properties and their wide range of applications. Moreover, nano-synthesis using plants is a promising approach among other biological sources because of the presence of the high amount of phytochemicals and the feasible procedures required in nano-synthesis. However, AgNP synthesis by incorporating *Commiphora wightii* (guggul) plant gum is not attempted previously. *C. wightii*, belonging to the family Burseraceae, is used in ayurvedic medicine due to its anticancer, antimicrobial and anti-inflammatory properties. The objective of this study was to green synthesize AgNPs using the gummy extract of *C. wightii* in a feasible, cost-effective and environmentally-friendly manner and evaluate their bactericidal efficacy. AgNPs were fabricated by the addition of *C. wightii* extract to $AgNO_3$ while stirring and heating. Bactericidal efficacy was determined against *Escherichia coli* and *Staphylococcus aureus* using the standard Kirby-Bauer Disk diffusion method. A rapid colour transformation was observed from light brown to deep brown indicating AgNP formation, and it was confirmed by a characteristic band at 427 nm. X-Ray Diffraction patterns revealed the crystalline nature and the Face Centred Cubic structure of AgNPs. Moreover, Transmission Electron Microscopic analysis highlighted well-dispersed spherical AgNPs around 5-20 nm. Fourier Transform Infra-Red spectra revealed the presence and involvement of functional groups of steroids, flavonoids, terpenoids, carbohydrates etc. *C. wightii* gummy extract alone and AgNPs synthesized using gummy extract showed antibacterial potential against both *E. coli* and *S. aureus*. The diameters of zones of inhibition were 12.56±0.35 nm and 10.27±0.25 nm for *E. coli* and *S. aureus*, respectively. Therefore, this method was an effective, single-step green synthetic approach for the synthesis of stabilized AgNPs and bactericidal efficacy for both bacterial gram classes proposes their applicability in biomedical utilities. Moreover, further modifications of this green procedure must be carried out before any industrial-scale production and applications.

Keywords: Bactericidal activity, *Commiphora wightii*, Green synthesis, Silver nanoparticles

Abstract No: 61 ***Physical Sciences***

NMDA AND TRPV1 RECEPTORS: POTENTIAL THERAPEUTIC TARGETS OF *PASPANGUWA* HERBAL FORMULA

J.C. Gunaratne[1*], D.R. Uduwela[1, 2] and R.J.K.U. Ranatunga[1, 2]

[1]Department of Chemistry, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]s16180@sci.pdn.ac.lk

Despite the broad use of cough (antitussive and expectorant) medicine, there is little evidence for its clinical use. Dextromethorphan is a widely used antitussive that is considered effective by the U.S. Food and Drug Administration. N-methyl D-aspartate (NMDA) receptors are the therapeutic target of dextromethorphan. The transient receptor potential vanilloid 1 (TRPV1) receptor stimulates the cough reflex and has recently been identified as a potential drug target for treating cough. We hypothesize that the mechanism of the anti-cough effects of *paspanguwa*, an ayurvedic herbal drink, is due to inhibiting NMDA and TRPV1 receptors. This study aimed to identify natural products in the formula that bind favourably to the active sites of the receptors. Twenty-three natural products from *paspanguwa* were examined. The cryo-EM structures of NMDA receptor (PDB 7eu7) and TRPV1 receptor (PDB 3J5P) were used as receptor coordinates. AutoDock Vina was used for molecular docking at four active sites: glycine-binding site, glutamate-binding site and the ion-channel of NMDA, and the active site of TRPV1 receptor. Diosgenin, solasodine and tomatidenol showed the highest binding affinity to both the glutamate-binding site and glycine-binding site; the affinity well above that of references indicates the possibility of these natural products acting as NMDA antagonists and non-competitive antagonists. Diosgenin, tomatidenol, and oleanolic acid showed the highest affinity to the NMDA channel; an affinity higher than that of references indicates the ability to act as better channel blockers. At the active site of TRPV1, solasodine, diosgenin, and tomatidenol showed binding affinity on par with the references, indicating that they might act as TRPV1 antagonists. Findings from the study show that natural products from *paspanguwa* bind to active sites of NMDA and TRPV1 receptors. The reported anti-cough properties of the formula may, at least in part, be due to inhibiting NMDA and TRPV1 receptors.

Keywords: Anti-cough, Molecular docking, Natural products

Abstract No: 69 ***Physical Sciences***

9.4% EFFICIENCY OF A QUASI-SOLID-STATE DYE-SENSITIZED SOLAR CELL UNDER LOW LIGHT IRRADIANCE

S.M.S. Gunathilake[1*], T.M.W.J. Bandara[1, 2] and B.M.K. Pemasiri[1, 2]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Physics, University of Peradeniya, Peradeniya, Sri Lanka
[*]shiwanthakc@gmail.com

To convert highly abundant solar energy to electricity, low-cost dye-sensitized solar cells (DSCs) have attracted researchers' attention. Solar cells do not receive constant irradiance throughout the day when used in real outdoor applications. The efficiency of Si solar cells decreases with decreasing irradiance. However, very few studies have focused on studying the performance of DSCs as a function of light intensity. The present research is focused on improving gel polymer electrolyte-based DSCs and studying their performances under variable irradiance. The cells were fabricated with photoelectrodes having six spin-coated TiO_2 layers photo-sensitized by N719 dye. The counter electrode was a piece of Pt-coated glass, and the gel polymer electrolyte contained binary salts tetrahexylammonium iodide and lithium iodide. Performance enhancers, 4-tert-butyl pyridine and 1-methyl-3-propylimidazolium iodide, were added to maximize the efficiency of the cell. In addition, the cell's performance was enhanced by the infusion of graphene into the fourth layer. The fabricated DSC was irradiated using Peccell PEC-LO1 solar simulator, and the irradiation level varied from 1,000 W m^{-2} to 67 W m^{-2}, changing the distance from the solar simulator to the cell. To the best of our knowledge, this is the first study of the light intensity dependence of efficiency in graphene-incorporated DSCs. The fabricated quasi-solid-state DSC performed at an overall maximum efficiency of 6.8%, an open-circuit voltage of 770 mA, a short circuit current density of 13.4 mA cm^{-2}, and a 66.3% fill factor under 1,000 W m^{-2} irradiation. The efficiency and fill factor of the DSC increased gradually with the decreasing solar irradiance. The DSC achieved maximum efficiency and fill factor of 9.4 and 83.3%, respectively, at 67 W m^{-2} of input solar irradiance. The present study concludes that the efficiency and fill factor of graphene-added DSC increase with the decrease of solar irradiance. Lower efficiencies at higher irradiance relate to the transport limitation of the redox mediator in such cells.

Financial assistance from the PGIS, University of Peradeniya (Grant No: PGIS/2020/10) is acknowledged.

Keywords: Dye-sensitized solar cells, Gel polymer electrolyte, Graphene, Light intensity, Low light irradiation

Abstract No: 70 ***Physical Sciences***

FABRICATION OF PRECIPITATED CALCIUM CARBONATE (PCC) BASED SUPERHYDROPHOBIC GLOVES FROM SRI LANKAN DOLOMITE

K.G.S.S. Dilhani[1*], D.G.G.P. Karunaratne[2] and A. Manipura[2]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Chemical and process Engineering, Faculty of Engineering, University of Peradeniya, Peradeniya, Sri Lanka
[*]dilhanigamages@gmail.com

Manufacturing bioinspired superhydrophobic covering on natural rubber gloves surface from Sri Lankan dolomite as a value-added process to local dolomite. In this study, we introduce a simple and effective method to synthesize superhydrophobic coating on glove surfaces using superhydrophobic precipitated calcium carbonate nanoparticles (nPCC) using dolomite as the raw material. Sodium stearates were used as a binder, while fatty acid was used to improve the superhydrophobicity. nPCC suspension was made with ethyl acetate, and it was applied on the glove surfaces *via* spray coating and dip coating methods. The products were subjected to scanning electron microscopy (SEM) to identify the morphology of nPCC and coating. SEM images confirm the presence of nano coating on PCC (1-100 nm) and on the glove surface (200 nm). Fourier Transform Infrared Spectroscopy (FTIR) was used to identify functional groups on surface coating, which confirmed the presence of stearates, ethyl acetate and fatty acid on the glove surfaces, while water contact angles were measured using a drop shape analyzer. In spray coating methods, obtained contact angles on glove surfaces were 142° for stearic modified and 144.5° for stearic\fatty acid-modified coating. It was 154.7° for dip coating methods. According to the results, stearates and fatty acids improve superhydrophobicity, while ethyl acetate gives a uniform nanoparticle suspension. Among the coating methods compared, spray coating gave a uniform coating on the glove surface.

Keywords: Fatty acid, Gloves, PCC, Stearic acid, Superhydrophobicity

Abstract No: 71 ***Physical Sciences***

INVESTIGATION OF PALMYRAH (*Borassus flabellifer* L.) NUTSHELL DERIVED ACTIVATED CARBON FOR REMOVAL OF NITRATES FROM GROUNDWATER

M. Mayurika* and J. Prabagar

Department of Chemistry, Faculty of Science, University of Jaffna, Jaffna, Sri Lanka
**mayurimahen2000@gmail.com*

Nitrate is one of the most worldwide contaminants due to its tendency to leach from soil to water, polluting drinking water resources, especially groundwater. The effect of nitrate on human health is described as primary toxicity, causing methemoglobinemia (blue baby syndrome), tumours and gastrointestinal cancers. The WHO has set the maximum contaminant level of 50 mgL^{-1} nitrates in drinking water. Therefore, this research was conducted to remove nitrate ions from groundwater using citric acid-activated carbon developed from palmyrah nutshells. The advantage of using this activated carbon made from palmyrah nutshell is that it can act as an absorbent like coconut shell and is available as waste material in South Asian countries. The palmyrah nutshells were cleaned, dried in the sun, and carbonized in a muffle furnace at 500 °C for 2 h. The chemical activation of carbon of the carbonized product was performed using citric acid with the impregnation ratio of carbon: citric acid at 1:2 at 30 °C for 24 h. The resulting slurry was washed with deionized water to neutral pH, dried at 110 °C for 8 h, and the activated carbon was obtained. This activated carbon was characterized for different physical and chemical parameters using standard Association of Official Analytical Chemists methods. Moisture, ash, fixed carbon, pH and bulk density were determined, and the values obtained were 4.0%, 3.5%, 75.2%, 6.83 and 0.64 g cm^{-3}, respectively. The nitrate removal efficiency was estimated at different pH values of 2, 4, 6, 8 and 10 by varying adsorbent dosages of 2, 4, 6, 8 and 10 gL^{-1} at the equilibrium contact time of 1, 2, 3, 4 and 5 h based on the concentration of adsorbed nitrate ion by palmyrah nutshell activated carbon. The results revealed that the maximum nitrate adsorption of 82.8% was found to be at the pH of 6 with the adsorbent dosage of 6 gL^{-1} and with a contact time of 3 h. At the pH of 6, the maximum amount of nitrate ions was adsorbed by the electrostatic interaction between the positive charge of the adsorbent and nitrate anion. In the pH range from 4 to 10, the maximum percentage of nitrate removal was achieved, while this percentage slightly decreased at pH 2. Nitrate removal showed an increasing trend from pH 2 to 6, and it decreased afterwards. This may be due to the presence of positive adsorption sites that favours nitrate adsorption and then OH^- ions that compete for the same adsorption sites. The results revealed that the activated carbon effectively reduced the nitrate content in groundwater below the permissible limits; hence, the activated carbon derived from palmyrah nutshells can be successfully applied in water treatment technologies to control the nitrate content.

Keywords: Adsorption, Citric acid activated carbon, Groundwater pollution, Nitrate removal efficiency, Palmyrah nut shells.

Abstract No: 78 ***Physical Sciences***

INVESTIGATION OF SIZE-TUNABLE NON-CATALYTIC CARBON SPHERES BY VARYING GROWTH PARAMETERS IN CHEMICAL VAPOR DEPOSITION

T.G.T.K. de Silva, B.V.N. Sewwandi and A.R. Kumarasinghe*

Department of Physics, Faculty of Applied Sciences, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
**argk@sjp.ac.lk.*

Carbon is a unique, life-forming element that can create various structures. These structures obtained from carbon have gained popularity in the scientific field due to their remarkable properties. Among them, the carbon sphere (CS) is a synthetically formed carbon structure that has attracted recent attention due to its applications in energy-storing devices, adsorption, and nanocomposites. In this study, NCS (Non-catalytic Carbon Spheres) in size range of 0.2-1.4 μm were produced *via* Chemical Vapor Deposition (CVD) through pyrolysis of acetylene in a nitrogen atmosphere. The effect of collector material in CVD, reaction time (30 – 90 min), deposition temperature (800 – 1100 °C), and precursor mass flow rate (at the constant ratio of C_2H_2/N_2) on the morphology (diameter) of the NCS produced using CVD was investigated. The characterization of the as-synthesized NCS was done through Scanning Electron Microscopy (SEM), Raman Spectroscopy, X-ray Diffraction (XRD), and Fourier Transform Infrared Spectroscopy (FTIR). SEM results showed that the size of the NCS particles depends on the reaction time and temperature but not on the mass flow rates of the precursor gasses at a constant ratio. The collector material in CVD showed a substantial effect on the size of the spheres, possibly due to the surface roughness of the substrates and the differences in the nucleation rates. The NCS with the lowest dimensions (~364 nm) of uniform sphericity were collected from the thermal blocks of the CVD. The XRD and Raman spectroscopy results of the NCS grown on the thermal block showed the characteristic graphitic peaks of the carbon structures, which confirmed the existence of graphitized hexagonal carbon networks. FTIR analysis of the NCS indicated that their surface consists of hydroxyl, carbonyl, and carboxylic functional groups. The presence of these groups in NCS would be an advantage when using them for their potential applications.

Financial assistance from the National Research Council (Grant No 16-015) is acknowledged.

Keywords: Chemical Vapor Deposition (CVD), Non-catalytic Carbon spheres (NCS), Reaction time, Temperature, Thermal Block

Abstract No: 79 ***Physical Sciences***

SINGLE-STAGE VERTICALLY ALIGNED CARBON NANOTUBES (VACNTS) SYNTHESIS BY PYROLYSIS OF FERROCENE AND ACETYLENE

G.D.G.D.P. Wijerathne, B.V.N. Sewwandi, and A.R. Kumarasinghe*

Department of Physics, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
**argk@sjp.ac.lk*

Carbon nanotubes (CNTs) have drawn much interest in material science due to their unique structure and extraordinary properties. Among different morphologies of CNTs, vertically aligned carbon nanotubes (VACNTs) are a fascinating class of nanomaterials that are highly dense and well-oriented along their longitudinal axis. For the fabrication of CNT macrostructures with morphologies ranging from network to aligned structures, the floating catalyst chemical vapour deposition (FC-CVD) technique is more successful and favourable than the conventional CVD methods. This study represents an effective method for synthesizing VACNTs using a novel single-stage FC-CVD process with high CNT yield, low cost, and facile fabrication. FC-CVD process was carried out by pyrolysis of ferrocene and acetylene at the temperature of 850 ^{0}C under a stream of Nitrogen (flow rate of 200 sccm) and Hydrogen (flow rate of 50 sccm). This single-stage FC-CVD approach has a substantial potential to produce VACNTs on a large scale compared to the traditional multi-stage assisted FC-CVD process. The as-grown CNTs were collected separately from the Si/SiO_2 wafer, silicon wafer, and the inner walls of the quartz furnace. The morphology and structure of the as-grown CNTs were investigated by SEM, Raman, and XRD. The formation of dense VACNT arrays was observed on the inner walls of the quartz furnace and silicon wafer under optimized conditions where 0.4 g of ferrocene and an acetylene flow rate of 100 sccm were used for a growth period of 30 minutes. CNT bundles with an average diameter of 70 nm and 90 nm with vertical heights of 170 µm and 9 µm were found on the quartz and silicon wafer surfaces, respectively. Steric effects and Van der Waals repulsive interactions led to the arrangement of dense vertical alignment. More randomly-oriented CNTs with varying diameter distribution were also observed on the Si/SiO_2 substrate. It revealed the dependency of the surface properties on the formation of CNTs with a distinct morphology. XRD and Raman studies showed that as-grown VACNTs are well-graphitized and indicated that the graphite structure resembles MWCNTs.

Financial assistance from the National Research Council (Grant No 16-015) is acknowledged.

Keywords: Acetylene, Ferrocene, Pyrolysis, Single-stage floating catalyst chemical vapour deposition (FC-CVD), Vertically aligned carbon nanotubes (VACNTs)

Abstract No: 84 ***Physical Sciences***

MICRO-PATTERN TRANSFER USING EPOXY-RESIN COMPOUND AS AN ALTERNATIVE TO POLY-DIMETHYLSILOXANE

W.D.G.M. Senarathna and S. Jayawardhana*

Department of physics, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
**sasanijay@sci.sjp.ac.lk*

Lithographic techniques provide tools with which micro-nano patterns can be transferred from one surface to another. This is highly beneficial in fields such as the development of superhydrophobic surfaces, semiconductors, and microfluidic devices. Soft lithography is an increasingly popular sub-technique that enables the replication of microstructures to and from flexible membranes, materials, and surfaces. Nevertheless, polymer double casting is a cumbersome procedure requiring additional treatment for anti-adhesion of the moulds and replicates. Here, we present an alternative material using commercially available epoxy resin for soft lithographic nano/micro-scale patterning. The negative mould was created by mixing the silicon and catalyst materials at a ratio of 100:2 by weight and allowed to dry. The epoxy resin was then mixed with the hardener at a ratio of 3:1 by weight and poured into the negative mould. The hardened epoxy resin was later peeled off to obtain the replication. The process was demonstrated using three natural plant species as master templates. They were taro (*Colocasia esculenta*), lotus (*Nelumbo nucifera*) and canna (*Canna coccinea*). The nano/microstructures of natural leaves and their replicates were characterized using scanning electron microscopy and contact angle measurements. It is crucial to notice that the non-wetting properties of the replicates were significantly lower than their original counterparts. Nonetheless, a comparison of the surface images revealed that the micro pattern of the original sample had been successfully transferred to the replicate. The replication approach presented here represents a simple and economical alternative method for the micro-replication of natural surface structures.

Keywords: Epoxy resin, Silicon rubber, Soft lithography, Superhydrophobicity

Abstract No: 86 ***Physical Sciences***

EXPERIMENTAL AND THEORETICAL INVESTIGATION ON PHOTOCATALYTIC HYDROGEN PRODUCTION FROM WATER/METHANOL SOLUTIONS BY CUPROUS OXIDE AND CUPRIC OXIDE COMPOSITE CATALYST

J.S. Perera* and D. P. Dissanayake

Department of Chemistry, University of Colombo, Colombo, Sri Lanka
**jehanperera0@gmail.com*

Water can be split into hydrogen and oxygen by using semiconductor metal oxide photocatalysts and solar energy. This is a clean and inexhaustible energy source, as both water and sunlight are plentiful. The goal of the present investigation was to generate hydrogen by photo-splitting water using a cuprous oxide-based nano photocatalyst. Using the hydrothermal methodology, a series of Cu_2O/CuO photocatalysts were produced by altering the processing conditions. The efficiency of the photocatalytic activity of the synthesized catalyst was studied using methanol/water (40/60%) mixtures. It was observed that the photocatalytic activity initially increased with increasing Cu_2O content in the catalyst and then decreased. According to XRD characterization of the catalysts, it was observed that the catalyst with the Cu_2O/CuO molar ratio of 68/32 has the highest photocatalytic activity (i.e., the most efficient gas evolution under illumination). A theoretical study was carried out to understand the role of Cu_2O in the photocatalytic process. The catalyst surfaces were modelled using the Quantum Espresso Suit of software and the graphical user interface of the same "BURAI". Density functional theory calculations were conducted using Perdew-Burke-Ernzerhof exchange-correlation (PBE) ultra-soft pseudopotentials. The efficiency of adsorption of the molecules of interest, i.e., H_2O, CH_3OH, H_2 and CO_2, on Cu_2O (111) and CuO (111) surfaces was investigated by calculating the adsorption energies. The theoretical investigation revealed that hydrogen adsorption on Cu_2O (111) is ~49 times stronger than that on CuO (111). Also, the Cu_2O (111) surface is more hydrophilic than CuO (111). Formation of CuO (111) on Cu_2O (111) surface may impart the desired properties by minimizing the adsorption of H_2 and thereby minimizing its dissociation. This would have improved the photocatalytic activity of the Cu_2O (111)/CuO (111) composite surface.

Financial assistance from the University of Colombo is acknowledged.

Keywords: Binding energy, Density functional theory, Hydrogen adsorption, Photocatalytic activity, Quantum Espresso

Abstract No: 88 ***Physical Sciences***

PHOTOVOLTAIC PERFORMANCE OF DYE-SENSITIZED SOLAR CELLS FABRICATED WITH CELLULOSE ACETATE NANOFIBER-BASED GEL ELECTROLYTE

M.S.H. Hettiarachchi[1, 2*], M.A.K.L. Dissanayake[1, 2], G.K.R. Senadeera[1, 3], T. Jaseetharan[1, 4] and K. Umair[1, 2]

[1]National Institute of Fundamental Studies, Hantana Road, Kandy, Sri Lanka
[2]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[3]Department of Physics, The Open University of Sri Lanka, Nawala, Nugegoda, Sri Lanka
[4]Department of Physical Sciences, Faculty of Applied Sciences, South Eastern University of Sri Lanka, Sammanthurai, Sri Lanka
[*]sanuri.he@nifs.ac.lk

Polymer nanofibers have emerged as scientifically intriguing novel materials where that can perform extraordinarily well with their unique chemical and physical properties. Electrospinning has become one of the simple and versatile methods to produce nanofibers, and electrospun polymer nanofibers can be applied in dye-sensitized solar cells (DSSCs). In contrast to conventional liquid electrolytes, which inherently lack long-term stability and suffer from electrolyte evaporation and liquid leakage, electrospun polymer nanofiber membrane-based quasi-solid-state gel electrolytes have offered a promising alternative. The quasi-solid-state gel electrolyte, made by trapping an electrolyte solution within a three-dimensional polymer nanofiber matrix, exhibits almost liquid-like ionic conductivities while offering better mechanical strength by a non-flowing electrolyte medium. In the present study, cellulose acetate (CA) nanofiber gel electrolyte-based DSSCs were fabricated. Their photovoltaic performance was investigated as a comparative study with conventional liquid and gel electrolyte-based DSSCs. Scanning electron microscopic images showed a porous membrane containing ultra-thin polymer nanofibers with an average diameter of 180 nm. In order to prepare quasi solid-state gel electrolyte, the CA nanofiber membrane was soaked with the liquid electrolyte prepared by dissolving iodine (I_2), tetrapropylammonium iodide (Pr_4NI), potassium iodide (KI) in ethylene carbonate (EC) and propylene carbonate (PC) co-solvent system. The photovoltaic parameters of DSSCs with nanofiber gel electrolyte show an efficiency of 6.06%, a short circuit current density (J_{sc}) of 13.9 mA cm^{-2} under the simulated sunlight of 100 mW cm^{-2} (1.5 AM). This efficiency value lies in between those of conventional liquid and gel electrolyte-based DSSCs exhibiting efficiencies of 6.53% and 5.50%, respectively. This study suggests that CA electrospun nanofiber gel electrolyte-based DSSC offers a possible alternative to obtain higher efficiencies than those of conventional gel electrolyte-based DSSCs while providing sufficient stability compared to the liquid electrolyte-based solar cells.

Keywords: Cellulose acetate, Dye-sensitized solar cells, Electrospinning, Nanofiber gel electrolyte

Abstract No: 91 ***Physical Sciences***

ANGULAR CORRELATIONS OF POSITRON EMITTERS BY SETTING UP A COINCIDENCE DETECTION SYSTEM

W.D.S.N. Gunarathna[1], C.S. Sumithrarachchi[2] and M.R. Lamabadusuriya[1*]

[1]Department of Nuclear Science, Faculty of Science, University of Colombo, Colombo, Sri Lanka
[2]Michigan State University, East Lansing, Michigan, USA
[*]manuja.lama@nuclear.cmb.ac.lk

In many nuclear decay processes, two or more simultaneous or successive radioactive emissions occur. The angular correlation of these events carries information that a single detection method cannot acquire. Coincidence methods are employed to detect these events and utilized in applications such as Positron Emission Tomography (PET) to produce functional and static images by acquiring position information. This study is focused on building proper instrumentation to assess a cost-effective method to characterize positron emitters that can be developed as PET-radiotracers in Sri Lanka. As the initial approach, the angular distribution of positron annihilation was obtained using ^{64}Cu. The thermal neutron activation was used to produce ^{64}Cu from a $CuSO_4.5H_2O$ sample. Two NaI (Tl) scintillation detectors have been used to build a delayed coincidence system coupled to scalar counters by applying energy windows using single-channel analyzers. The well-known angular distribution of ^{60}Co with the theoretical angular correlation coefficients has been used to validate experimental results and to optimize input delay time and source-to-detector distance. A standard ^{22}Na source was used to determine the coincidence efficiency of the experimental setup, which was then used to quantify ^{64}Cu in the sample. The experimentally acquired angular distribution correlation function and coefficients for ^{60}Co show an agreement with the theoretical data. The efficiency of the coincidence setup was measured as 0.18% for 511 KeV positron annihilation gamma emission. The activity concentration of neutron-activated ^{64}Cu has been quantified as 136.8 Bq/g. The angular distribution of ^{64}Cu and ^{22}Na was compared with each other. Hence, it can be concluded with this setup; it is possible to evaluate positron emitters produced in Sri Lanka cost-effectively at the production site as the initial approach prior to the direct testing with PET scanners which need higher expenses.

Keywords: Annihilation, Coincidence, ^{64}Cu, PET, Positron

Abstract No: 93 ***Physical Sciences***

REMOVAL OF CALCIUM AND MAGNESIUM IONS FROM SLUDGE GENERATED IN ELECTROCOAGULATION AND DEVELOPMENT OF A METHOD TO SEPARATE ALUMINIUM IONS

N.K. Jayasekera and A.C. Herath*

Faculty of Applied Sciences, Rajarata University of Sri Lanka, Sri Lanka
**ajithch037@gmail.com*

A sludge generated during electrocoagulation (EC) consists of harmful ions which could cause deleterious effects on the environment. Instead of simply discarding it, the ions trapped in sludge can be separated and recovered to gain economic value. The present study focused on developing a method to separate Mg^{2+}, Ca^{2+}, and Al^{3+} present in sludge. A sludge consisting of Mg^{2+}, Ca^{2+}, and Al^{3+} was generated through EC. It was dissolved in HCl, and upon the addition of NaOH, a precipitate of $Mg(OH)_2$ and $Ca(OH)_2$ was formed while Al^{3+} got converted into $[Al(OH)_4]^-$. After sucrose was added to the precipitate, $Mg(OH)_2$ remained while $Ca(OH)_2$ converted into a soluble complex of Ca^{2+}. The Ca^{2+} component was separated as $CaCO_3$ by passing CO_2 to the calcium-sucrate solution. At the end of the procedure, 53% and 68%, respectively, of $Mg(OH)_2$ and $CaCO_3$ were separated from the sludge. These high recovery percentages indicate this method is suitable for separating Ca^{2+} and $Mg^{2+,}$ and the isolated $CaCO_3$ and $Mg(OH)_2$ can be used as industrial raw material. As the recovery percentage of sucrose was 98, it is possible to reuse it in this procedure. Next, a method was developed to remove $[Al(OH)_4]^-$ in the filtrate. A polyaniline/zirconia composite (PZC) was synthesized and equilibrated with a 100 mg/l $[Al(OH)_4]^-$ solution at different pH values. These ions received a removal efficiency of 85% at pH 9. Therefore, this method could be applied to remove Al^{3+} present in the sludge after converting it into $[Al(OH)_4]^-$. The recovery percentages of Ca^{2+} and Mg^{2+} indicate that further improving this treatment method by optimizing the conditions would be beneficial in minimizing sludge disposal problems.

Keywords: Al^{3+}, Ca^{2+}, Electrocoagulation, Mg^{2+}, Polyaniline-zirconia composite

Abstract No: 102 ***Physical Sciences***

NANOLIPOSOMES OF *SPONDIAS PINNATA* STEM BARK AQUEOUS EXTRACT: *IN VITRO* ANTIDIABETIC ACTIVITY AND RELEASING PROFILES

R.R. Wadasinghe[1*], P. Kalansuriya[2], A.P. Attanayake[2] and B.M.R. Bandara[1]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Biochemistry, Faculty of Medicine, University of Ruhuna, Galle, Sri Lanka
[*]ransikawadasinghe@gmail.com

Nanoliposomes are amongst the most versatile lipid-based carriers, which can encapsulate a range of compounds with different polarities. Decoctions, prepared from *Spondias pinnata* (L. f.) Kurz (wal ambarella) stem bark is used in Sri Lankan traditional medicine for the management of diabetes mellitus. Encapsulation of aqueous extract of stem bark (SAE) of *S. pinnata* in nanoliposomes could enhance its therapeutic potential by increasing bioavailability and providing controlled release. The present study investigates the in vitro anti-hyperglycaemic activity of SAE-encapsulated nanoliposomes (SAE-NLS) using α-amylase inhibitory, α-glucosidase inhibitory, glucose uptake, and glucose adsorption assays along with in vitro release profiles. Dried, powdered stem bark parts of *S. pinnata* were extracted using distilled water under ultrasonication to prepare SAE. SAE-NLS were synthesized from SAE, [phosphatidylcholine and cholesterol (20:1)] and an aqueous phase [phosphate buffer saline (pH 6.8) with Tween® 80 (0.1% v/v)], using a modified emulsification and ultrasonication methods. The synthesized SAE-NLS were characterized via size, zeta potential and FTIR data, encapsulation efficiency (EE) and loading capacity (LC) determination. The free polyphenol content was determined by the Folin-Ciocalteu method and was used in the estimation of EE. Further, the in vitro antidiabetic activity of SAE-NLS was screened using α-amylase, α-glucosidase inhibitory, glucose uptake and glucose adsorption activity assays. The Z-average particle diameter (389 nm), polydispersity index (0.37), and zeta potential (−27.27 mV) of SAE-NLS indicated moderate polydispersity. The free polyphenol content was determined by the Folin-Ciocalteu method. The highest EE (95.42±0.56%) and LC (0.02±0.00%) were observed when SAE was loaded at 3.0% w/v. The α-amylase inhibitory activity and α-glucosidase inhibitory activity (IC50) of SAE-NLS were 2.29±0.14 and 1.44±0.03 mgmL-1, respectively, while those for SAE were 0.05±0.01 and 0.08±0.00 mg mL-1, respectively. The glucose uptake (16.07±0.14%) at 10 mM glucose concentration and glucose adsorption (0.22±0.06 mmolg-1) of SAE-NLS at 50 mM were significantly higher ($p<0.05$) than those of reference standard metronidazole (5.81±1.27% and 0.05±0.01, respectively). The release of SAE from SAE-NLS was higher in simulated gastric fluid (60.63±0.27%) than in simulated intestinal fluid (24.11±0.94%) after 10 h. SAE-NLS showed higher α-glucosidase inhibitory and glucose adsorption activities than acarbose, and metronidazole, respectively. The results revealed that SAE-NLS are potential nanocarriers with potent in vitro antidiabetic activity providing controlled release.

Financial assistance from the AHEAD (Grant No AHEAD (DOR)-15) is acknowledged.

Keywords: Antidiabetic, Nanoliposomes, *Spondias pinnata*

Abstract No: 104 ***Physical Sciences***

HIGHLY CONDUCTING FLUORINE-DOPED TIN OXIDE THIN FILMS BY SPRAY PYROLYSIS TECHNIQUE FOR OPTOELECTRICAL APPLICATIONS

K.U.R.R.S. Rathnayaka[1*], T.M.W.J. Bandara[1, 2], G.R.A. Kumara[3] and K. Wijayaratne[1, 2]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Physics, University of Peradeniya, Peradeniya, Sri Lanka
[3]National Institute of Fundamental Studies, Kandy, Sri Lanka
[*]roshanrathnayaka1994@gmail.com

Transparent conductive oxide (TCO) films are one of the main components of many electrochemical devices, such as dye solar cells (DSCs) and supercapacitors. Fluorine-doped tin oxide (FTO) films are the most widely used TCO substrates due to their inexpensive preparation and higher temperature tolerance. As a rule-of-thumb, FTO films with 80% transmittance and a standard sheet-resistance (R_{sh}) value of 10 $\Omega\ \square^{-1}$ are usually chosen for solar cell applications. Optical transmittance and electrical sheet resistance trade off each other. Here, the effect of spray time on FTO layer thickness, sheet resistance, transparency, and film morphology was studied. For this purpose, a series of FTO films were prepared on glass substrates by changing the film thickness by varying the spray time. The precursor solution, containing 9.01 g of $SnCl_4.5H_2O$ and 2.40 g of NH_4F in 400 cm3 of methanol, was sprayed onto a soda-lime glass substrate at 500 °C. The electrical, optical, structural, and morphological properties of fabricated FTO films were compared with a commercially available FTO glass (CFTO) sample. In addition, a series of DSCs was prepared using fabricated FTO films and CFTO. By using a simple spray pyrolysis technique, it was possible to reduce the sheet resistance of FTO film below 1 $\Omega\ \square^{-1}$ while keeping the resistivity around 3.5 Ω cm. According to the DSCs prepared using these films, better energy conversion efficiencies can be obtained via FTO films with low transparency and low sheet resistance. Their stability and fill factor were significantly better (higher than 70%) than standard commercial FTO films with higher transmittance (T) and average Rsh. The efficiency of the DSC series showed a linear relationship with T^2/R_{sh}. The results indicate the transparency of FTO is not a dominant factor, and translucent FTO films with carefully controlled light scattering properties may be used in fabricating dye solar cells with superior efficiency.

Financial assistance from PGIS (Grant No PGIS/2020/05) is acknowledged.

Keywords: Dye-sensitized solar cell, FTO, Optical transparency, Spray pyrolysis, Sheet Resistance

Abstract No: 109 ***Physical Sciences***

CHITOSAN-COATED MAGNETITE NANOPARTICLES LOADED WITH POLAR EXTRACTS OF *OSBECKIA OCTANDRA* LEAF

M.R.D.G. Kumari[1], T.M.K.I.B. Tennakoon[1], R.M.G. Rajapakse[1*], M.P. Thomas[1], B.M.R. Bandara[1, 2] and R.P.V.J. Rajapakse[3]

[1]Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka
[2]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[3]Department of Veterinary Pathobiology, University of Peradeniya, Peradeniya, Sri Lanka
[*] rmgr@pdn.ac.lk

Targeted drug delivery improves drug bioavailability and safety, particularly in cancer chemotherapy. When drug-loaded magnetite nanoparticles (MNPs) are employed, the rate of drug release can be controlled by an external magnetic field. The present study aims to synthesize chitosan-coated magnetite nanoparticles (CMNPs) loaded with leaf extracts of *Osbeckia octandra*; chitosan, a linear copolymer polysaccharide derived from chitin, confers biocompatibility to magnetic nanoparticles. The plant *O. octandra*, which is endemic to Sri Lanka, is known for its anticancer, antidiabetic, and hepato-protective properties. The dry leaf powder of *O. octandra* was extracted sequentially with hexane, dichloromethane, methanol, and water using Soxhlet extraction. The antioxidant capacity of the sequential extracts was determined using 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging and ferric reducing antioxidant power (FRAP) assays; antioxidants prevent free radical damage associated with cancer development. To evaluate the toxicity of the extracts toward healthy cells, the extracts were subjected to *in vitro* cell viability studies on Vero 76 cells. The polar extracts (methanol and water) displayed the highest antioxidant capacity comparable to that of ascorbic acid and the highest cell viability (100%) on Vero 76 cells. Accordingly, the methanol and water extracts were treated with CMNPs to obtain the corresponding extract-loaded nanoparticles, MCMNPs and WCMNPs, respectively; MNPs were prepared by the co-precipitation method and CMNPs by surface coating of MNPs with chitosan. The presence of magnetite in each type of magnetic nanoparticles was confirmed by powder X-ray diffractometry and Fourier transforms infrared (FTIR) spectroscopy. Scanning electron microscopy revealed the average particle size of MNPs, CMNPs, MCMNPs, and WMNCPs as 34.19±9.34, 32.67±7.21, 42.89±8.73, and 41.49±8.21 nm, respectively. The incorporation of chitosan into CMNPs was indicated by FTIR, and thermogravimetric analysis (TGA) revealed that 20.4% of the MNP was coated with chitosan. Methanol and water extracts were loaded onto CMNPs with encapsulation efficiencies of 81% and 70%, respectively.

Keywords: Chitosan, Magnetite, Nanoparticles, *Osbeckia octandra*, Targeted drug delivery

Abstract No: 110 ***Physical Sciences***

SYNTHESIS OF CYCLODEXTRIN-COATED MAGNETITE NANOPARTICLES AS A POTENTIAL DRUG FOR TREATING ATHEROSCLEROSIS

T.M.K.I.B. Tennakoon, M.R.D.G. Kumari, M.P. Thomas and V.N. Seneviratne*

Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka
**vns@sci.pdn.ac.lk*

Cardiovascular diseases derived from atherosclerosis are the most common cause of mortality worldwide. Nevertheless, it has been found that the current drug treatment methods are incapable of regressing atherosclerosis plaques. Some studies have shown that cyclodextrins (CDs) can regress atherosclerosis plaques by dissolving the intracellular and extracellular cholesterol crystals (CCs), which induce an artificial inflammatory response that could destabilize the atherosclerosis plaques. Current work presents a novel synthesis route using the co-precipitation method to synthesize β-cyclodextrin coated magnetite nanoparticles (BCD-MNPs). An inclusion complex (S@BCD-MNPs) was assembled between Simvastatin and BCD-MNPs using the co-evaporation technique to enhance the efficiency of BCD-MNPs performance. Synthesized particles were characterized using powder X-ray diffraction (PXRD), Fourier-transform infrared spectrophotometry (FTIR), scanning electron microscopy (SEM)) and thermogravimetry analysis (TGA). SEM results showed that synthesized BCD-MNPs and S@BCD-MNPs are in the range of (59.51±11.19) nm and (49.41±13.15) nm, respectively. The appearance of characteristic β-CD bands at 1048 cm^{-1} and 3650-3050 cm^{-1}, corresponds to -OC-O-CO- stretching (α-1,4-glycosidic linkages) and O-H stretching (alcohol groups) in BCD-MNPs FTIR spectra confirmed the successful functionalization of BCD-MNPs. Furthermore, TGA data shows 7.18% (W/W) weight loss, corresponding to the thermal decomposition of β-CD in the temperature range of 180-350 °C for BCD-MNPs. Simvastatin loading and Simvastatin releasing profiles in a cholesterol microenvironment were studied with the help of a UV-Visible Spectrophotometer (UV-Vis). Drug loading efficiency was found to be 65.5%. The trend in UV-vis absorbance for the simvastatin release profile in the cholesterol microenvironment shows that the cholesterol content in the medium decreases and the simvastatin content in the medium increases over time.

Keywords: Atherosclerosis, Cardiovascular diseases, Cyclodextrins, Magnetite nanoparticles, Simvastatin

Abstract No: 114 ***Physical Sciences***

TIN AND ZINC OXIDE COMPOSITE DYE-SENSITIZED SOLAR CELLS WITH AN EXTREMELY THIN LIQUID FILM AS THE REDOX ELECTRON MEDIATOR

H.W. Gardiarachchi[1, 2], A.D.T. Medagedara[1, 2], G.R.A. Kumara[2*] and K. Tennakone[2,3]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]National Institute of Fundamental Studies, Kandy, Sri Lanka
[3]Department of Physics, Georgia State University, Atlanta, USA
[*]grakumara2000@yahoo.com

Some major issues that hamper the stability of dye-sensitized solar cells (DSCs) are dye degradation, liquid electrolyte leakage, and evaporation. This can occur because of sealing imperfections and photocatalytic reactions that transpire at the TiO_2 surface triggered by the ultraviolet component of solar radiation in the presence of water. To overcome imperfections in sealing, solid-state DSCs can be developed. In these cells, the liquid redox mediator is replaced by a p-type hole conducting material. Compared to their liquid equivalents, solid hole conductors typically have lower electron mobility. Hence, recombination reactions predominate in solid-state DSCs, and the cells exhibit poorer power conversion efficiencies. The photo-degradation of both dye and the electrolyte can be eliminated by adopting less photocatalytically active larger band-gap n-type oxide semiconductors with the conduction band edge positioned competently. SnO_2 (band gap 3.8 eV) fulfils this condition, but DSCs based on SnO_2 working electrodes are inefficient due to the rapid recombination reactions. This can be overcome by applying an ultra-thin layer of higher band gap oxide to cover the crystallite surface of SnO_2. In this work, the usual liquid electrolyte (I^-/I_3^-) was used to fill the pores of the SnO_2/ZnO composite working electrode, sensitized with the N719 dye. Then, the excess electrolyte was wiped off. Finally, these pores were sealed using graphite powder. This treatment annihilates losses due to evaporation and leakage while sustaining high electron mobilities. An optimum energy conversion efficiency of 3.06% was obtained for this DSC with the corresponding cell parameters of open circuit voltage 0.57 V, short circuit current density 8.19 mA cm^{-2}, and fill factor 0.66 under 1.5 AM illumination. A maximum incident photon to the current conversion efficiency of 39% was attained in the wavelength range from 510 nm to 535 nm.

Keywords: Dye-sensitized solar cell, Graphite, Tin oxide, Zinc oxide

Abstract No: 115 ***Physical Sciences***

LOW-COST PROTON EXCHANGE MEMBRANES FOR MICROBIAL FUEL CELLS USING CLAY AND ACTIVATED CARBON

H.M.P.P. Molagoda[1*], T.M.W.J. Bandara[1] and E.Y. Fernando[2]

[1]Department of Physics, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Biological Sciences, Rajarata University, Mihintale, Sri Lanka
[*]piumanim@sci.pdn.ac.lk

The proton exchange membrane (PEM) is a significant component that affects the performance of the microbial fuel cell (MFC). Electro-neutrality between the two chambers is very important in MFCs, and it is performed by PEM, which transfers the protons across the membrane. A Nafion membrane is widely used as PEM in MFC for exchanging protons, but it is costly. Therefore, further research on low-cost PEM, which is high in porosity and mechanical strength, is vital. In this study, a PEM was made using natural clay and activated carbon derived from coconut shells (ACCS) and was compared with the results obtained for the Nafion membranes in other studies. In both MFCs, the volume of the anode and cathode chamber was 250 ml, and a phosphate buffer solution (50 mmol dm^{-3}) was added to the cathode while wastewater was added to the anode chamber. In this study, lake sediment was used as the source of electrochemically active bacteria in the anode chamber of MFC. Open circuit voltage and short circuit current density of clay and ACCS membrane were observed as 270 mV and 920.0 mA m^{-2}, respectively. The maximum power density obtained from the MFC using clay and ACCS (43.3 mW m^{-2}) was lower than the MFC with Nafion as PEM (202±6 mW m^{-2}). However, calculations showed that the cost per square meter for PEM developed from clay and ACCS (5,600 LKR) was much lower than the Nafion membrane (4.0 million LKR). Furthermore, a performance comparison of MFCs revealed that the cost per watt for clay and ACCS membrane was 0.13 million LKR, while that of Nafion was about 19.8 million LKR. Hence, low-cost clay and ACCS membranes were found to have the potential to replace Nafion membranes in MFCs for their field-scale applications. Therefore, MFC prepared using clay and ACCS can be used as a low-cost and clean energy source to generate bioelectricity.

Keywords: Activated carbon derived from coconut shell (ACCS), Bioelectricity generation, Cost per watt, Natural clay, Proton exchange membrane (PEM)

Abstract No: 121 ***Physical Sciences***

GRAPHITE POWDER BASED LAYER FOR ACTIVATED CARBON SUPERCAPACITOR TO ENHANCE CONNECTIVITY BETWEEN ACTIVATED CARBON ELECTRODE AND CURRENT COLLECTOR

A.D.T. Medagedara[1, 2], H.W. Gardiarachchi[1, 2], G.R.A. Kumara[1*], T.M.W.J. Bandara[2, 3] and K. Tennakone[1, 4]

[1]National Institute of Fundamental Studies, Kandy, Sri Lanka
[2]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[3]Department of Physics, University of Peradeniya, Peradeniya, Sri Lanka
[4]Department of Physics, Georgia State University, Atlanta, USA
[*]grakumara2000@yahoo.com

One of the most widely used techniques for making a supercapacitor is the fabrication of electrodes with activated carbon. The interface between the electrode material and the current collector has a significant impact on its performance. In this work, we used the spray pyrolysis method to form a graphite layer on top of the current collector, and on top of it, an activated carbon layer was formed. We discovered that the existence of a layer made of graphite powder between the electrode material and the current collector could significantly improve the performance of the supercapacitor. The rectangular shape of the Cyclic Voltammetry (CV) exhibits ideal supercapacitor behaviour, but the loose contact between the current collector and the electrode material causes the rectangular shape of the CV to be distorted. The behaviour of a supercapacitor made of graphite slightly deviated from the optimum CV, proving the importance of the graphite layer for the connection of the activated carbon electrode. The supercapacitor with the best performance was obtained when the concentration of the binder in the graphite powder was 20% (w/w) and the suspension and heat-treated at 300°C for 20 min; the procedure showed a specific capacitance of 23.51 F g^{-1}. The cell with the same conditions except the graphite layer had a relatively low specific capacitance value of 19.76 F g^{-1}. Electrochemical Impedance Spectroscopy measurements show that the series resistance of the cell with a graphite layer is 0.720 $\wedge$, and the series resistance of the cell without a graphite layer is 0.774 $\wedge$. These results show the feasibility of employing graphite powder as a layer between an electrode and a current collector, increasing the specific capacitance and acting as an anti-corrosive material at the same time. As a result, it extends the supercapacitor's performance and durability.

Keywords: Activated carbon, Graphite, Supercapacitor

Abstract No: 125 ***Physical Sciences***

DESIGN AND ANALYSIS OF A HIGH-SPEED BLOWING SANITIZING MECHANISM UNIT FOR DISINFECTION CHAMBERS

W.G.K.P. Gamage* and I.P. Dharmathilaka

Department of Engineering Technology, Faculty of Technological Studies, Uva Wellassa University, Badulla, Sri Lanka
**kasun.prabhash@icloud.com*

The current study presents a design and analysis of an efficient and innovative mechanism to disinfect in controlling and preventing COVID-19. This mechanism is an alternative to the time-consuming and expensive disinfection process, and it can be focused on specific places on the body. The proposed device uses a high-speed airflow that passes through a venture. The high-pressure sprinkle will spread the sanitizing chemical in the middle of the venture. After spraying the chemical, the device will blow air to dry the chemicals on the skin. The study aims to assess the sparing speed of the sanitizing chamber. These whole simulations and analyses were done using SOLIDWORKS. The diffusion angle, contraction ratio, inlet-outlet pressure difference, and velocity characteristics were crucial parameters when choosing the best shape for the venture. After choosing and designing a better shape for the venture, the analysis part was done. Flow rates of air and water were applied to respective inlet sides and venture inlet. A venture inlet has been installed, and its needle has been attached at the most velocity point of the venture tube. In this study, an input flow velocity of air has been supplied at 100 m s^{-1}, and the output side has been set up as environment pressure. The validated computational fluid dynamic model was used to evaluate two scenarios; one is an increase in mass flow rate, and the second thing is to reduce turbulence and develop well flow at the end of the unit. At the end of the study, the well-analyzed mechanism could be invented with high speed and expected objectives. A higher flow rate is thought to increase the atomization quality and spray coverage of alcohol-based sanitizer liquid for sanitizing chamber and walkthrough gates applications.

Keywords: Automated Sanitizing, Computational Fluid Dynamic, Disinfection Chambers, Venture Mechanism, Quick-Drying Mechanism

Abstract No: 126 ***Physical Sciences***

SYNTHESIS OF GRAPHENE OXIDE QUANTUM DOTS USING LOCAL GRAPHITE

W.A.L.P. Wedasingha[1*], W.M.A.T. Bandara[1], M.B. Wijesinghe[1], I.P.L. Jayarathna[2], S.V.R. Weerasooriya[2] and M.D.R. Perera[2]

[1]Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka
[2]National Institute of Fundamental Studies, Kandy, Sri Lanka
[*]s16159@sci.pdn.ac.lk

Graphene-based quantum dots are zero-dimensional biocompatible nanomaterials that are less than 10 nm in size, and it carries distinctive features such as good thermal conductance, excellent mechanical strength, good chemical stability, and excellent electronic properties. Owing to the versatile nature of graphene-based quantum dots, extensive attention has been gained in many industries to utilize graphene oxide quantum dots (GOQDs). Numerous research efforts have been made so far to develop successful synthesis pathways to obtain GOQDs with desired properties. However, using local graphite as the precursor material, this study reports an environmentally friendly synthesis route for GOQDs. In this particular method, local graphite powder was converted into graphene oxide by improved Hummer's method and the subsequent conversion of graphene oxide to GOQDs using the one-step hydrothermal synthesis approach. The prepared materials were characterized by Ultraviolet-visible (UV-Vis) spectroscopy and ultraviolet transilluminator. According to the UV-vis spectroscopic analysis of graphene oxide showed peaks around 250 nm which is due to $\pi \rightarrow \pi^*$ transitions of the aromatic π electrons. In contrast to that, GOQD showed an extra peak at around 340−360 nm, which ascribes to the $n \rightarrow \pi^*$ transition of carbonyl bonds or other oxygenated functional groups present on the surface of GOQD. The formation of a quantum dot was confirmed by an ultraviolet transilluminator which gave a light blue colour under the UV light. These GOQDs have potential applications in biomedical imaging, adsorption of heavy metals, and electronic applications.

Financial assistance from the National Research Council of Sri Lanka (NRC 19-90), and JRDC is acknowledged.

Keywords: Graphene oxide, Green approach, Hydrothermal synthesis, Local graphite, Quantum dots

Abstract No: 129 ***Physical Sciences***

STRUCTURAL AND MORPHOLOGICAL INVESTIGATION OF SODIUM DODECYL SULFATE (SDS) - DIRECTED LINDE TYPE-A (LTA) ZEOLITE SYNTHESIZED AT VARYING CRYSTALLIZATION TEMPERATURES

M.D.R. Perera[1*], R.A.L.R. Amarasena[1], W.M.A.T. Bandara[2], R. Weerasooriya[1] and I.P.L. Jayarathna[1]

[1]National Institute of Fundamental Studies, Kandy, Sri Lanka
[2]Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]dilini.pe@nifs.ac.lk

Recently, nanocrystalline LTA-type zeolites have attracted much research attention due to their unique and promising functioning in a wide area of applications like catalysis, gas adsorption and separation, and medicinal applications. However, obtaining morphologically controlled LTA nanocrystals is a complicated but necessary task since the morphology of LTA crystals substantially influences the performance of their applications. This study aimed to investigate the structure-directing ability of sodium dodecyl sulfate (SDS), an eco-friendly anionic surfactant for forming nanocrystalline LTA zeolites with controlled morphology at varying crystallization temperatures. Following the microwave crystallization approach, synthesis was carried out at 100, 110, 130, and 150 °C crystallization temperatures with 900 W for 3 h, starting from the gel solution with the molar ratio of 5.5 Na_2O:1.0 Al_2O_3:4.0 SiO_2:190 H_2O: 0.2 SDS. The resulting materials were characterized by powder X-ray diffraction (PXRD) and scanning electron microscopic (SEM) techniques for an in-depth understanding of their structure and morphology. The PXRD results confirmed the successful synthesis of LTA zeolites at all four temperatures. However, with the increase in crystallization temperature, the phase purity tends to decrease due to the formation of hydroxy-sodalite (HS) impure phases at elevated temperatures (130 °C and 150 °C). A remarkable decrease in the crystallinity (80.2%) was observed for the sample crystallized at 130 °C but had the lowest average crystallite size (78 nm). Moreover, SEM monographs revealed the formation of the spheroidal "cotton-ball" structure of HS on surfaces and along with cubic crystals of LTA zeolite and crystal defects confirmed by the deeply truncated edges with rough crystal surfaces predominated at both higher temperatures. Accordingly, the study concludes that the best suitability of 100 °C crystallization temperature for the LTA synthesis is to have a controlled morphology with the highest crystallinity, with the aid of SDS.

Keywords: LTA zeolite, Morphology, Nanocrystalline, SDS, Structure directing

Abstract No: 131 ***Physical Sciences***

ZINC-DOPED HYDROXYAPATITE/CHITOSAN BIODEGRADABLE POLYMER COMPOSITE FOR BONE GRAFTING APPLICATIONS

R. T. Mohotti[1*], A. Manipura[1], S. Jagoda[2] and N. Adassooriya[1]

[1]Department of Chemical and Process Engineering, Faculty of Engineering, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Veterinary Pathobiology, Faculty of Veterinary Medicine and Animal Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]rashmimohotti@yahoo.com

The occurrence of bacterial infections during and after bone graft surgeries are rising to the point of concern, despite the use of antibiotics and controlled hygienic practices. Better methods of preventing bacterial infections are needed, and the fabrication of materials with antibacterial properties within the material itself can be of added advantage. Hence, an investigation into the possibility of synthesizing a bone graft material with antibacterial properties was conducted. Suitable materials for the composite were reviewed and selected. These materials had the added advantage of biocompatibility and degradation. Thus, a polymer composite for bone grafting applications was prepared using chitosan, hydroxyapatite, and zinc. Four composites with varying zinc (doped at 0.2, 0.4 and 2% of Zn) and chitosan ratios were synthesized, and scaffolds were prepared by a compression pelletizing process with 10 kN force. The composites were characterized through Fourier Transform Infrared (FTIR), Powdered X-Ray Diffraction (PXRD), and Thermogravimetric analysis (TGA) techniques. The composites were thermally stable till around 300 °C proving suitable use in the specific application. Water absorption, stability in fluids, compressive strength and antibacterial properties of the composites were tested. The compressive strength of the scaffolds obtained ranged from 4-11 MPa, which is satisfactory for cancellous bone applications. The composites displayed effective inhibition against *Escherichia coli* and *Staphylococcus aureus* after 18 and 30 h of incubation. Stability in fluids had to be further enhanced, though satisfactory water absorption levels were observed.

Keywords: Antibacterial, Bone graft, Chitosan, Hydroxyapatite, Polymer composite

Abstract No: 132 ***Physical Sciences***

MECHANOCHEMICAL SYNTHESIS OF UREA: SALICYLIC ACID COCRYSTAL AS A SUSTAINED RELEASED NITROGEN SOURCE

M.S.N. Madanayake[1*], N.H. Madanayake [2] and N.M. Adassooriya[1]

[1]Department of Chemical and Process Engineering, Faculty of Engineering, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Botany, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]e16210@eng.pdn.ac.lk

Global agriculture and food and nutrition security are challenged by the premature decomposition of urea in the soil before plant uptake. Crystal engineering is a solution to reduce the nitrogen (N) loss from urea due to its high-water solubility. Thus, cocrystals of urea have recently gained interest as synthetic N fertilizers to reduce solubility barriers and release kinetics of urea. In this study, urea cocrystals with salicylic acid as the coformer was prepared using mechanochemistry *via* neat grinding and liquid-assisted grinding in both 1:1 and 2:1 stoichiometric ratio and subjected to solid state characterization techniques, including Powder X-ray diffraction (PXRD), Fourier transform Infrared spectroscopy (FTIR), and Thermogravimetric analysis (TGA). The results confirmed the formation of already reported 1:1 cocrystal while suggesting a possible new form of 2:1 urea: salicylic acid (U: SA) cocrystal. Results of the TGA confirmed the anhydrous and guest-free nature of cocrystals. PXRD patterns revealed the presence of a new crystalline phase which is different from a physical mixture of starting compounds. Shifting of peaks in FTIR spectra validated the formation of intermolecular amide–acid interactions in the cocrystal crystal structure. The release study was carried out using the reported 1:1 cocrystal system in soil (pH=5.9), and it took 10 days to elute around 85% of urea compared to commercial urea (8 days) confirming that U: SA cocrystal is a potential candidate for sustained-release nitrogen fertilizer. Reduced urea leaching in soil resulting from mechanochemical cocrystallization of urea with SA can be thereby indicated as a viable strategy towards improving N uptake in an efficient, eco-friendly, and less toxic method.

Keywords: Cocrystals, Mechanochemistry, Nitrogen loss, Sustained-release nitrogen fertilizers, Urea leaching

Abstract No: 150 ***Physical Sciences***

MONTMORILLONITE NANOCLAY REINFORCED CARBOXYMETHYL CELLULOSE/HYDROPHOBIC TiO_2 NANOCOMPOSITE AS A BIODEGRADABLE FOOD PACKAGING MATERIAL

C.V. Ihalavithana[1*], S.S.S.D.S. Jagoda[2] and N.M. Adassooriya[1]

[1]Department of Chemical and Process Engineering, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Veterinary Pathobiology, University of Peradeniya, Peradeniya, Sri Lanka
[*]e16139@eng.pdn.ac.lk

Recent studies have been conducted on biodegradable polymer nanocomposites from a structural and functional perspective and their applications in food packaging due to triggered concerns of looking for materials and processes compatible with the environment. In this regard, due to its hydrophilic nature, titanium dioxide (TiO_2) underwent hydrophobic modification by stearic acid (SA, 3 w/w% of TiO_2) *via* a physical coating method using ethanol as the solvent to prepare functional carboxymethyl cellulose (CMC) based nanocomposite film appropriate for food packaging. The novel CMC-based ternary nanocomposite film was synthesized by incorporating 5 w/w% of sodium montmorillonite (Na^+MMT) and 1 w/w% of modified TiO_2 *via* a drop-casting method. As prepared, the modified TiO_2 and nanocomposite film were characterized by FTIR spectroscopy to demonstrate the interactions and PXRD and TGA analysis to investigate the crystallinity and thermal behaviour of the nanocomposite films, respectively. FTIR results showed that SA was closely and firmly combined with TiO_2 particles; therefore, the changes in surface characteristics of TiO_2 promoted the interaction between CMC, MMT, and TiO_2 in nanocomposite film. According to PXRD analysis, the CMC chains were loaded into the silicate layers' gallery to produce an intercalated nanomorphology. TGA analysis highlighted that physically coated SA in TiO_2 microcrystals had improved thermal stability. The performance of the nanocomposite films was demonstrated by moisture content and tensile tests. The results showed that modified TiO_2 decremented moisture content, tensile strength, and elongation at the break by 2.9%, 29.4%, and 27.0%, respectively. It was deduced that the long hydrocarbon chain of SA, which is non-polar, has conferred hydrophobicity to the nanocomposite, promoting the water-resistance and increasing the extensibility of the film.

Financial assistance from University Research Grant (Grant No URG/2021/17E) is acknowledged.

Keywords: CMC-based nanocomposite, Food packaging, Hydrophobicity, Surface modification, Titanium dioxide

Abstract No: 170 ***Physical Sciences***

GREEN SYNTHESIS OF ZINC OXIDE NANOPARTICLES FROM *AMARANTHUS VIRIDIS* AND *COSTUS SPECIOSUS*: PROCESS OPTIMIZATION AND ANTIMICROBIAL POTENTIAL

S.W. Thrikawala, H.A.I.R. Perera* and M.P. Thomas

Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka
**ishanieperera@sci.pdn.ac.lk*

Nanomaterials have been emerging as a new generation of antimicrobial agents to mitigate the crisis associated with antimicrobial resistance. Among them, Zinc Oxide Nanoparticles (ZnO NPs) stand out due to their biocompatibility and easy synthesis. The objective of this study was to explore a simple, eco-friendly method to synthesize ZnO NPs using zinc acetate dihydrate as the precursor from aqueous leaf extracts of *Amaranthus viridis* (*Kurathampala*) and *Costus speciosus* (*Thebu*). Aqueous leaf extracts of both plants were prepared, and optimization of the synthesis in response to yield, characterization and antimicrobial activity determination were conducted. The effects of precursor concentration and reaction temperature and their interactions during the synthesis were determined by response surface methodology employing the central composite design. Within the chosen range, the precursor concentration was identified as a significant variable ($p < 0.05$) as opposed to the reaction temperature in the synthesis. From the PXRD patterns, ZnO NPs were highly pure, confined to the wurtzite structure with mean crystallite sizes of 20.01 and 15.99 nm for *A. viridis* and *C. speciosus* mediated synthesis, respectively, and most effectively calcinated at 450 °C. Investigation of FTIR spectra verified functional groups in charge of stabilizing and capping of ZnO NPs. Roughly spherical particles of average sizes < 60 nm were observed from SEM imaging. In comparison to Sigma-Aldrich ZnO (< 50 nm), ZnO NPs mediated via *A. viridis* and *C. speciosus* showed a high antifungal potential against a standard isolate of *Candida albicans* (ATCC 90028). A minimum inhibitory concentration of 5.12 mg/mL against standard isolates of gram-negative bacteria *Pseudomonas aeruginosa* (ATCC 27853) and *Escherichia coli* (ATCC 25922) were obtained for the ZnO NPs synthesized *via A. viridis* and *C. speciosus* from the agar dilution method, while the effect on gram-positive bacteria was not notable. Overall, the results elucidated a rapid, cost-effective, environmentally-friendly method for ZnO NP synthesis, which showed antimicrobial potential against fungal and gram-negative bacterial strains.

Keywords: Antimicrobial activity, Central composite design, Green synthesis, ZnO nanoparticles

Abstract No: 186 ***Physical Sciences***

MOLYBDENUM DISULFIDE ON REDUCED GRAPHENE OXIDE HYBRIDS WERE DEVELOPED *VIA* ONE POT HYDROTHERMAL ROUTE AS A CATALYST FOR HYDROGEN EVOLUTION REACTION

P.M. Premadasa[1], S.A. Panamldeniya[1], Y.K. Abeykoon[1], H.M.M. Munasinghe[2] and N. Gunawardhana[1, 2*]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Sri Lanka Technological Campus, Padukka, Sri Lanka
[*]nandag@sltc.ac.lk

Green hydrogen production from the cathodic reaction of water splitting (hydrogen evolution reaction) is one of the most significant discoveries in recent years. In this regard, molybdenum disulfide (MoS_2) is used as an alternative catalyst for platinum due to its high availability and lower binding energy, which is close to zero. 1-T MoS_2, 3-R MoS_2, and 2-H MoS_2 are the major phases of MoS_2, and 2-H MoS_2 is the most stable form, but only the edge sites are activated, and the whole basel plane is almost inactive. Therefore, the activity of 2-H MoS_2 is based on the nature of the edges-sites. In this study, MoS_2–graphene oxide (MoS_2–GO) composites were prepared via a one-step hydrothermal method on the three distinct GO materials, which were prepared under different oxidation durations (24, 48, and 72 h) in the modified hummer's method. The MoS_2 with differently oxidized GO was characterized by SEM, PXRD, and FTIR to disclose the characteristics of the materials. In addition, the electrochemical performance of MoS_2-GO was investigated by using linear sweep voltammetry (LSV). The results showed that MoS_2 layers were successfully grown on the surface of GO, which is prepared at the highest oxidation duration (72 h). It has a higher number of shaped edges with uniform growth. According to the FTIR results of GO and GO-MoS_2, 72 h oxidized GO has more (COOH) carboxylic groups, and the growth of MoS_2 has been initiated through COOH groups. The XRD spectrum of the MoS_2/RGO revealed that the MoS_2 prepared on 72 h oxidized GO nanosheets (MoS_2/RGO-72) had the highest d spacing value due to the inserted GO into the MoS2 layers. Moreover, MoS_2/RGO-72 was the best catalyst for the hydrogen evolution reaction (HER) because MoS_2/RGO-72 needs the lowest potential value to initiate the HER reaction (overpotential). Finally, the growth of MoS_2 on GO is possible to change by varying the oxidation duration of GO to have MoS_2/RGO material with a greater number of activated sharp edges.

Financial assistance *from Sri Lanka Technological Campus Padukka.* (*Grant No: RRSG/20/A2*) *is acknowledged.*

Keywords: Edge-Sites, Graphene Oxide, Hydrothermal, Molybdenum Disulfide

Abstract No: 192 ***Physical Sciences***

EDDY CURRENT INSPECTION-BASED DAMAGE DETECTION OF CARBON FIBRE-REINFORCED POLYMER COMPOSITES

A.G.C.S. Amarasinghe, R.R.D. Ranawaka, E.H.N. Dilshan, I.P. Dharmathilaka, G.A.A.I. Tennakoon and H.M.C.M. Herath*

Department of Engineering Technology, Faculty of Technological Studies, Uva Wellassa University, Badulla, Sri Lanka

**madhubhashitha@uwu.ac.lk*

Carbon fibre-reinforced polymer composite is used in many aerospace, automobile, and civil engineering industries. During the manufacturing stage and end-user stage, carbon fibre composite material is subjected to different kinds of damage, such as delamination, de-bonding, and fibre breakages. Those damages may lead to destroying the application with a life-threatening catastrophe. To identify these kinds of damages, several non-destructive testing (NDT) techniques are used, such as visual, ultrasonic, and optical fibre sensing. However, when considering the initiation and propagation of the damage, microlevel and invisible cracks are crucial. This study used plain weave carbon fibre fabric with an appropriate resin-hardener mixture to make carbon fibre-reinforced composite sheets by hand layer-up process. Subsequently, the samples were subjected to drop weight impact tests with 0.6 j, 1.2 j, 3.0 j, 6.0 j, and hammer impact tests. By using an Ectane-2 eddy current inspection equipment, both sides of the carbon fibre samples were scanned before and after the impact damage. The defect's location could be seen on the c-scan plane, while the crack propagation could be seen on the impedance plane of the Ectane-2-magnify software screen. Variations in voltage showed an irregular pattern on the impedance plane because of the damage to the carbon fibre strips that affected the electrical conductivity of the composite. The eddy current inspection method is capable of identifying the damage location and propagation of plain weave carbon fibre-reinforced polymer components. In the future, fibre weaves such as twill and unidirectional need to be investigated.

Keywords: Carbon fibre (CF), Composite materials, Eddy current, Non-destructive technology (NDT), Woven fabrics

Abstract No: 193 ***Physical Sciences***

ANTIOXIDANT ACTIVITY OF PROPOLIS OF THE ENDEMIC STINGLESS BEE, *TETRAGONULA PRAETERITA*, FROM DIFFERENT CLIMATIC ZONES OF SRI LANKA

U.C.M. Thilakarathna[1], D.R. Uduwela[1*], A.P. Welegedara[1], B.M.R. Bandara[1], W.A.I.P. Karunaratne[2]

[1]Department of Chemistry, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Zoology, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]dimanthi.uduwela@sci.pdn.ac.lk

Tetragonula praeterita (Walker) is the only endemic stingless bee species found in Sri Lanka. Propolis is a sticky lipophilic resinous substance produced by a mixture of bee wax, plant resins, pollen and exudates, including organic and inorganic earth components and salivary secretions of stingless bees. The bioactivity of propolis depends on its chemical composition, which varies with the bee species, food source, ecosystem, climatic zone, season and vegetation. This study aimed to compare the antioxidant activity of propolis samples obtained from Kandy (KAN), Kurunegala (KUR) and Batticaloa (BAT) belonging to wet, intermediate and dry climatic zones of Sri Lanka, respectively. Ethanol extracts prepared by Soxhlet extraction were assessed for antioxidant capacity by 1,1-diphenyl-2-picrylhydrazyl (DPPH) assay, ferric reducing antioxidant power (FRAP) assay, Folin-Ciocalteu method (for assaying total polyphenolic content, TPC) and aluminium chloride colorimetric method (for assaying total flavonoid content, TFC). The IC50 values of DPPH radical scavenging assay were 155.75±8.19 (KAN), 538.89±16.14 (KUR) and 1,191.67±2.92 mg L-1 (BAT) and the corresponding FRAP values were 102.46±0.01, 71.30±0.01 and 60.17±0.01 mmol g-1 dm-3. The TPC values of KAN, KUR and BAT samples were 37.0±3.1, 16.8±1.5 and 14.4±1.1 mg (gallic acid equivalent) g-1, respectively. The antioxidant activities correlated with the TPC values but not with the TFC values, 179.2±31.8 (BAT), 135.2±1.1 (KAN) and 111.3±3.9 (KUR) mg (quercetin equivalent) g-1. Therefore, it can be concluded that the antioxidant capacity of *T. praeterita* propolis depends on the climatic zones from which the samples are collected and that the TPC contributes to the antioxidant capacity of the bee propolis.

Keywords: Antioxidant activity, Bee propolis, Climatic zones, Endemic, Tetragonula praeterita

Abstract No: 201 ***Physical Sciences***

BIODEGRADABLE POLYMER-COATED UREA GRANULES AS A SLOW-RELEASE NITROGEN SOURCE

J.A.M. Dilhan[1*], R.M.G. Rajapakse[1,3] and N.M. Adassooriya[1,2]

[1]Postgraduate Institute of Science, University of Peradeniya, Sri Lanka
[2]Department of Chemical and Process Engineering, Faculty of Engineering, University of Peradeniya, Sri Lanka
[3]Department of Chemistry, Faculty of Science, University of Peradeniya, Sri Lanka
[*]malithdilhan0401@gmail.com

Urea is the most popular nitrogenous fertilizer due to its relatively low cost and high nitrogen composition. However, approximately 30-50% of urea is only utilized by plants resulting in low nutrient use efficiency (NUE). Several environmental issues originate *via* the loss of urea throughout various processes, such as direct volatilization, accumulation of urea via runoff, and leaching of urea as nitrates. Controlled-release fertilizers (CRFs) are one of the promising methods to increase NUE and minimize environmental impact. During this study, attempts were made to synthesize biodegradable polymers coated urea granules using cellulose acetate (CA) and polyvinyl alcohol (PVA). 4.5% (v/v) CA solution was prepared in acetone at room temperature with constant stirring at 800 rpm, and this solution was coated on urea granules by the solvent casting method. 3% (v/v) PVA solution was prepared by dissolving PVA in distilled water at 80 ℃ with constant stirring at 1,000 rpm. Then 30% (w/w) by polymer mass citric acid was added as a crosslinker to the PVA solution after it cooled to room temperature. This solution was sprayed on CA-coated urea granules to synthesize CRFs (UCPC30). Finally, CRFs were dried at 105 ℃ for 2.5 h for cross-linking. The successful polymer coatings were confirmed by Fourier transform infrared spectroscopy, powder X-ray diffraction, and scanning electron microscopy. The release behaviour of the prepared polymer-coated urea was investigated in the soil medium (pH=5.9), and it was observed that 92% of urea was released from the CRFs in a slow and sustained manner for up to 16 days. Meanwhile, 90% of urea was released from commercial grade within 8 days. The porous hydrogel matrix of the PVA regulates the penetration of urea molecules and extends the release time. Therefore, biodegradable polymer-coated urea granules are ideal candidates for slow-release fertilizer.

Keywords: Biodegradable, Controlled release fertilizers, Nutrient release efficiency, Release behaviour

Abstract No: 203 ***Physical Sciences***

TiO_2 NANOPARTICLES INCORPORATED CMC-MMT NANOCOMPOSITE FOR FOOD PACKAGING APPLICATIONS

A.W.N.D. Perera[1*], S.N. Wijesooriya[3] and N.M. Adassooriya[1,2]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Chemical and Processing Engineering, University of Peradeniya, Peradeniya, Sri Lanka
[3]Department of Food Science and Technology, Wayamba University of Sri Lanka, Gonawila, Sri Lanka
[*]nawodaperera1995@gmail.com

The demand for sustainable food packaging material has increased compared to nonbiodegradable packaging because plastic waste is a serious environmental problem. In this study, different composites of citric acid (CA) crosslinked montmorillonite (MMT) reinforced carboxymethyl cellulose (CMC) films with TiO_2 nanoparticles (NPs) (average size < 20 nm) incorporated to act as antimicrobial agents were investigated for applications in food packaging. Films were fabricated using the solvent casting method with 25% (w/w) CA as the crosslinking agent, and 1%, 3%, and 5% TiO_2 NPs were added to the CMC-MMT nanocomposite with glycerol as a plasticizer. The films were characterized by FTIR, TGA, and PXRD and evaluated for water solubility, moisture content, and moisture uptake ability. The addition of CA and TiO_2 NPs lowered the moisture uptake (MU), water solubility (WS), and moisture content (MC) by reducing polymer network interactions. FTIR analysis confirmed the formation of ester crosslinks between CMC and CA. It was found that MC decreased from 34.3% to 33.3% when the concentration of CA increased and reduced to 29.3% with the addition of 5.0% TiO_2 NPs. The WS was reduced from 67.9% to 66.9% when the amount of CA increased from 15.0% to 25.0% and reduced from 66.7% to 65.2% when the amount of TiO_2 NPs increased from 1.0% to 5.0%. Incorporation of 3% TiO_2 NPs into CMC/MMT/CA25% film remarkably reduced the MU by 21.9% at 97.0% RH and 16.1% at 40.0% RH. According to the thermal analysis, the addition of TiO_2 NPs enhanced the thermal stability of CMC films. The PXRD revealed that TiO_2 NPs and MMT modified the original structure of the CMC by increasing the crystallinity of the films. From the overall results, CA crosslinked TiO_2 NPs incorporated CMC-MMT films were found to exhibit the lowest WS, MU, and MC.

Financial assistance from University Research Grant (Grant No URG/2021/17E) is acknowledged.

Keywords: Moisture Uptake, Moisture Content, Nanocomposite, Water Solubility

Abstract No: 204 ***Physical Sciences***

ENHANCING PERFORMANCE OF THIN FILM SOLAR CELLS USING METAL-LIKE SMALL PARTICLES: A COMPUTATIONAL APPROACH

A.N. Wijenarayana* and M.L.C. Attygalle

Department of Physics, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
**amadie12wijenarayana@gmail.com*

Thin-film solar cells are ideal for energy harvesting due to their low cost in manufacturing. However, one of the major drawbacks is the low absorption of the material layers which can reduce the solar cell's performance. In this computational study, we tried to improve the key performance of the solar cell by increasing the light absorption of the cell by introducing metal-like small particles in the semiconductor layers of two thin-film solar cells; amorphous silicon solar cell (a-Si: H) with p-i-n layers structure and cadmium telluride solar cell (CdTe) with p-n layers structure. This study was carried out using two open-source software. The MiePlot software was used to find the refractive index of the modified semiconductor layer for each wavelength and the data was used to find the absorption coefficients corresponding to each wavelength in the spectrum range of 300-800 nm. The SCAPS-1D software was used to model the solar cells under the AM 1.5 solar spectrum and obtain the key performance parameters of the solar cells. Gold and silver metal nanoparticles of radius 10 nm were introduced separately in the p-a-Si: H layer, n-a-Si: H layer and i-a-Si: H layer of the a-Si: H solar cell. Similarly, the same type of metal nanoparticles was introduced separately in the p-CdTe and the n-CdS layers of the CdTe solar cell. Due to the limited computational power, only fifty nanoparticles were dispersed at a 1% standard deviation in the surrounding semiconductor medium in each case. Each solar cell with the new layer properties was modelled using SCAPS-1D software and compared with the solar cells without the metal nanoparticles. The key performance parameters: short circuit current, open circuit voltage, and efficiency of the solar cells, were improved in each case when the active semiconductor layers (i-a-Si: H and p-CdTe) were modified with gold and silver nanoparticles. By introducing metal nanoparticles, the localized surface plasmon resonance enhances the electromagnetic field in the vicinity of the metal spheres by improving the absorption. The a-Si: H and CdTe solar cell's efficiencies were increased at the introduction of silver nanoparticles in the active layers (i-a-Si: H and p-CdTe) compared to the introduction of gold nanoparticles, and this can be due to the stronger plasmonic resonance produced by silver nanoparticles compared to gold nanoparticles.

Keywords: Localized surface plasmon resonance, Nanoparticles, SCAPS 1D, Solar energy, Thin-film solar cells

Abstract No: 224 ***Physical Sciences***

ACTIVATED CARBON SYNTHESIZED FROM JACK WOOD FOR SUPERCAPACITORS

A.M.B.S. Alahakoon[1*], H.M.N. Wickramasinghe[1] and T.M.W.J. Bandara[1, 2]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Physics, University of Peradeniya, Peradeniya, Sri Lanka
[*]buddhikaalahakoon94@gmail.com

Supercapacitors (SCs), a novel energy storage system, have attracted significant attention because of their higher power density and longer cycling stability compared to those of secondary batteries. In addition, their energy density is higher than that of traditional capacitors. As an electrode material, activated carbon has many advantages, such as high surface area and porous structure, high chemical and thermal stability, and comparably high electric conductivity. In this study, electrochemical double-layer capacitors (EDLC) are prepared using the activated carbon (AC) derived from Jack wood (*Artocarpus heterophyllus*). Porous carbon material with a high surface area was prepared by carbonization of the Jack-wood. Subsequently, activation was accomplished by NaOH treatment and heating to 800 ºC for 1 h. The AC-based electrodes were prepared on fluorine-doped tin oxide (FTO) substrate in order to build SCs. In this work, biomass-based AC was prepared as electrode material, while aqueous H_2SO_4 (1 M) was used as the electrolyte. The electrochemical properties of AC-based SCs were investigated using cyclic voltammetry and galvanostatic charge-discharge measurements. CV confirmed that charge storage takes place electrostatically without occurring any redox reactions. In addition, SCs exhibited a relatively high specific capacity of 147.19 F g^{-1} at 2 mV s^{-1} scan rate along with the aqueous 1 M H_2SO_4 electrolyte. Further, the supercapacitor demonstrated a power density of 68.47 W kg^{-1} and an energy density of 8.02 Wh kg^{-1} at the charge-discharge current density of 0.5 mA cm^{-2}. SCs showed ~94.98% of initial capacitance retention after 1,000 cycles implying excellent cycling stability and rate capability according to cyclic voltammetry. Recurrent charge/discharge curves confirmed specific capacitance retention of 92.58% at 3 mA cm^{-2} after 100 cycles.

Financial assistance from the Postgraduate Institute of Science (PGIS), University of Peradeniya Research Grant (Grant No. PGIS/2020/05) is acknowledged.

Keywords: Electrochemical double layer, Porous carbon, Supercapacitors

Abstract No: 237 ***Physical Sciences***

EFFICIENT DYE-SENSITIZED SOLAR CELL CONTAINING BINARY SALT ELECTROLYTE AND IRRADIANCE LEVEL DEPENDANCE OF THEIR PERFORMANCE

H.M.N. Wickramasinghe[1*], K.B. Wijayaratne[1, 2] and T.M.W.J. Bandara[1, 2]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Physics, University of Peradeniya, Peradeniya, Sri Lanka
[*]narmadawick@gmail.com

Liquid electrolytes (LEs) are being used as electrolytes in Dye-Sensitized Solar Cells (DSSCs) due to their superior conductive properties and versatility. The electrical contact between electrolytes and porous electrodes can be easily achieved using LEs since LEs readily diffuse into pores and voids of electrodes. Therefore, in general, LE-based DSSCs deliver higher efficiencies. However, the adverse effects of liquid electrolytes, such as electrolyte leakage, volatility, and flammability, should be mitigated to prepare chemically and physically statable DSSCs. In this study, the performances of new LE-based DSSCs have been investigated. DSSCs exhibit enhanced charge transport properties, leading to higher efficiency for photoelectrochemical energy conversion applications. The effect of the frequency dependence of the real and imaginary components of the AC conductivity on the dielectric polarization of the electrolyte was investigated to comprehend the capacitive effect of the cell. The novel liquid electrolyte investigated in this study comprised ethylene carbonate (EC), propylene carbonate (PC), 1-butyl-3-methylimidazolium iodide (BMII), 4-tert-butyl pyridine (4TBP), tetrahexylammonium iodide (Hex4NI), and lithium iodide (LiI). The combination of iodide salts establishes a binary system of small and large cations instead of a conventional single-salt electrolyte. The ambient temperature conductivity of the electrolyte was 11.43 mS cm^{-1}, which is high enough to prepare efficient DSSCs. This electrolyte, previously optimized TiO_2 multi-layer photoelectrodes, and standard Pt counter electrodes were used in assembling DSSCs. When observed under definitive 1,000 W m^{-2} simulated solar irradiation, the highest conversion efficiency was 8.37%. The corresponding short circuit current density (Jsc) was 16.61 mA cm^{-2}, the open-circuit voltage (Voc) was 720 mV, and the fill factor (FF) was 69.99%. However, when the light intensity was reduced to 397 W m^{-2}, a significantly high efficiency of 10.57% was observed. Further, it was observed that the heavy ions as a binary salt system improve the performance of the studied liquid electrolyte without compromising the short-term stability.

Financial assistance from the Postgraduate Institute of Science (PGIS), University of Peradeniya Research Grant (Grant No. PGIS/2020/05) is acknowledged.

Keywords: Liquid electrolyte, Dye-sensitized solar cells, Ionic conductivity, Impedance spectroscopy

Abstract No: 244 ***Physical Sciences***

ANTIMICROBIAL AND ANTIOXIDANT ACTIVITIES OF STINGLESS BEE (*TETRAGONULA PRAETERITA* AND *T. IRIDIPENNIS*) PROPOLIS FROM RATNAPURA DISTRICT, SRI LANKA

W.P.C.O. Pathirana[1], A.P. Welegedara[1*], B.S. Nanayakkara[2] and W.A.I.P. Karunaratne[3]

[1]Department of Environmental and Industrial Sciences, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Botany, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[3]Department of Zoology, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]adarshiw@sci.pdn.ac.lk

Propolis is a biologically active, resinous substance produced by stingless bees by mixing their saliva and wax excretions with substances collected from botanical sources. Accordingly, the bioactivity of propolis depends on many factors, including geographical region, vegetation, and bee species. According to literature, ethanolic extract of *Tetragonula iridipennis* (TI) stingless bee propolis collected from Kandy, Sri Lanka, shows a remarkable in vitro antioxidant activity against 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical and antibacterial activity against Gram-positive bacteria [Minimum Inhibitory Concentration (MIC) values of 16 - 32 mg L^{-1}]. The bioactivities of propolis collected from other districts of Sri Lanka have not been reported. Therefore, the current study aimed to investigate the antimicrobial and antioxidant activities of *Tetragonula praeterita* (TP) and TI stingless bee propolis sourced from Ratnapura, Sri Lanka. The ethanol extracts of propolis were obtained using the Soxhlet method. The antioxidant and antimicrobial activities of extracts were determined using the DPPH radical scavenging assay and agar dilution method by determining the MIC, respectively. The TI extract showed a higher antioxidant activity (IC_{50}=253.707±6.075 mg L^{-1}) compared to the TP extract (IC_{50}=737.493 ± 8.451 mg L^{-1}) while that of L-ascorbic acid was IC_{50} = 8.140 ± 0.093 mg L^{-1}. Antimicrobial activity was tested against three Gram-negative (Escherichia coli, *Klebsiella pneumoniae* and *Pseudomonas aeruginosa*), two Gram-positive (Staphylococcus aureus and Methicillin-Resistant Staphylococcus aureus-MRSA) bacterial strains and the fungus, Candida albicans within the concentration range of 16 to 1,280 mg L^{-1}. TI extract showed remarkable antimicrobial activity, with MICs of 16 mg L^{-1}. In contrast, the MICs of TP extracts were ≥ 320 mg L^{-1}. Our results, compared with the previous findings, emphasize the dependence of the propolis bioactivity on the bee species and vegetation from which the bees source their food and hive-construction material.

Financial assistance from the University of Peradeniya Research Grant (Grant No URG/2021/35/S) is acknowledged.

Keywords: Antimicrobial activity, Antioxidant activity, Propolis, Sri Lankan stingless bees

Abstract No: 245 ***Physical Sciences***

SOLUTE DESCRIPTORS FOR CINNAMYL ACETATE BY GAS CHROMATOGRAPHY AND LIQUID-LIQUID PARTITION SYSTEMS

K.P. Hewage and J.A.T.C. Ariyasena*

Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka.
Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.
**jatca@sci.pdn.ac.lk*

Cinnamyl acetate is a naturally occurring compound in Cinnamon leaf oil. It is widely used in the flavour and fragrance industry because of its sweet balsamic and floral odour. Hence, the quantification of its properties, such as toxicity, is important as it is used in cosmetics which are in direct contact with the consumer. The conventional methods of determining these properties are costly and need a significant amount of human and technical resources. However, the use of the Abraham solvation parameter model, which is based on the quantitative structure-property relationships, has become popular in estimating solute properties and the environmental distribution with significantly lower cost by using fewer resources. This model is expressed as $log\ log\ SP = c + eE + sS + aA + bB + vV$ for transfers between two condensed phases. Here, SP is a Free energy-related solute property, simple letters are system constants, and capital letters are Solute descriptors. V: McGowan's Characteristic Volume, E: excess molar refraction, S: dipolarity/polarizability, A and B: hydrogen-bond acidity and basicity. The determination of solute descriptors for cinnamyl acetate was carried out using the gas chromatographic technique with poly (dimethyldiphenylsiloxane) and poly (cyanopropylphenyldimethylsiloxane) stationary phases and organic biphasic partition systems. The stationary phases were calibrated, and isothermal retention factor values were determined at 20 °C intervals from 80 °C to 260 °C. Cinnamyl acetate was equilibrated in 19 organic biphasic systems, and the partition coefficients were determined. The descriptor values were then determined using the Solver algorithm in MS excel® such that the standard deviation would be minimum. The determined descriptor values for cinnamyl acetate are, E= 0.983 S=1.203 A= 0.000, L=5.980, B= 0.648 and V= 1.453, respectively, with a standard deviation of 0.077. The determined descriptor values can be used to estimate the distribution of cinnamyl acetate in environmental and industrial partition compartments.

Financial assistance from the National Research Council (Grant No 20-086) is acknowledged.

Keywords: Cinnamyl acetate, Descriptors, Gas chromatography, Solvation parameter model

Abstract No: 246 ***Physical Sciences***

CLOSED SPACE SUBLIMATED CdS THIN FILMS FOR CdS/CdTe SOLAR CELLS: EFFECT OF CdS LAYER THICKNESS

K.M.N.S. Bandara[1], A.A.I. Lakmal[1], V.A. Seneviratne[1, 2], M.A.K.L. Dissanayake[3] and B.S. Dassanayake[1, 2*]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Physics, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[3]National Institute of Fundamental Studies, Kandy, Sri Lanka
[*]buddhikad@pdn.ac.lk

The target of photovoltaic systems has always been to reduce costs while increasing efficiency. Cadmium telluride (CdTe) has a narrow bandgap of 1.45 eV and is utilized as the absorber material in CdS/CdTe thin film solar cells, while cadmium sulfide (CdS), which has a wider bandgap of 2.42 eV, is used as the window material. There are numerous ways to deposit a CdS window layer, and among them, the close-spaced sublimation (CSS) technique is one of the most effective methods. The work reported here mainly focused on optimizing the thickness of CSS synthesized CdS window layer. To reach the desired thickness range, the deposition time duration was changed from 100 to 180 s. Temperatures for the source and substrate were set at 660 and 560°C, respectively. Around 2-3 Torr of an inert atmosphere was maintained using Ar gas. UV-visible spectroscopy was used for the optical characterization, and a PEC L01 solar simulator was used to study the electrical characteristics. The thickness of the CdS layer was measured using an X-ray fluorescence spectrometer. The highest average efficiency of 7.0% was obtained for the small area dot cells of 0.2 cm^2, with an open-circuit voltage (VOC) of 692 mV, a short circuit current (JSC) of 20.2 mA/cm^2, and a fill factor (FF) of 50.3% under the AM 1.5 illumination for the deposited CdS layer thickness of 310 nm.

Financial assistance from the Solar Edu-Training Project of the State Ministry of Skills Development, Vocational Education, Research & Innovation is gratefully acknowledged.

Keywords: CdS/CdTe solar cells, CdS window layer thickness, Close-spaced sublimation

Abstract No: 257 ***Physical Sciences***

ADSORPTION OF TRP-CAGE MINI PROTEIN ON A GRAPHENE SURFACE: A MOLECULAR SIMULATION APPROACH

A.P Jayaweera and S. Weerasinghe*

Department of Chemistry, University of Colombo, Colombo, Sri Lanka
**weera@chem.cmb.ac.lk*

Examination of protein adsorption to solid surfaces with molecular dynamic simulations will yield many different aspects of innovations in the field of biochemistry. In contrast to computational simulations, laboratory experiments for protein adsorption on solid surfaces are rather expensive and time-consuming. Therefore, a computational approach is preferred, and protein adsorption to solid surfaces remains a challenge to chemists due to its highly complex behaviour. This research was primarily focused on trp-cage mini protein (PDB ID: 1L2Y) adsorption on a graphene solid surface. Molecular dynamic simulations were conducted using GROMACS software, and the Kirkwood-Buff derived force field (KBFF20) was incorporated. Four simulations were conducted: the original protein near the solid surface, the protein rotated by 180° around a horizontal axis, and the protein adsorption on the solid surface having +0.1*e* or -0.1*e* partial charge on each atom in the graphene layer. Adsorption was explained by the change of distance between the centre-of-masses (COMs) of protein and the graphene surface along the vertical axis. The diffusion coefficient was used to indicate the rate of adsorption of the protein. The first and second simulations concluded that the protein was stable near the COM distances of 0.732 nm and 0.760 nm starting from 1 nm away from the graphene surface. The calculated average one-dimensional diffusion coefficients along the vertical axis were 1.914 (±0.008) × 10^{-4} nm^2 ns^{-1} and 1.248 (±0.009) × 10^{-4} nm^2 ns^{-1} for simulations one and two, respectively. For other simulations, overall adsorptions of the protein were not indicated. The study concludes that protein adsorption depends on the number of hydrophobic and hydrophilic residues exposed to the solid surface, and the more hydrophobic residues it has, the higher tendency for the protein to adsorb onto the non-polarized surface.

Keywords: Graphene, Molecular Dynamics, Protein Adsorption, Surface Science

Abstract No: 261 ***Physical Sciences***

FABRICATION OF REDUCED GRAPHENE OXIDE-BASED PAPER USING L-ASCORBIC ACID

H.H. Samarakkody[1*], D.W.P. Dahanayake[2], J.P. Liyange[1] and L.R.A.K. Bandara[1]

[1]Department of Physics, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Physiology, University of Peradeniya, Peradeniya, Sri Lanka
[*]hasithaheli@gmail.com

Reduced graphene oxide (rGO) is a material with potentially interesting properties which leads to many applications. Paper-based rGO is effective in applications like bioelectrical electrodes, water purification and sensors. Fabrication of paper-based rGO begins with oxidizing graphite to graphene oxide (GO) and reducing paper-based GO using chemical or thermal reduction. In chemical reduction, hydrazine hydrate (H_6N_2O), sodium borohydride ($NaBH_4$), and hydroiodic acid (HI) are used, as they are strong reducing agents. However, their toxic nature has doubted the possibility of using paper-based rGO for bioelectric signal acquisition and water purification. Therefore, there is a necessity to fabricate paper-based rGO using green and non-toxic methods. This study presents a novel method of fabricating cellulose membrane (CM) filter paper-based rGO using L-ascorbic acid, a non-toxic reducing agent. The precursor, GO, was synthesized by the modified Hummer's method using Sri Lankan graphite. The vacuum filtration technique was used to deposit GO on the CM filter paper, and the CM filter paper-based GO reduced at 70 ºC using L-ascorbic acid. Fourier-transform infrared spectroscopy (FTIR) and Raman spectroscopy confirmed the deposition of GO and the reduction state of paper-based GO. Oxygen functional groups seen in the FTIR spectrum of CM filter paper-based GO confirmed the hydrophilic nature, which helps the proper bonding between GO and CM filter paper. Raman analysis revealed a significant increase in I_D/I_G ratio from 0.886 to 1.186 and I_{2D}/I_G ratio from 0.030 to 0.076 after reducing CM filter paper-based GO with the concentration of 500 mg l^{-1} at 70 ºC. This increase showed the reduction ability of L-ascorbic acid and the restoration of carbon-carbon bonds under sp^2 hybridization. Also, the I_{2D}/ I_G ratio increased as the GO concentration increased from 62.5 mg l^{-1} to 500 mg $l^{-1,}$ indicating that the optimized CM filter paper-based rGO may have high electrical properties.

Keywords: Cellulose membrane filter paper, L-ascorbic acid, Reduced graphene oxide, rGO paper, Vacuum filtration

Abstract No: 265 ***Physical Sciences***

AMMONIA GAS DETECTION USING DOPED ZINC OXIDE THIN FILMS

R.A.U.D. Ranasinghe* and P.W.S.K. Bandaranayake

Department of Physics, University of Peradeniya, Peradeniya, Sri Lanka
**s16444@sci.pdn.ac.lk*

Ammonia is a toxic gas which is harmful to human health and the environment. It is mainly emitted from agricultural fertilizer and in manufacturing plastics, dyes and fabrics. The exposure limit of ammonia to the human being is 25 mg l^{-1} for 8 h or 35 mg l^{-1} for 10 minutes. Therefore, accurate monitoring of ammonia gas in the environment is critical. The present study investigates doped zinc oxide thin films for constructing low-cost, quick-response and high-sensitivity ammonia gas sensors. Pure zinc oxide (ZnO), Al-doped and Fe-doped ZnO thin films were synthesized on glass or alumina slides via a simple and cost-effective sol-gel method using zinc acetate, 2-methoxyethanol and monoethanolamine. The elemental composition, structure and surface morphology of crystals were characterized by X-ray fluorescence (XRF), X-ray diffraction (XRD) and scanning electron microscopy (SEM), respectively. In addition, the effects of various doping materials on optical properties were investigated by UV-Visible spectroscopy. The bandgap energy (E_g) for pure ZnO thin films was 3.40 eV, and the lowest bandgap energy of 3.38 eV was observed for Al-doped thin films. The sensor responses for Al-doped ZnO thin film are 83% and 49% for 500 mg l^{-1} NH_3 at operating temperatures of 200 ^{0}C and at room temperature, respectively. The response time and recovery time at 200 ^{0}C were 11 and 7 min, respectively. The gas sensing analysis showed that increased NH_3 concentration and doping material improved the gas sensing response.

Keywords: Aluminum doping, Ammonia sensor, Ferric doping, Response time, Zinc oxide films

Abstract No: 274 ***Physical Sciences***

NICKEL CONCENTRATION IN IMITATION JEWELLERY SOLD BY SMALL-SCALE RETAILERS IN KANDY AREA

U.A.L. Udugama, L.H.G.B.S. Wijethunga and J.A.T.C. Ariyasena*

Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka.
**jatca@sci.pdn.ac.lk*

Nickel (Ni) is usually incorporated in the imitation jewellery industry. When exposed to higher levels, Ni can be the main source of Allergic Contact Dermatitis (ACD). The present study investigates the Ni concentration in imitation jewellery sold by small-scale retailers in the Kandy area. According to the nickel directive of the European Union (EU), the nickel released from the jewellery to pierced parts of the body should be <0.2 µg cm^{-2} $week^{-1}$. Nickel released from the jewellery coming into direct and prolonged contact with the skin should be <0.5 µg cm^{-2} $week^{-1}$. If the nickel concentration is > 0.05% w/w (500 µg g^{-1}), it is not advisable to come into direct contact with healing wounds after piercing. In order to investigate whether the small-scale retailers in the Kandy area adhere to standard regulations, the imitation earring samples were collected from five small-scale retailer shops in the Kandy area once a month for 12 months. The samples were collected in monthly intervals as the retailers renewed their stocks monthly. Surface analysis of the earring samples was performed using XRF to have an initial estimation of the metal composition, and the accurate concentrations were determined using atomic absorption spectrophotometry (AAS). The artificial sweat immersion method was used to determine the nickel concentrations released into the sweat solutions by preparing artificial sweat solutions with ultra-pure water, 0.5% sodium chloride, 0.1% urea, and 0.1% lactic acid. pH value was adjusted to 6.5 using 1% ammonia. Each earring sample was placed in the artificial sweat and stored in an incubator at 34 ℃ for 7 days. The nickel concentrations ranged from 0.04 µg cm^{-2} $week^{-1}$ to 317.70 µg cm^{-2} $week^{-1}$. Percentage Ni concentrations in earring samples were determined using AAS after dissolving in aqua regia in order to extract all Ni into solution. The results showed that Ni concentration ranged from 0.01 µg g^{-1} to 4.70 µg g^{-1}. Out of 180 earring samples tested, 110 samples exceeded the threshold limit of 0.2 µg cm^{-2} $week^{-1}$ from the sweat solution method, and 130 samples exceeded the accepted threshold level of 0.05% w/w. All tested small-scale retailers have exceeded the permissible level of Ni during the investigated period.

Keywords: Earrings, Imitation Jewelry, Kandy, Nickel

Abstract No: 283 ***Physical Sciences***

OPTIMIZATION OF ELECTROSPINNING PARAMETERS TO PRODUCE POLY (ETHYLENE OXIDE) NANOFIBERS

M.H.M.A.K. Bandara, W.S.S. Gunathilake*, D.R. Uduwela, J.M.S. Jayasinghe and A. Wickramasinghe

Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka
**smdhgunathilake@yahoo.com*

Electrospinning, one of the most cost-effective nanofiber production techniques, involves converting polymeric solution into solid nanofibers by applying an electric force. The technique needs optimization of several parameters, such as solution parameters (viscosity, concentration, surface tension, conductivity, temperature, and type of the solvent), instrumental parameters (shape of collector, geometry of spinneret, solution flow rate, drum speed, tip to collector distance and applied voltage), and ambient parameters (air velocity, temperature, and humidity of the environment) to refine nanofiber morphology, diameter, and porosity. However, certain promising materials, such as chitosan and protein-based biopolymers, cannot be electrospun in their pure form. It has been found that blending these materials with poly (ethylene oxide) (PEO) increases their spinnability. Therefore, this study aimed to optimize the solution and instrumental parameters for PEO to produce uniform fine nanofibers without beads, using the electrospinning technique and to identify the most determinant factor in this process. The effect of the polymer concentration, solvent, voltage, flow rate, drum speed, temperature, and tip-to-collector distance was tested and optimized in this study. The prepared nanofibers were characterized using Scanning Electron Microscopic (SEM) images. The polymer concentration and type of solvent were the most determinant solution factors that affected the electrospinning process of PEO. Six per cent (w/w) PEO concentration and 90% (w/w) acetic acid are the best solution conditions to obtain uniform fibres without beads. The voltage and the tip-to-collector distance are the most determinant instrumental parameters. Flow rate and drum speed could easily be optimized after the optimization of polymer concentration, solvent, voltage, and tip-to-collector distance. Based on SEM data, it could be concluded that the best instrumental parameters for the formation of uniform fine fibres without beads, with an average diameter of 268.6 nm are 20 kV voltage, 20 cm tip-to-collector distance, 700 rpm drum speed, and 0.5 ml/h flow rate at room temperature.

Financial assistance from the AHEAD RIC grant- Faculty of Science, University of Peradeniya (Grant No AHEAD/RA3/RIC/PDN/SCI/Wound dressing) is acknowledged.

Keywords: Electrospinning, Parameter optimization, PEO

Abstract No: 284 ***Physical Sciences***

DIELECTRIC BEHAVIOUR OF CYANOETHYLATED CELLULOSE-HYDROXYAPATITE NANOCOMPOSITES

S.G.G. Arachchige[1*], C. Sandaruwan[2], C.H. Manatunga[3], V.P.S. Perera[4], R.M.G. Rajapakse[5] and N.M. Adassooriya[6]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Sri Lanka Institute of Nanotechnology (Pvt) Ltd, Sri Lanka
[3]Department of Physics, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
[4]Department of Physics, The Open University of Sri Lanka, Nawala, Sri Lanka
[5]Department of Chemistry, University of Peradeniya, Peradeniya, Sri Lanka
[6]Department of Chemical & Process Engineering, University of Peradeniya, Peradeniya, Sri Lanka
[*]sathika.bhani@gmail.com

Nanofillers exhibit high dielectric constant, but they have poor flexibility and breakdown strength. Polymers have excellent flexibility, low dielectric loss and high breakdown strength but have much lower dielectric constants. Thus, the incorporation of nanoparticles into a polymer has a greater potential to enhance the dielectric behaviour of the overall composite. During this study, hydroxyapatite nanoparticles (HA Nps) were synthesized using wet chemical precipitation, and different weight fractions of nanoparticles, 5%, 10% and 15% in cyanoethylated polymer (CRS), were prepared. Powder X-ray diffraction patterns confirmed the presence of HA Nps and CRS polymer. Scanning electron microscopy was used to analyze the morphology of the synthesized HA Nps and to measure the thicknesses of nanocomposite films. Fourier transform infrared spectroscopy was used to study bonding interactions of synthesized compounds. Capacitance values were measured in the frequency range from 1 kHz to 1 MHz, and all nanocomposite films showed higher dielectric constants at lower frequencies than CRS bare polymer (21). The dielectric constants of composites at 1 kHz were 32, 44, 67 for 5%, 10% and 15% weights, respectively. All nanocomposites showed a lower leakage current when increasing the voltage. The dielectric constant of nanocomposites has increased with increasing the loading of HA Nps, which may be due to the formation of large volumes of interfacial regions. It can be thought that nanoparticles in 15% HA composite have agglomerated at higher loading, thus showing the most significant decrease in dielectric constant when increasing the frequency. At lower frequencies, all types of polarization mechanisms are involved, which leads to an increased dielectric constant. When the frequency increases, relaxation processes occur. Therefore, the dielectric constant decreases with increasing frequency as all polarization mechanisms do not contribute. Significant attention is not given to investigating the dielectric properties of CRS-based nanocomposites in the literature. These results suggest that CRS-HA polymer nanocomposite is a potential candidate for applications in the dielectric material of capacitors.

Keywords: Cyanoethylated cellulose, Dielectric constant, Hydroxyapatite, Nanocomposites, Nanoparticles

Abstract No: 286 ***Physical Sciences***

ENHANCEMENT OF THERMOELECTRIC PROPERTIES OF COPPER (I) THIOCYANATE USING GRAPHITE

J.A.J. Heshan*, T.M.W.J. Bandara and L.K. Narangammana

Department of Physics, University of Peradeniya, Peradeniya, Sri Lanka
**heshanjaj@gmail.com*

The effects of global warming and the depletion of fossil fuels led the world to pursue reliable renewable energy sources and to improve the efficiencies in current energy conversions. Thermoelectricity is the direct conversion of heat energy into electricity. Recently, this phenomenon has been applied as an efficient waste heat recovery mechanism. Thermoelectric generators (TEGs) are incorporated in generating thermoelectricity under applied temperature differences. A TEG contains an array of p-n junctions created using two dissimilar thermoelectric materials (TEMs). Using expensive and toxic rare earth materials such as Tellurium in room temperature TEGs has limited the commercialisation of this technology. Copper (I) thiocyanate (CuSCN) has recently earned significant attention as a p-type semiconductor due to its excellent hole-transporting characteristics. Thus, it is used in many optoelectronic applications, including perovskite solar cells. This project investigates and optimises the thermoelectric properties of CuSCN pellets by doping with a carbonaceous material. Pellets pressed with a diameter of 13 mm and a thickness of 1.5 mm using commercial CuSCN powder were used to investigate thermoelectric properties. Graphite was used as a dopant to modify the thermoelectric performance of CuSCN pellets. Electrical conductivity, thermal conductivity, and Seebeck coefficient were measured for CuSCN pellets as well as for graphite-doped CuSCN (G-CuSCN) pellets. The figures of merit values were also calculated at the respective temperatures. The obtained electrical conductivities of CuSCN and G-CuSCN pellets at 373 K were 722.2 and 77.4 S m^{-1}, respectively. The thermal conductivities of CuSCN and G-CuSCN pellets at 373 K were 1.28 and 0.81 W m K^{-1}, respectively. G-CuSCN showed a positive Seebeck coefficient of 0.67 mV K^{-1} at 373 K, confirming the p-type semiconductor nature of this material. In order to generate a steady state voltage, CuSCN should be heated up to 423 K. G-CuSCN resulted in a figure of merit value of 1.69×10^{-8} at 373 K. CuSCN and G-CuSCN generated maximum output power of 29.9 and 139.9 nW at average temperature gradients of 393 K and 343 K, respectively. After the incorporation of graphite into CuSCN, the thermal conductivity of the material decreased, indicating the improvement of favourable properties needed for an efficient TEM. In addition, G-CuSCN generated more power than CuSCN, revealing that graphite can improve the thermoelectric properties of CuSCN.

Keywords: CuSCN, Figure of merit, Renewable energy, Seebeck coefficient, Thermoelectricity

Abstract No: 290 ***Physical sciences***

CONSTRUCTION AND APPLICATION OF A PORTABLE MUON DETECTOR

S. A. K. D. Senadheera*, T.P. Ranawaka, J.A.C.P. Jayalath and D.R.A. Mendis

Department of Physics, University of Peradeniya, Peradeniya, Sri Lanka
**s16473@sci.pdn.ac.lk*

Particle physics studies the fundamental aspects of nature, the very building blocks of the universe, and has revolutionized the way we observe our known universe. Even though working with powerful accelerators and sophisticated detectors is ideal, not all institutions have such facilities. Therefore, a low-cost muon detector was built according to the design of the desktop muon detector by the Massachusetts Institute of Technology. A plastic scintillator is used as the scintillation material in the detector due to its low cost and ability to be shaped into the required shape and size. A silicon photomultiplier is used as the electronic light sensor as it is much cheaper, smaller, and better at detecting the excitation energies of charged particles compared to the photomultiplier tubes. Other components include basic electronic components such as an Arduino nano, operational amplifiers, resistors, capacitors, and inductors. The detector was used to obtain count rates in Colombo, Sri Lanka. Under several approximations, the muon flux obtained in Colombo at sea level is 9.6×10 m^{-2} s^{-1} sr^{-1}. During calibration, the triggering threshold was set so that the detector would trigger for particles with higher energies compared to typical surface background radiation energies. Therefore, to calculate the approximate total muon flux, a correction was made to account for the muons with lower energies than the trigger threshold. The correction was done by comparing two count rate vs silicon photomultiplier voltage graphs. One graph was plotted using a detector that was not calibrated, and the other graph was obtained from the literature. The graph obtained from the literature contains a plot obtained using detectors of the same design operated in coincidence mode. This is the major approximation used to calculate the muon flux. The flux value obtained was 4% lower relative to the muon flux recorded at higher latitudes, according to the literature. This observation is justifiable because Colombo is close to the geomagnetic equator and muon flux varies with the geomagnetic latitudes. Moreover, the data obtained from the detector follows a Poisson distribution where the theoretical and experimental distributions closely correlate, thereby confirming the detection of truly random events. This detector provides a new avenue of research as there are numerous applications in various fields.

Keywords: Cosmic ray muon flux, Geomagnetic equator, Particle physics, Poisson distribution of cosmic rays, Portable muon detector

Abstract No: 291 ***Physical Sciences***

OPTICAL AND STRUCTURAL PROPERTIES OF POLYVINYL ALCOHOL BASED POLARIZED FILMS MODIFIED WITH Ag-NANOPARTICLES AND IODINE

K.S. Dharmasiri[2], H.A.M.M. Hapuarachchi[1, 2*], B.M.K. Pemasiri[2] and V.A. Seneviratne[2]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Physics, University of Peradeniya, Peradeniya, Sri Lanka
[*]hammmalin@gmail.com

At present, polymer materials are being used for many applications due to their unique physical, mechanical, and optical properties. Many studies have been done on polyvinyl alcohol (PVA) polymer for various applications because PVA has some useful properties compared to many other polymers, such as, solubility in water, film-forming ability, and flexibility. Plasticizers can also be used in order to change some physical properties of PVA polymers. In this study, several modifications are done for the PVA films, which can be used as light polarizers. For this purpose, Ethylene glycol (EG) added PVA, Ag nanoparticles (NPs) added PVA, and Iodine added PVA films were tested for optical and structural characteristics using UV-Visible data and Powder X-ray diffraction (PXRD) data. The UV-Visible data for EG/PVA films show that adding EG to the PVA films decreases the transmittance of the film. The XRDs of EG/PVA films show that EG is decreasing the crystallinity of the PVA film. UV-Visible data of PVA/Ag-NPs films show that the addition of Ag nanoparticles reduces the films' transmittance in the visible region. Particularly the transmittance value is much lower at around 400 nm than that of pure PVA film, indicating more absorption of blue light. Therefore PVA/AgNPs films can be used as blue light filters. The addition of Ag nanoparticles can be used to increase the crystallinity of the PVA polymer matrix, which is vital for the strength of the film. UV-Visible data for stretched PVA/Iodine films show low transmittance compared to the pure PVA film in the visible region, which is almost equal above 700 nm.

Keywords: Ag-nanoparticles, Iodine, Polarizes, PVA

Abstract No: 297 ***Physical Sciences***

WILD TARO (*COLOCASIA ESCULENTA*) STARCH-BASED BIOPLASTICS FOR VARIOUS APPLICATIONS

R.G.T.P. Karunarathna* and V. Sivakumar

Department of Physics, University of Peradeniya, Peradeniya, Sri Lanka
**s16394@sci.pdn.ac.lk*

The plastic industry relies strongly on the use of petroleum-derived materials. However, the low degradability of these materials is a major environmental concern. Starch is a natural polymer, and starch-based bioplastic materials are more environmentally friendly as they degrade faster than conventional plastic materials. Therefore, starch-based bioplastics as substitutes for petroleum-derived materials have attracted the attention of many researchers. Literature shows that most researchers have used corn, potato, cassava etc., as starch sources for bioplastics. However, less work is reported on the utilization of wild taro (*Colocasia esculenta*) as a source of starch. Wild taro contains a high amount of starch (70-80%) by mass and is abundantly available in Sri Lanka. This study aimed to produce, characterize, and investigate the possible applications of wild taro starch-based bioplastics. The major applications tested during this study were food packaging, the production of grow bags for young plants and ornamentation using thin sheets. Glycerol and gelatin were used as plasticizers during the production of bioplastics. The bioplastic samples were prepared with various amounts of plasticizers and thicknesses. Properties such as density, solubility, biodegradability, sealing properties, morphology, chemical resistance, wettability, and tensile strength were tested for the prepared samples. The density and water solubility of the sample was calculated to be 10.9 g cm^{-3} and 27.9%, respectively. The wettability of the surface was tested by measuring the contact angle between the surface and the water. The surface is less hydrophilic with contact angles in the range of 70°- 80°. The measured tensile strength and Young's modulus were 0.04 MPa and 3.70×10^{4} N m^{-2}, respectively. The overall results showed that wild taro starch-based bioplastics are suitable for packaging, ornamentation, and producing grow bags.

Keywords: Bioplastic, Degradation, Plasticizers, Starch

Abstract No: 308 ***Physical Sciences***

EXTRACTION AND CHARACTERIZATION OF CELLULOSE NANOCRYSTALS FROM FILTER PAPER USING SULFURIC ACID HYDROLYSIS

K.G.R. Samarawickrama[1*], U.G.S. Wijayapala[1] and C.A.N. Fernando[2]

[1]Department of Textile and Apparel Engineering, Faculty of Engineering, University of Moratuwa, Moratuwa, Sri Lanka
[2]Department of Nano Science Technology, Faculty of Technology, Wayamba University, Kuliyapitiya, Sri Lanka
[*]rumeshsnt@gmail.com

Cellulose nanocrystals are celluloses at the nanoscale that are taken from natural fibres and arranged in a tightly structured crystalline particle structure. The aim of this study was to look into the utilization of Whatman filter papers as a source of raw materials for the extraction of cellulose nanocrystals. Whatman filter paper is a cellulose paper created by utilizing a significant amount of alpha-cellulose. Its contents are a sign of its consistency and excellent quality, as alpha cellulose is thought to be the most stable form of cellulose. Cellulose nanocrystals extraction from Whatman filter papers using sulfuric acid hydrolysis was studied, and extracted cellulose nanocrystals were characterized. The sulfuric acid hydrolysis was performed with 64% (w/w) sulfuric acid and combined using a liquor ratio of 1:20 with Whatman filter paper while being subjected to strong magnetic stirring at 50 °C for 90 min. The extracted cellulose nanocrystals have been characterized by Transmission Electron Microscopy (TEM) analysis, Fourier Transform Infrared (FTIR) spectroscopy analysis and X-ray Diffraction (XRD) analysis. The TEM analysis clearly showed the formation of needle-shaped CNC particles having a size range between 10-30 nm in diameter and 100-200 nm in length. The FTIR spectrum showed the functional groups of the isolated cellulose nanocrystals from Whatman filter paper using sulfuric acid hydrolysis. XRD pattern confirmed that the CNCs from the Whatman filter paper could be extracted through sulfuric acid hydrolysis.

Financial assistance from the University of Moratuwa (Grant No. SRC/LT/2021/13) is acknowledged.

Keywords: Acid hydrolysis, Cellulose, Cellulose nanocrystals, Sulfuric acid, Whatman filter paper

Abstract No: 6 ***Science Education***

IMPACT OF TEACHING AND LEARNING PROCESS ON STUDENTS' SCIENCE LEARNING: A CASE STUDY IN BADULLA EDUCATION ZONE

K.M.N.T.K. Bandara[1*] and A.A. Manike[2]

[1]Faculty of Science and Technology, National Institute of Education, Maharagama, Sri Lanka
[2]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]nirangabandara08@gmail.com

The teaching-learning process is vital in education. Thus, the results of a successful teaching-learning process are invaluable. However, it is not easy to separate the learning process from the teaching-learning process, as they interact closely. Therefore, it is essential to recognise the impact of the teaching and learning process on students' science education. Three hundred students and 25 teachers from GCE Ordinary Level classes from 21 schools in the Badulla Education Zone were used to achieving this goal. Mixed methods were used in the study. From that, simple random and stratified sampling techniques were used in the quantitative method. The purposive sampling technique was used in the qualitative method. Data were collected from questionnaires, interviews, and observations. Data were analysed using statistical packages and thematic analysis techniques. The information on the teaching-learning process was collected under the following factors: teaching strategies, teaching methodology, feedback and evaluation, and positive and negative reinforcement. According to the results, there was a linear correlation between Science scores, teaching methods and materials, teaching strategies, feedback and evaluation, and positive and negative reinforcement ($p<0.05$). Similarly, the Pearson correlation coefficient values (r) of the above variables were 0.747, 0.723, 0.742, and 0.695, respectively. Furthermore, there was a very strong linear positive correlation among factors such as teaching strategies vs teaching methods and materials ($p<0.0001$, $r=0.935$) and teaching strategies against feedback and evaluation ($p<0.0001$, $r=0.954$). Furthermore, qualitative analyses showed similar results with notable influences of the following themes on the teaching-learning process of science: teaching strategies, teaching methodology, feedback and evaluation, and positive and negative reinforcement for student performance. Therefore, by enhancing the quality and effectiveness of the teaching-learning process, students' academic and non-academic achievements can be improved.

Keywords: Correlation, GCE (O/L), Science, Teaching-learning process

Abstract No: 67 ***Science Education***

KNOWLEDGE, PREVENTION PRACTICES, AND BARRIERS IN RESPONSE TO COVID-19 INFECTION IN A TERTIARY EDUCATIONAL INSTITUTE

I.M. Upeshadi[1], K.R.I. Bandara[1], A. Sahardeen[1], T.S.H. Kalpana[1], N.D.D.S. Lakruwan[1], J.D.K. Dunukara[1*] and T.D.C.P. Gunasekara[2]

[1] Department of Biomedical Science, Faculty of Health Sciences, K.I.U., Battaramulla, Sri Lanka
[2]Department of Microbiology, Faculty of Medical Sciences, University of Sri Jayawardhanapura, Nugegoda, Sri Lanka
[*]jayani@kiu.ac.lk

Variants of COVID–19 are highly contagious, resulting in a major threat to human life and the global economy. Infection control involves recommended preventive measures, but barriers could hinder following the guidelines. Therefore, the study was conducted to assess the knowledge and preventive measures for COVID-19 and to identify the barriers among undergraduate students at Kaatsu International University (KIU). A descriptive cross-sectional online survey was carried out from August 2021 to May 2022 among 350 undergraduates using a convenience sampling method. Data were collected through a self-administered, pre-tested questionnaire disseminated through social media after obtaining ethical approval (KIU/ERC/21/86). Data were analysed using SPSS version 25, and all hypotheses were tested at the 95% confidence interval (with 0.05 marginal error). Values for the total score of knowledge and preventive practice were defined and modified as poor (<33%), average (34 - 66%) and good (>67%), respectively. Most respondents were female (78.2%), while 52.4% of the sample represented the Western Province. Biomedical science students (40.8%) and 4th-year students (47.8%) had good knowledge of the disease. A significant correlation ($p<0.05$) was observed between the total knowledge score, degree program, and academic year. 46.7% demonstrated an average level of preventive practices. Only academic year, degree programme, gender and employment status were significantly associated with total preventive practice score ($p<0.05$). The usage of hand sanitisers was identified as a burden to employed undergraduates ($p<0.033$). Public transportation (74.5%) was identified as the highest obstacle to following preventive practices, and 50.1% of respondents had difficulty maintaining social distancing. In conclusion, most respondents had poor knowledge of COVID-19, while the practice of preventive measures was satisfactory among the study population.

Keywords: Barriers, COVID-19, Preventive measures, Undergraduates

Abstract No: 100 ***Science Education***

PROSPECTIVE TEACHERS' PERCEPTIONS OF CONSTRUCTIVISM AND ITS IMPLEMENTATION IN SCHOOLS

W.K.K.H.S. Gunasekara[1*], A.K. Amarasinghe[2] and H.M.S.P. Madawala[3]

[1]Hapitigam National College of Education, Mirigama, Sri Lanka
[2]Department of Mathematics, University of Peradeniya, Peradeniya, Sri Lanka
[3]Department of Botany, University of Peradeniya, Peradeniya, Sri Lanka

The pedagogical internship is one of the vital steps of teacher development programmes conducted by the National Colleges of Education (NCoEs) in Sri Lanka. Here, the constructivist approach is one of the most commonly used teaching-learning theories as it develops advanced skills among students. During the internship year, the prospective teachers are allowed to experience a real classroom environment. This research aimed to determine prospective teachers' perceptions of constructivism as a learning theory and its implementation in government schools in Sri Lanka. The mixed-methods approach based on the explanatory sequential design was used in this study. The sample included 100 prospective teachers following the secondary mathematics internship from two NCoEs. Data were gathered using a questionnaire and semi-structured interviews. Semi-structured interviews were conducted only with 10 prospective secondary mathematics teachers in three schools who taught mathematics for Grades 6 to 9. Interviews were recorded, and transcripts were prepared. The responses were examined by descriptive and content analysis. The questionnaire findings revealed that 95% of prospective teachers were aware of the theory of constructivism, and 98% were optimistic about that approach in the teaching-learning process. However, despite their theoretical knowledge of constructivism, most prospective teachers (98%) faced issues while implementing it in schools due to the lack of practical experience during their training. Responses to the semi-structured interviews revealed that the prospective teachers were not given sufficient hands-on training in using the theory of constructivism during their time at NCoEs. The lack of motivation by the lecturers of NCoEs in implementing constructivism was also noted as a drawback. The research concludes that teacher development institutions should organise programmes for prospective teachers to develop and improve their hands-on skills in using the theory of constructivism during their internship to enable them to use it in schools more confidently.

Keywords: Internship, National Colleges of Education, Secondary Mathematics, Teacher Development, Theory of Constructivism

Abstract No: 159 ***Science Education***

KNOWLEDGE AND ATTITUDE TOWARDS POLYCYSTIC OVARIAN SYNDROME AMONG STUDENTS OF KAATSU INTERNATIONAL UNIVERSITY, SRI LANKA: A CROSS-SECTIONAL STUDY

N.A.F. Shihana[1], K.N. Pathinathan[1], A.U. Gunathilaka[1], Y.A.S.V. Yapa[1], W.S.R. Silva[1], P.J. Wijekumar[1*], N.D.K. Ranadeva[1] and E.A.S.T. Edirisinghe[2]

[1]Department of Biomedical Science, Faculty of Health Science, KIU, Battaramulla, Sri Lanka
[2]Department of Anatomy, Faculty of Medical Science, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
[*]jalini@kiu.ac.lk

Polycystic ovarian syndrome (PCOS) is the most prevalent metabolic and reproductive health disorder among women worldwide. This study aimed to investigate the knowledge and attitude toward polycystic ovarian syndrome among an undergraduate population and the association with specific socio-demographic factors. A descriptive cross-sectional study was conducted among 272 female undergraduates of the KAATSU International University (KIU), Sri Lanka, through a simple random sampling method. Data were collected through a pre-tested self-administered questionnaire and analysed using SPSS version 26. The study was approved by the ERC of KIU (KIU/ERC/21/93). The mean age of the sample was 24.7±3.2 years. Regarding knowledge of PCOS, 29.4% had poor, 61.4% had moderate, and only 9.2% had good knowledge, while in terms of attitude, 4.2% had a low, 32.4% had moderate, and 33.1% had a high attitude towards PCOS. Among the females who reported being diagnosed with PCOS, 65.1% (28/43) had moderate knowledge, and 55.8% (24/43) had a high attitude toward PCOS. The population's primary source of knowledge about PCOS was the internet, followed by health education and awareness programmes. This study revealed that there was no significant association between the knowledge level about PCOS and the socio-demographic factors (age, marital status, having children) in the total population ($p<0.05$). At the same time, there was a significant association between marital status and attitude level ($p<0.05$). The results concluded that PCOS-diagnosed females had a satisfactory level of knowledge and attitude. In contrast, the overall knowledge and attitude towards PCOS are insufficient among the total population. Thus, there is a need to enhance the knowledge about PCOS and its symptoms for proper evaluation and diagnosis.

Financial assistance from KIU is acknowledged.

Keywords: Attitude, Knowledge, Polycystic ovary syndrome, Socio-demographic factors

Abstract No: 160 ***Science Education***

EFFECT OF INQUIRY-BASED LEARNING AND SOCRATIC DIALOGUE METHODS ON ACHIEVEMENT OF GCE (A/L) CHEMISTRY COMPARED TO CONVENTIONAL TEACHING METHOD

D.R. Mahabaduge[1], L. Liyanage[2*] and M.D.P. de Costa[1]

[1]Department of Chemistry, University of Colombo, Colombo, Sri Lanka
[2]Department of Applied Computing, University of Kelaniya, Kelaniya, Sri Lanka
[*]laalitha@kln.ac.lk

Inquiry-Based Learning (IBL.) and Socratic Dialogue (SD) are the most effective teaching approaches to problem-solving and improving critical thinking. Therefore, the present study aimed 1) to identify the effectiveness of the IBL and SD teaching on student achievement in the General Certificate of Education (GCE.) Advanced Level (A/L) chemistry and the knowledge retention of the subject matter compared to conventional teaching method (CTM), which serves knowledge as a teacher-centred method, 2) to assess the effectiveness of IBL and SD in the development of higher-order thinking skills (HOTS) and lower-order thinking skills (LOTS), and 3) learner perceptions toward the IBL and SD methods. This study employed a quasi-experimental design using 60 selected students in the science stream from each grades 12 and 13 in St Bridget's Convent, Colombo, Sri Lanka. Two types of teaching approaches (treatments), namely IBL and SD and CTM, were systematically designed and implemented. A chemical bonding lesson was conducted for Grade 12 students (Group I), while Grade 13 students (Group II) followed the electroplating lesson using these two treatments separately. Students' achievement was measured using test papers (pre- and post-tests) consisting of six sub-questions: three for HOTS and three for LOTS. Post-tests evaluated knowledge retention after one month for both groups. Independent sample t-tests ($p < 0.05$) were used for analysis. Findings confirmed that students' achievement in chemistry was significantly higher in IBL and SD treatment (76 and 53%) compared with the CTM treatment (58 and 43%) in both Group I and Group II, respectively. Also, HOTS in different groups were promoted by the IBL and SD teaching approach. LOTS of Group I students were positively affected by IBL and SD methods, while LOTS of students in Group II were comparable with those in the CTM group. Knowledge retention in the two groups was significantly higher in IBL and SD methods (72 and 51%) compared to the CTM (51 and 34%), respectively. The majority of students who learned chemical bonding and electroplating using the IBL and SD methods were positive in the rubric assignment. Therefore, this study concludes that IBL and SD strategy is more effective in understanding, memorising, and critical thinking in chemistry.

Keywords: Chemistry education, Chemical bonding, Electroplating, Rubric assignment, Teaching methods

Abstract No: 176 ***Science Education***

EFFECTIVENESS OF USING WEB-BASED MATERIALS IN TEACHING SIMPLE HARMONIC MOTION FOR GCE (A/L) STUDENTS: A CASE STUDY IN GAMPAHA DISTRICT, SRI LANKA

C. Weerasinghe[1] and W.D. Chandrasena[1,2*]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Science Education Unit, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]wdchand@pdn.ac.lk

In the Sri Lankan education system, traditional lecture methods are used to teach Combined Mathematics. Simple Harmonic Motion is one such lesson taught in Combined Mathematics for GCE (A/L) students. The primary purpose of this study is to develop a new teaching material to improve the performance level of students who are attempting simple harmonic motion questions at the GCE (A/L) examination. Past research revealed that computer-assisted teaching and learning processes encourage students' performance in mathematics. Students (206) and teachers (15) were selected from four schools through a convenience sampling technique in the Gampaha District in the Western Province, Sri Lanka. In this study, both qualitative and quantitative data were used. A pre-test, a post-test, a questionnaire, and semi-structured interview schedules were used to collect data. Quantitative data were analysed using SPSS 22.0, and qualitative data were analysed using thematic analysis. Using pre-test results, students were assigned into two homogeneous groups, an experimental group and a control group. The experimental group was instructed with web-based assisted material with structured essay-type questions, while the control group was taught using the lecture method. The results revealed that there was no significant difference between the pre-test marks in the control (51.8±32.3) and experimental (52.6± 31.8) groups: $t_{(204)}$=0.185, p= 0.854. However, the findings showed that there was a significant difference in the mean values of post-test marks for control (56.6±26.1) and experimental (69.8±23.3) groups; $t_{(204)}$=3.835, p=0.0001 after the intervention. As such, the new teaching material developed using web-based resources and the structured type problems positively affect the student performance level in simple harmonic motion lessons. Thus, it is suggested to use such strategies to enhance student performance through meaningful learning.

Keywords: Computer-assisted learning, Simple harmonic motion, Teaching materials

Abstract No: 180 ***Science Education***

IMPACT OF SECONDARY LEVEL MATHEMATICS TEACHERS' PEDAGOGICAL CONTENT KNOWLEDGE IN GRADE SIX ALGEBRA: A CASE STUDY IN THE GALLE EDUCATION ZONE

D.D. Rupasinghe[1*], A.K. Amarasinghe[2] and P.R.K.A. Vitharana[3]

[1]Amarasuriya Teachers' College, Unawatuna, Galle, Sri Lanka
[2]Department of Mathematics, University of Peradeniya, Peradeniya, Sri Lanka
[3]Department of Education, University of Peradeniya, Peradeniya, Sri Lanka
[*]deepadayangani@gmail.com

Secondary-level mathematics teachers' pedagogical content knowledge (PCK) in Algebra is a crucial factor of teachers' knowledge that influences the quality of the students' meaningful learning. This mixed methods research aimed to investigate the influences of mathematics teachers' PCK on sixth-grade students' comprehension of algebra. National-level statistics indicate that the students' mathematics achievement in the GCE (O/L) examination is low, and algebra is identified as the most critical subject component contributing to this. Literature suggests that the mathematics teachers' PCK is poor, so it is crucial to investigate to address students' low achievement. This study was carried out in the Galle Education Zone (n=292) to investigate the mathematics teachers' PCK in depth through the explanatory sequential research design. The mathematics teachers' PCK in algebra was quantitatively measured with the help of a validated and reliable questionnaire. The results showed that teachers possess a medium level of PCK (43.33±6.99). The qualitative data collected from classroom observations and the post-lesson interviews were analysed from reflexive thematic analysis. In the second phase, a sample (n=8) was selected using the stratified sampling method, and each teacher taught the sixth Graders one algebraic lesson on algebraic symbols. The qualitative data reflected three themes such as building algebraic concepts in students' minds, addressing students' misconceptions and students' understanding. Moreover, the mathematics teachers were unsuccessful in concept-building and addressing the students' misconceptions. They demonstrated a lack of content knowledge in basic algebraic concepts. They use neither appropriate teaching strategies nor creative activities to develop students' thinking processes. Thus, it is suggested to offer professional development programmes for mathematics teachers to uplift the status of Science Education in Sri Lanka.

Keywords: Algebra, Algebraic misconceptions, Algebraic thinking, Pedagogical content knowledge, Secondary level mathematics teachers

Abstract No: 195 ***Science Education***

ENHANCING STUDENTS' LEARNING OF SCIENCE CONCEPTS THROUGH A BLENDED LEARNING APPROACH

R.K.S.P.N. Ranaweera and A.D.A. de Silva

Department of Science, National Institute of Education, Maharagama, Sri Lanka
sisika.ranaweera@gmail.com

The blended learning approach is essential to enhance students' interest in science. The primary objective of this study is to explore whether the blended learning approach can be used to enhance students' knowledge and understanding of science concepts and their interests in learning science. Under new educational reforms to be implemented in Sri Lanka, the existing science curriculum has been revised by incorporating inquiry-based and blended learning approaches. Prior to the island-wide implementation of the reforms, newly developed curriculum materials were tested through a pilot study. The current study is based on one of the pilot studies conducted with 30 grade 10 students. The purposive sampling technique was employed. Google classroom was used as the blended learning platform. While pair work and hands-on activities were carried out in the physical classroom, introduction to the lesson, recording, reporting and self-reflection on hands-on activities were facilitated through Google classroom. Students' views on the blended learning experience were gathered through an observation schedule and student interviews. Students' knowledge and understanding were assessed by using rubrics. Results revealed that using the blended learning approach has enhanced students' knowledge and understanding of some science concepts and their interest in learning science. In addition, students could develop inquiry skills and 21st-century skills through blended learning activities.

Keywords: Assessment, Blended learning, Hands-on activities, Inquiry-based learning, Students' interests

Abstract No: 229 ***Science Education***

CONCEPTUAL UNDERSTANDING OF GENETICS AMONG GRADE 10 STUDENTS: A CASE STUDY IN THE KANDY EDUCATION ZONE

A.I. Vidanapathirana[1*] and C.L. Abayasekara[1,2]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Botany, University of Peradeniya, Peradeniya, Sri Lanka
[*]ashaliy@gmail.com

Understanding Genetics at GCE (O/L) is considered difficult by the students, while most teachers believe that teaching Genetics is not easy. The objective of the current study was to investigate the conceptual understanding of Genetics among students in grade 10 (Sinhala medium) government schools in the Kandy Education Zone. The research used mixed methods, and data were gathered quantitatively through a two-tier diagnostic test and qualitatively using semi-structured and informal interviews. The sample consisted of 173 students representing both genders from six schools in the Kandy Education Zone, representing school types *viz.*, 1 AB (Schools with Advanced Level Science stream classes), 1C (Schools with Advanced Level Arts and Commerce streams but no Science stream) and Type 2 (Schools with classes only up to grade 11). The quantitative data were analysed using Minitab statistical software. The study revealed that the extent of conceptual understanding of Genetics could be diagnosed through the two-tier diagnostic test. At the same time, the number of students who correctly answered the content choice ranged from 28.3 to 94.2% and those who answered both the content and the reason correctly ranged from 11.0 to 65.3%. This indicates that the students select content responses without a proper understanding, indicating that the tenth-grade students have several misconceptions about genetics. Thirty-two major misconceptions were identified by analysing items on the grade 10 Genetics diagnostic test. There was no statistical difference in students' performance between gender or school type. In conclusion, the study revealed that the conceptual understanding of Genetics among grade 10 students was not satisfactory, and the students had several misconceptions about Genetics.

Keywords: Biology Education, Genetics, Misconceptions, Two-tier diagnostic test

Abstract No: 309 ***Science Education***

STUDENT AND TEACHER PERCEPTIONS ON ONLINE TEACHING AND LEARNING SCIENCE IN GRADES 6 AND 7: A CASE STUDY IN KANDY EDUCATION ZONE

W.M.C.K. Basnayake[1] and W.D. Chandrasena[1,2*]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Science Education Unit, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
[*]wdchand@pdn.ac.lk

Online education has been vital due to the closure of schools during the COVID-19 pandemic and, thereafter, fuel shortage in the country. However, teaching and learning science are most critical due to the practical nature of the subject. In this situation, online learning has to be empowered through necessary strategies to meet the challenges. Thus, this research aims to investigate issues related to online teaching and the learning process of science in grades 6 and 7. The data was collected through a convenience sample through teacher and student questionnaires. The sample comprised 84 teachers and 150 students from the Kandy Education Zone. Results revealed that 93% of students and 89% of teachers prefer face-to-face lessons. Moreover, 95% of teachers disagreed with conducting online lessons to deliver science due to the difficulty of teaching some scientific concepts. Further, 88% of teachers argued that assessing and evaluation could not be accomplished effectively in online mode. Around 93% of students agreed that online learning is ineffective in learning science. Though 79% of teachers have a good internet connection with powerful devices, 65% of students do not have individual devices with a good internet connection. Moreover, students in lower grades prefer face-to-face science lessons to online lessons. Lack of experience and knowledge of the technology of teachers badly affects the online teaching and learning process in Sri Lanka. Thus, it is suggested to remedy the above issues appropriately to enhance the science teaching and learning process in schools to meet national goals effectively to prepare students with 21st Century skills.

Keywords: Grade 6 and 7 students, Online teaching and learning, Science

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ISBN 978-955-8787-09-0