University of Peradeniya

**Postgraduate Institute of Science**

# PROCEEDINGS

## PGIS Research Congress 2023

Volume 10

**Cover Image:** *Scientists, like animals searching for water, have an unending thirst for knowledge.*

The cover page displays the Sri Lankan Leopard, *Panthera pardus kotiya*, an endemic subspecies in Sri Lanka. This magnificient animal stands as the sole big cat species inhabiting the island. *Panthera pardus kotiya* is considered a flagship species that not only contributes to biodiversity conservation but also fosters the growth of ecotourism. It is classified as an endangered species, primarily due to habitat loss and human-leopard conflicts. Conservation efforts have been undertaken to protect their natural habitats and reduce conflicts with humans.

Photo credit: © Udara Karunarathne

# POSTGRADUATE INSTITUTE OF SCIENCE

# UNIVERSITY OF PERADENIYA

# SRI LANKA

## PGIS RESEARCH CONGRESS 2023

# PROCEEDINGS

## 3rd – 4th November 2023

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## Message from the Director, Postgraduate Institute of Science

The Postgraduate Institute of Science (PGIS) at the University of Peradeniya fosters the advancement of science, technology, and society via postgraduate programmes and scientific research. With its diverse array of scientific disciplines across eleven Boards of Study, the Institute emphasizes nurturing innovative thinking and supports fresh postgraduates in commencing research careers at PGIS. In recent years, the research and development endeavours of the Institute have experienced steady growth, solidifying its reputation as an exemplary national institution dedicated to the advancement of science.

As a national Institute, PGIS collectively strives to push the boundaries of knowledge, paving the way for transformative advancements that will shape the future of our society and the world at large. Every year, several hundred participants, including scientists from universities, research institutes, senior public-sector officials, industry representatives, and postgraduate students, attend the conference, contributing immensely to the promotion and sharing of cutting-edge research with a stimulating scientific atmosphere.

It gives me great pleasure to welcome you to RESCON-2023, the annual two-day Research Conference of PGIS that serves as the Institute's main event. The Congress offers a unique opportunity for scholars, researchers, and professionals to engage in meaningful discussions, share valuable insights, and foster collaborative partnerships that will shape the future of scientific endeavours. We encourage all participants to actively contribute to the vibrant intellectual atmosphere by presenting their most recent research, participating in thought-provoking discussions, and networking with peers and experts from a variety of scientific disciplines.

I extend my heartfelt gratitude to the Organizing Committee of RESCON-2023, the referees for their invaluable help in the review process and all those who have contributed to the success of this prestigious event. May this Congress serve as a catalyst for the advancement of science and the promotion of collaborative efforts that will drive impactful change nationally and globally.

I hope you have a stimulating and productive time at the Research Congress.

**Prof. H.M.T.G.A. Pitawala**

*Director, Postgraduate Institute of Science*

**PGIS Research Congress 2023**

**Message from the Congress Chairperson**

I am indeed privileged and honored to write this message on behalf of the tenth Postgraduate Institute of Science Annual Research Congress (PGIS RESCON) 2023 Organizing Committee. It is indeed an honor for me to welcome you to this prestigious event which stands as a testament to the dedication and collaborative spirit of the scientific community. This event, the largest in the PGIS calendar, has evolved into a vital platform for knowledge exchange, uniting both local and international researchers and scholars under one roof. Over two dynamic days on the 3rd and 4th of November 2023, 178 abstracts spanning under five major themes; Life Sciences, Physical Sciences, ICT, Mathematics, and Statistics, Science Education, and Earth and Environmental Sciences, will be presented. We are happy to announce that the congress will be held as a physical event where the researchers of various disciplines will get a chance to interact with scientists around the country. I am thankful to the authors for entrusting us with your research and for being an integral part of our conference.

I consider it a great honour to have as our Chief Guest, Prof. Rajith Senaratne the Chairman, National Science Foundation, Sri Lanka and the Keynote speaker Prof. Kosala Weerakoon, Faculty of Medicine and Allied Sciences, University of Rajarata. I am profoundly grateful for the invaluable contributions made by the plenary speakers, whose expertise and insights have played a pivotal role.

The success of this event is indebted to the untiring efforts of numerous individuals. I extend my deepest gratitude to Prof. H.M.T.G.A. Pitawala, Director, Postgraduate Institute of Science, for his invaluable encouragement and guidance. I would like to express my heartfelt gratitude to Dr. Kapila Wijayaratne for his invaluable support in his role as the Secretary. I extend my special thanks to Prof. Charmalie Abaysekara, the Editor-in-Chief and Dr. Ashwini Amarasinghe, the Assistant Editor, Theme coordinators, Theme members and Editorial Assistants for their unwavering support and dedication in handling all editorial matters. I would like to express my heartfelt gratitude to the reviewers and session chairs who have devoted their time and expertise to ensure the quality and integrity of the proceedings and technical sessions. I am particularly grateful to all the conveners and subcommittee members, whose tireless efforts and meticulous planning have made this conference a resounding success. I extend my heartfelt appreciation to all the members of PGIS for their unwavering assistance.

I am deeply grateful to Prof. T.M.W.J. Bandra and his team for organizing and successfully conducting a one-day pre-conference workshop with the active participation from both local and international researchers, making the event a resounding success.

Finally, my heartfelt thanks to the presenters; your presence has enriched this congress, making it a vibrant and intellectually stimulating gathering.

**Dr Thilini Chathurika Weerarathne**
*Chairperson/PGIS RESCON 2023*

**PGIS Research Congress 2023**

**Message from the Editor-in-Chief**

I count it my pleasure and privilege to send a message to RESCON 2023. It has indeed been an exciting and interesting journey for the past ten months or more working together with a team of committed persons, giving of their best amidst their very busy schedules, in order to make RESCON 2023 a fruitful reality.

First and foremost, I thank all the authors who contributed to our conference by sending us abstracts of their research. As quoted by Carl Sagan, *"Somewhere, something incredible is waiting to be known"*, and each of you have contributed in different ways to make this a reality, in the fields of Life Sciences, Environmental and Earth Sciences, Physical Sciences, ICT, Mathematics, and Statistics and Science Education.

*"Scientists have become the bearers of the torch of discovery in our quest for knowledge."* – Stephen Hawking. May the torch that has already been lit by each of you spread within you and beyond to the rest of the scientific world, through your presentations, communications and interactions during the congress sessions on the 3rd and 4th of November. Our hope is that each of you will be spurred on to reach further heights in your specific research or to develop new ideas with the opportunity you have of physically interacting with each other after many years of having online conferences. We would encourage all the authors to make the maximum use of this opportunity that was denied to many over the past few years and contribute to the sessions by responding and sharing your own knowledge and experience.

It is with pride that we report that this year we have abstracts submitted from all our state universities, many private universities, research organizations and 15 abstracts from authors and co-authors from, Australia, Austria, India, Malaysia, Nigeria, South Africa, South Korea, Sweden and the United States of America. While we received 203 abstracts in total, the congress will showcase 178 abstracts, which amounts to an acceptance of 88% of the abstracts, each abstract having gone through a careful and competent process of reviewing.

My sincere thanks go to all the reviewers in each field, from different institutions, different universities and our university, for efficiently and meticulously going through the review process for each abstract and for making fair decisions. The constructive ideas given by the reviewers no doubt helped the authors to improve the quality of their abstracts.

I say a big thank you to our Theme Coordinators, Theme Members and Editorial Assistants who did a humongous task day and night, in communicating with the authors and bringing out the best in each abstract as well as enabling us to keep to schedule. I owe an immense debt of gratitude to Dr. Ashwini Amerasinghe, our Assistant Editor who was the mastermind behind the entire process, drawing up a time-line and allocating each task to different persons, and much more. I say thank you to Dr. Kapila Wijeratne, the Secretary of RESCON 2023, without whose support we couldn't have reached this level of achievement.

Last but not least my thanks go to Dr. Thilini Weeraratne, our very efficient Chairperson of RESCON 2023, for her unstinted assistance, support and commitment at each and every stage of the editorial process. I also take this opportunity to thank the Director, Prof. H.M.T.G.A. Pitawala for his valuable advice and ready assistance at all times, and the PGIS staff for their support all through the editorial process.

Let me wish all the presenters the very best - enjoy your time at the conference! I hope you will take back with you new insights on developing your research, or maybe new thoughts on a completely new line of research that you may like to undertake, while making use of the opportunities for collaborating among scientists across the country and beyond, reminding ourselves that *"Every great advance in science has issued from a new audacity of imagination."* ~ John Dew.

Thank you,

With all good wishes,

**Dr. Charmalie Abayasekara.**
*Editor-in-Chief, PGIS RESCON 2023*

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**PGIS Research Congress 2023**

**Biographies and Speech Summaries of Keynote Speaker and Plenary Speakers**

## A Brief Biography of Prof. Kosala Weerakoon

**Keynote Speaker, RESCON 2023**

Kosala Weerakoon is a professor in medical parasitology and former head of the Department of Parasitology, Faculty of Medicine and Allied Sciences, Rajarata University of Sri Lanka. He is also a Visiting-Scientist at QIMR-Berghofer Medical Research Institute, Brisbane, Australia, a Visiting-Lecturer at the Faculty of Medicine, Wayamba University of Sri Lanka, a Fellow of the Royal Society for Public Health, UK, and a Fellow of the Royal College of Physicians of Edinburgh, UK. His research focuses on tropical illnesses with particular interest in tropical infectious diseases. He is a passionate advocate for public engagement and scientific outreach and has consistently sought opportunities to communicate his research findings to wider audiences, fostering a greater understanding and appreciation for the field of parasitology.

### Keynote Speech Summary

### Harnessing research for community well-being

Science has been a driving force behind the progress and advancements that have shaped our modern world. From life-saving medical treatments to technologies that connect us globally, scientific discoveries have revolutionized every aspect of our lives. However, the journey from scientific discovery to tangible community benefit is often marked by challenges. There exists a gap that must be bridged between the laboratory and the community, between knowledge and action.

## A Brief Biography of Prof. Johannes Barth

## Plenary Speaker, Earth and Environmental Sciences, RESCON 2023

Since 2008 Johannes Barth is coordinator and head of an international research group in Germany at Friedrich-Alexander-Universität Erlangen-Nürnberg. The team runs a well-established laboratory with mostly analyses of major ions, trace elements as well as carbon, oxygen and water isotopes. Worldwide aqueous systems of investigation range from rivers, lakes and reservoirs to groundwater and their biogeochemical interactions. Before starting in Erlangen, Johannes Barth coordinated one of the largest environmental projects in Europe named AquaTerra (2004 – 2008). Before this task (between 2000 and 2004) he held a lectureship in Biogeochemistry in Scotland. This period was preceded by a post-doctoral fellowship at the Queen's University Belfast in Northern Ireland (1998-2000), after he had completed his PhD on the St. Lawrence River at the University of Ottawa (Canada) between 1994 and 1998. His basic geological and hydrogeological training took him from Germany (Munich) via Scotland (Edinburgh) and back to Germany, where he finished his Diploma at the Ruhr-Universität Bochum in 1993.

## Plenary Speech Summary

## Rivers, Lakes And Groundwater: Investigations By Geochemical And Stable Isotope Tools

Inland waters are important reflectors of ecosystem and environmental health issues of our continents. Except for losses by evapotranspiration, essentially each drop of water that falls on a land surface ends up in rivers and lakes. In most cases, this water is also transported to surface water systems via complex pathways by groundwater. Therefore, better biogeochemical understanding of inland water compartments also implies improved understanding of our environment. Important challenges include to unravel environmental pressures by pollution and to separate them from natural processes such as weathering of rocks. Such investigations also imply the search for better understanding of how continental water compartments (i.e. groundwater, rivers and lakes) are connected. On the one hand, concentrations patterns and gradients of inorganic and organic dissolved and particulate matter can help such understanding. On the other hand, further information can be gained from stable isotopes. These can for instance be measured in the water molecule itself or in dissolved and particulate matter. In contrast to radio-isotopes stable isotope do not undergo radioactive decay even on geological time scales. On larger scales such as river basins, stable isotope changes are mostly investigated in so called natural abundance format. This means that tisotope ratios are investigated such as they are found in nature without addition of further labelled isotope tracers. Examples of investigation include evaluations of evaporation from open water bodies, mixing of water masses with water isotopes or investigations of respiration-photosynthesis behavior in open water bodies. Stable isotope investigations are most powerful if they are combined with concentration patterns of dissolved and particulate matter but also combinations with novel investigations of landscapes by for instance geographic information systems (GIS) can be very helpful.

## A Brief Biography of Dr. Chaminda Ranasinghe

## Plenary Speaker, ICT, Mathematics, and Statistics, RESCON 2023

Dr. Chaminda Ranasinghe functions as Founder/Chief Executive Officer of IDEAHUB (PVT) LTD. Dr. Ranasinghe obtained his B.Sc. (Hons) Degree in Computer Science from the University of Colombo, Sri Lanka in 1997 and a Diploma in Marketing from the Chartered Institute of Marketing (UK) in 1995. He obtained his Ph.D. from the University of Colombo related to Machine Learning (Software Agent Technology) in 2008. He is a member of CIM (U.K.), IEEE, ACM and CSSL. Dr. Ranasinghe works as a Senior Lecturer for the University of Colombo School of Computing in M.Sc. and B.Sc. streams.

Dr. Ranasinghe has over 25 years of experience in the IT Industry. He started his career as a Software Engineer and designed and developed technology platforms for the telecommunication and banking sectors. He has worked in managerial positions as Head of Research & Development, Chief Information Officer, Chief Operating Officer and Chief Executive Officer.

### Plenary Speech Summary

### What is ChatGPT Doing? The future of believable stories for humans

ChatGPT is a human-like text-generation tool based on neural networks. It is classified as a Generative Adversarial Network (GAN) or based on Transformer Architecture (GPT) related to Natural Language Processing (NLP) using Large Language Models (LLMs). Every artificial neural network corresponds to some overall mathematical function and ChatGPT does the same – but with billions of terms. Though we know how a weight-based neural network with around 175 Billion weights works in theory, the actual generative capability of the tool is considered a potentially surprising scientific discovery.

The success of ChatGPT has reached another tipping point in the history of humans - who have mastered the use of tools. The linguistic output of ChatGPT follows the patterns using its training data which are based on text from books, content from the Internet and other materials. What is amazing is how human-like the output is when considering the holistic connectedness across the comprehensive essays of responses generated for given prompts. What it produces can be called statistically probable, at least at a linguistic level. However, the responses from ChatGPT cannot be called the “truth” and also could be considered as a touch of reality in dilution. The responses are very human-like and convincing, however, they are in reality, fictional creations of a GAN - nevertheless, we can definitely call it a believable story – human evolution has deep relationships to believable stories.

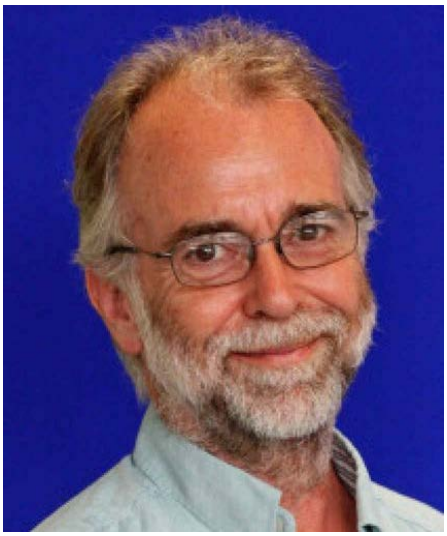
The interest and addiction of humans to converse with ChatGPT is reasonable based on our inherent attraction towards believable stories. The dilution of the truth and the reality of ChatGPT responses may sound like a drawback, nevertheless, it could be considered tremendously useful due to its detachment from the constraints of reality which results in imagination, creativity and out-of-the-box responses.

The practical uses of GANs are many and various in nature. However, it is obvious that humans would always get addicted to a tool that makes life easy. Further, any tool that makes a human think and work less has favoured exponential adoption when referring to the lessons and trends from history. Hence, our adaptation and addiction to tools based on GANs – generative text, images, music, programming code, videos – will increase and

become infused into tools of general use such as development IDEs, digital customer service assistants, music generated based on mood, etc. in the not so distant future. The trend of using GAN-based technology is predicted to be the next important wave of technology that would make artificial intelligence part of our daily lives.

## A Brief Biography of Prof. Danny O'Hare

## Plenary Speaker, Physical Sciences, RESCON 2023



Prof. O'Hare is full Professor of Biosensor Technology in the Department of Bioengineering at Imperial College. He studied chemistry at Imperial College, followed by a PhD in the Physiological Flow Studies Unit at Imperial. He joined the Department of Bioengineering in 2001 as lecturer having previously worked as senior lecturer in the School of Pharmacy and Biomolecular Sciences at the University of Brighton. He is a Fellow of the Royal Society of Chemistry and has had international collaborations in Korea, Taiwan, Japan, the United States and Europe.

He contributed to the development the MEng degree programmes Biomedical Engineering and Molecular Bioengineering at Imperial College, developed and led an intercalated BSc for medical students in Bioengineering and is currently director of the MRes Medical Device Design and Entrepreneurship.

His research interests are in the application of electrochemical methods to biomedical and clinical problems. His research encompasses fundamental aspects of electrochemistry, novel electrode materials, analogue electronics, signal processing as well as multidisciplinary collaborations in cardiology, orthopaedics, drug development, neurochemistry, cancer and infectious diseases. The translation of technology into clinical application is central to his research.

### Plenary Speech Summary

### Minimally-invasive biosensing: towards point-of-care devices

Point-of-care and wearable devices have demonstrable real world benefits for patients in the diagnosis of disease and in the management of chronic conditions. Electrochemical sensors and biosensors offer many advantages in such situations including low cost, simple instrumentation, relative ease of miniaturization and an ability to function in opaque biological media. However, biological fluids are challenging analytical media for any surface-based chemistry due to the plethora of surface-active spectator species such as plasma proteins. Implantation, whilst enabling continuous measurement and minimizing analyte losses due to sample pre-treatment also poses additional problems arising from foreign body responses.

This presentation will include discussion of the problems associated with clinical measurement. These include diffusional blocking, partitioning of analytes into adsorbed layers, deactivation of electrocatalytic sites, and compromised recognition chemistry performance from the sensor perspective, and from the patient perspective include inflammation and consequent analyte entrainment, blood vessel occlusion, pain, bleeding and risk of infection. Sampling and selection of the site of interest present additional technological challenges in order to obtain clinically useful information. Further challenges include translation of technology from the laboratory bench to real world measurements, where every aspect of the measurement process needs to be sufficiently robust for reliable non-expert use.

We have recently been investigating two orthogonal approaches to clinical measurement: (i) microneedle biosensors implanted into viable epidermis which avoids nerve endings, exposure to blood and can be implanted and removed non-surgically (ii) exhaled condensed breath as a non-invasive analytical matrix and source of biomarkers.

We have applied microneedle biosensors in human subjects as part of a study towards closed loop control of antimicrobial drugs. Optimised dosing is critical to good stewardship of antimicrobials since it can minimize the selection pressure arising from underdosing and enable the safe administration of drugs with low therapeutic indices. The quantification of host factor responses to infection, such as C-reactive protein, is a potential further refinement facilitated by the use of real-time biosensing as we aim for the long-term goal of individualized dosing. We have also applied microneedles to the measurement of lactate, an important prognostic indicator in septic shock.

Exhaled breath condensate (EBC) can be collected by breathing on to a cooled surface. Early work has been compromised by poor thermofluid analysis and control of temperature and flow which impair accuracy and precision. We have developed a novel portable device for the collection of EBC that enables correction for natural breathing patterns and optimization with respect to target analyte concentration. Combined with disposable sensors, we have evaluated performance in healthy volunteers and in patients with chronic obstructive pulmonary disease (COPD) where hydrogen peroxide is a marker of inflammation and exacerbation. More recently we have extended the analytes to include lactate, enabling its monitoring in community settings and pre-hospital care. The results obtained from the disposable electrochemical biosensors have been validated against LC-MS.

Electrochemical sensors combined with minimally-invasive sampling have the potential to provide a new approach to decentralized clinical biochemistry and chemical pathology.

## A Brief Biography of Prof. Shironica Priyanthi Karunanayaka

## Plenary Speaker, Science Education, RESCON 2023

Shironica Priyanthi Karunanayaka is a Senior Professor in Educational Technology at the Open University of Sri Lanka (OUSL). She served as the Dean of the Faculty of Education at OUSL from 2018 to 2021 and from 2012 to 2015. She was also the Head of the Department of Secondary and Tertiary Education from 2006 to 2012. She has been an academic at OUSL since 1993. Prior to that, she has gained experience as a trained teacher of Science serving in the secondary school system in Sri Lanka for over a decade. She served as an Honorary Adviser to Commonwealth of Learning during 2019-2021, and from April 2023, she is appointed as an Honorary Chair of Commonwealth of Learning (COL Chair).

Prof. Karunanayaka holds the Degree of Doctor of Education from the University of Wollongong, Australia, awarded in 2001, specializing in Information Technology in Education and Training. She obtained the Post Graduate Diploma in Education from the University of Colombo in 1996. She holds a first class in the Bachelor of Science Degree from the OUSL, receiving the Gold Medal Award for the Best Performance in 1990.

Being an active researcher, Prof. Karunanayaka has many publications to her credit in both national and international fora. Her research focus lies mainly in the areas of Technology Enhanced Learning, Learning Experience Design, Open Educational Resources, and Open Educational Practices. Recently, Prof. Karunanayaka received the CVCD Excellence Award presented by the Committee of Vice-Chancellors and Directors in Sri Lanka for the Most Outstanding Senior Researcher-2022 in the field of Social Sciences and Legal Studies.

### Plenary Speech Summary

### Open Science—The Next Frontier in Opening up Educational Practices

‘Openness’ in education is an evolving concept that may be viewed through various lenses. These include open access, open data, open-source software, open licensing, open educational resources (OER), open educational practices (OEP), open pedagogy, and open science, among many other notions of ‘open’ practices in teaching and learning. For instance, through open licensing, OER enable free and open access, reuse, re-purpose, redistribution, and adaptation of resources to address different contextual and learning needs. OEP comprise collaborative practices that include the creation and sharing of OER, as well as participatory pedagogical practices that encourage interaction and co-creation of knowledge. Thus, OEP fundamentally relates to the application of open practices in teaching, learning, and research. The term ‘open science’ has emerged extending the principles of openness to the scientific process. It is frequently used as an umbrella term that involves various movements aiming to remove the barriers for sharing outputs, resources, methods, or tools, at any stage of the research process, including open access to scientific publications and open research data. It is about making science more accessible, inclusive, and equitable by increasing scientific collaborations and sharing of information for the benefit of science and society. The rationale behind open science is that scientific knowledge is a product of social collaboration, and its ownership belongs to the community. The idea that scientific outputs generated by public research are a public good that everyone should be able to use freely and openly, is aligned with the core value principle of openness in education. Opening up educational practices in such a way promotes a more

open, participatory, creative, and sharing culture, which calls for transformational changes in educational institutions. Enacting shifts in practitioners' mindsets and actions towards creative, innovative, and scholarly practices of openness can be realized through systematic design, development, and implementation of meaningful capacity development interventions involving innovative pedagogical designs and advancing digital technologies.

**PGIS Research Congress 2023**

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# Earth and Environmental Sciences

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

# SPATIAL MULTI-CRITERIA EVALUATION MODEL FOR LANDSLIDE HAZARD ZONATION USING GEOGRAPHIC INFORMATION SYSTEM - A STUDY FROM KANDY DISTRICT

**K.M.A.U. Senevirathna* and D.T. Jayawardana**

*Department of Forestry and Environmental Science, Faculty of Applied Sciences, University of Sri Jayewardenepura, Nugegoda, Sri Lanka.*
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Landslides are the most common disasters in mountainous regions in Sri Lanka. Landslide hazard zonation (LHZ) mapping is a powerful tool together with the Geographic Information System (GIS) in identifying landslide-prone areas. Kandy District is one of the landslide-vulnerable areas in the Central Highlands of Sri Lanka. This study was carried out to identify the causative factors for landslides in the Central Highlands of Sri Lanka and develop the landslide hazard zonation map following the Spatial Multi-Criteria Evaluation (SMCE) model. The literature survey identified eight major landslide causative factors: slope, aspect, soil, geology, land use, rainfall intensity, distance from the road, and distance from the stream. The spatial geo-databases for each causative factor were developed and analysed using Arc GIS 10.5 software. The contribution of each causative factor to the slope failures was evaluated using the Analytic Hierarchy Process (AHP) and modelled with the SMCE model in a GIS environment. The developed SMCE model is at an acceptable level as the acquired consistency ratio (CR) value is 0.07 ($\leq$ 0.1). Forty-seven per cent (910.25 $km^2$) of Kandy District's land area belongs to the moderate landslide susceptibility zone. Secondly, the low susceptible zone showed the greatest land extent, 39% (744.48 $km^2$) of the study area. High and very high landslide-susceptible zones showed 12% (242.55 $km^2$) and 0.1% (1.83 $km^2$) for the study area. The developed SMCE model showed a 75% accuracy with previous landslide information. The developed landslide hazard zonation map can be used to identify the future landslide susceptible regions in the Kandy District. Accordingly, policymakers and developers can use this LHZ map effectively in future development activities.

**Keywords**: Geographic information system, Kandy, Landslide hazard zonation, Spatial multi-criteria evaluation model

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

# PLASTIC DEGRADATION INTO SECONDARY MICROPLASTICS IN COASTAL AREAS AFFECTED BY THE MV X-PRESS PEARL MARITIME DISASTER

**G.M.S.S. Gunawardhana, U.L.H.P. Perera, A.S. Ratnayake*, W.A.D.B. Weerasingha and H.C.S. Subasinghe**

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The MV X-Press Pearl maritime disaster has severely affected the sensitive marine and coastal environment on the west coast of Sri Lanka. Large quantities of plastic pellets (nurdles or plastic pellets < 5 mm and estimated at 1680 tonnes) were released into the Indian Ocean. A substantial proportion of plastic pellets/primary microplastics (MPs) can degrade to secondary MPs. This study aimed to understand the degradation of plastic pellets into secondary MPs under the extreme conditions of fire and chemicals during the MV X-Press Pearl maritime disaster. Beach sand samples were collected from mean sea level and berm at 40 locations covering the affected west coast of Sri Lanka and an additional 20 samples covering the entire coastline of Sri Lanka. Microplastics were separated using the Wet Peroxide Oxidation (WPO) process. The secondary MP quantities and microscopic observations were noted. Fourier Transform Infrared Spectroscopic (FTIR) analysis was carried out to identify functional groups of MPs. The difference in average values of secondary MPs at mean sea level (large MPs = 33 ± 56 items per 1 $mm^2$ and total MPs = 61 ± 66 items per 1 $mm^2$) and the berm (large = 61 ± 154 items per 1 $mm^2$ and total MPs = 106 ± 165 items per 1 $mm^2$) suggested that large quantities of MPs had spread in other areas in the Indian Ocean with oceanic currents. The baseline average value of secondary total MPs was about 53 ± 66 items per 1 $mm^2$ in other coastal areas of Sri Lanka. The positive correlation between large and total secondary MPs and plastic pellets pollution index indicates that a significant amount of plastic pellets were degraded into secondary MPs under the influence of nitric acid and heat/fire within six to eight days after the accident. Based on FTIR observations, these secondary MPs were mainly composed of low-density polythene (LDPE) and linear low-density polythene (LLDPE). Consequently, these lightweight polymers can spread over a wider region and can cause severe environmental threats on a global scale as transoceanic marine pollutants.

*Financial assistance from the Accelerating Higher Education Expansion and Development (AHEAD) Development Oriented Research (DOR) grant, funded by the World Bank* (*Grant No: AHEAD/DOR/056), is acknowledged.*

**Keywords**: Coastal pollution, Maritime disaster, Microplastics (MPs), Secondary MPs, Wet peroxide oxidation (WPO).

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

# POTENTIAL FOR PROMOTING AVITOURISM IN NANTHIKADAL LAGOON, MULLAITIVU, SRI LANKA

**S.M.N. Samarakoon[*] and C. Wijesundara[2*]**

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Avitourism plays a major role in wildlife tourism, contributing significantly to ecotourism. It has the potential to integrate sustainable development with wildlife conservation. The present study focused on the use of bird diversity for promoting ecotourism, specifically avitourism, in a selected area in Mullaitivu District, which consists of a unique geographical landscape including four lagoons, 208 freshwater tanks, a dense forest, and a 78 km stretch of coastline. All these resources give good opportunities for bird diversity, bird habitats, and potential for avitourism. In addition, the presence of infrastructure facilities such as road networks help promote avitourism within the study area. The point count method was utilized for estimating the bird diversity in the area. Sampling was conducted at nine selected points, encompassing three habitat types around Nanthikadal Lagoon. During the study period, 79 bird species belonging to 35 families were identified. Waterbirds were the dominant group observed, and among them, 26 species were migrants. According to the global/national conservation status, 10 species were Near Threatened (NT) and 3 were endemic. The forest area had the highest bird diversity (Shannon Index: 3.985), followed by shrub land (3.919) and marshy area (3.694). The present study also explored the potential for promoting avitourism, knowledge generation on bird diversity, and bird conservation. The Mullaitivu region not only holds avitourism potential, but also becomes a prime destination for ornithological studies, particularly in the realm of avitourism. It will simultaneously complement and enhance many other existing options for ecotourism.

**Keywords:** Avitourism, Conservation, Ecotourism, Nanthikadal Lagoon, Sri Lanka

***Abstract No: 34*** ***Earth and Environmental Sciences***

# DOES THE ENVIRONMENTAL SCORE OF ESG (ENVIRONMENTAL, SOCIAL, AND GOVERNANCE) REPORTING HAVE AN EFFECT ON CORPORATE PERFORMANCE OF COMPANIES?

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Integrating environmental, social, and governance (ESG) factors into investment decision-making has gained momentum in recent years, causing companies (mostly large-scale) to acquire and disclose the sustainability in ESG form in reporting. Out of all three aspects of ESG, environmental reporting is crucial since it gives insights into measures taken to address serious industrial environmental aspects. However, there are individuals questioning the requirement of environmental reporting. Therefore, the objective of this study is to measure the relationship between the Environmental score of ESG performance against the corporate performance of publicly listed companies in Sri Lanka, using the list of 128 companies for the year 2020. The data collection of the study was done through annual reports to quantify the qualitative ESG data using the Refinitiv methodology of ESG quantification as the independent variable. The two dependent variables to measure corporate performance are return on equity (ROE) and return on assets (ROA), collected through the same annual reports. The statistical analysis includes scatter plots, regression analysis and residual analysis to measure the significance of the relationship. However, the results of this study show no significant relationship between environmental score with both ROE and ROA. It concludes no relationship with corporate performance for the year 2020. Therefore, this study does not communicate the need for any environmental information reporting to improve the corporate performance of the companies. The limitations of conducting for the year 2020, a year with the pandemic, can directly impact the results. Furthermore, reasons may include greenwashing and the unsuitability of Refinitiv methodology for the Sri Lankan context.

**Keywords**: Cooperate performance, Environmental reporting, ESG, Sri Lanka.

***Abstract No: 35*** ***Earth and Environmental Sciences***

# PRELIMINARY CHEMICAL INVESTIGATION OF TWO BROWN MARINE ALGAL SPECIES IN SRI LANKA

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Brown marine algae are currently of great interest due to their abundance of bioactive compounds that can be used for several therapeutic and other applications. About 320 species of marine algae belonging to different families have been identified along the coast of Sri Lanka. In the present study, brown marine algal species *Sargassum polycystum* and *Turbinaria ornata* found in the Jaffna coastal area were studied for their phytochemicals, functional groups, minerals and fatty acid profile with standard assays. Aqueous algal extracts for the phytochemical screening were prepared by mixing dried, powdered samples in distilled water (1:10 w/v) followed by sequential extraction for 24 hours, while dried powdered samples were used for functional group analysis by FTIR and mineral content by ICP-MS. The fatty acid profile was analysed by direct transesterification of fatty acids followed by GCMS. Phytochemical screening results revealed the presence of reducing sugars, saponins, glycosides, triterpenoids, tannins, phenols, and alkaloids in both algal species. FTIR analysis indicated the presence of functional groups corresponding to alkaloids, amino acids, polysaccharides such as pectins and polymers such as lignins and cutins. Both algal species contained calcium, potassium, sodium, copper, iron and zinc. Trace amounts of heavy metals chromium, nickel, arsenic, mercury and lead were detected in both dried and powdered samples. *Sargassum polycystum* had the highest calcium content (6.8% dry weight [DW]), while *T. ornata* contained the highest potassium (7.2% DW). Both algal dried powders are good sources of iron due to their relatively high content (881 mg/kg *S. polycystum* and 583 mg/kg *T. ornata* DW). Pentadecanoic acid and hexadecanoic acid (palmitic) were the most prevalent fatty acids present in *S. polycystum* (50%) and *T. ornata* (38%). According to the results of the present study, both algae are good sources of bioactive compounds, essential minerals and bioactive fatty acids.

**Keywords**: Functional groups, Minerals, Phytochemicals, *Sargassum polycystum*, *Turbinaria ornata*

***Abstract No: 37*** ***Earth and Environmental Sciences***

# CARBON FOOTPRINT OF SELECTED SRI LANKAN TEA INDUSTRIES

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Tea production has significant effects on the environment, including habitat conversion, reduction in biodiversity and ecosystem function, high energy consumption, and high use of pesticides and fertiliser. The impact of the tea industry on climate change and the best mitigation measures are still up for debate. This study was conducted to identify the parameters to quantify the greenhouse gas emission associated with fertiliser, material and energy usage in the tea sector in Sri Lanka and calculate the estimated value for Greenhouse Gas (GHG) emission in the tea sector. The Life Cycle Analysis (LCA) approach was used to estimate the carbon footprint across the life cycle of goods and services, including GHG emissions and other environmental impacts. Emissions were calculated based on resource consumption for the main processes in the tea life cycle in two major tea-producing companies from April 2019 to March 2020 in Sri Lanka, and total emissions were calculated using the average carbon footprint per 1 kg of tea and total tea production in Sri Lanka. Agrochemical application (>55%) is recognised as a major carbon-emitting activity in the tea manufacturing process. Water boiling is the highest carbon-emitting and high energy-consuming activity in the consumption phase. In the Sri Lankan context, tea consumption accounts for 66% of the overall carbon footprint, whereas tea manufacturing accounts for 34% of total GHG emissions per cup of tea. However, the overall estimated carbon footprint of tea production (cradle to gate) is 812,857 $tCO_2e$ (51% of total), and the carbon footprint for local consumption is 784,788.76 $tCO_2e$ (49% of total carbon footprint), and the estimated total carbon footprint (cradle to grave) for Sri Lankan tea sector is 1,597,646.26 $tCO_2e$ per year.

**Keywords**: Climate change, Greenhouse gas emission, Life Cycle Assessment, Sri Lanka, Tea

***Abstract No: 38*** ***Earth and Environmental Sciences***

# CHANGES IN WATER CONSUMPTION PATTERNS POST-INSTALLATION OF REVERSE OSMOSIS WATER TREATMENT PLANTS IN DIMBULAGALA, SRI LANKA

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Installing Reverse Osmosis (RO) water treatment plants is seen as a solution to provide safe drinking water to areas in Sri Lanka affected by chronic kidney disease of unknown etiology (CKDu). The current study intends to identify changes in water consumption patterns post-installation of RO plants in the Dimbulagala divisional secretariat division, considered one of the CKDu prevalent areas in Sri Lanka. In the present study, a questionnaire survey was carried out on 154 households to get the perspectives on the quality of drinking water: palatability and appearance. In addition, accessibility to the water source was determined by considering the travel time. The findings revealed that 52% of the population agreed that they had palatable drinking water before installing RO units. In addition, 86% of the sample population agreed that the drinking water had a clear appearance. With the commissioning of RO units, the water usage from other sources has been reduced over the period between 2010 - 2022 (tap water 6%, rainwater 4%, well water 18%, surface water 12% and bottled water 2%). About 28% of the population has rejected RO-treated water due to non-disclosed reasons. While 28% of the total population have access to RO water from their premises, 26% travel more than 15 minutes to access RO water. However, 66% of the total population was satisfied with the water availability and the quality post-installation of RO units. Lack of awareness of health concerns related to contaminated groundwater consumption, financial constraints, distance to access the RO plant and differences in palatability were the main reasons which prevented the consumption of RO-treated water. Therefore, the need for adequate knowledge transfer to the community on RO technology is warranted.

**Keywords**: CKDu, Portable water, Reverse Osmosis (RO), Water quality, Water treatment

***Abstract No: 62*** ***Earth and Environmental Sciences***

# EVALUATION OF DIFFERENT SUBSTRATES FOR HYDROLYSIS AND SUBSEQUENT METHANOGENESIS IN THE ANAEROBIC REACTOR

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Anaerobic digestion is essentially a procedure that turns organic substrates into biogas, which serves as a renewable energy source. In this digestion process, different substrates are utilised for degradation. Biogas production is governed by four digestion stages of substrates: hydrolysis, acidogenesis, acetogenesis, and methanogenesis. Biogas production is prominent at the latter stage of the digestion process of the substrate in the anaerobic reactor. The time taken to initial degradation (hydrolysis, acidogenesis, acetogenesis) of the substrate can vary from a few days to several weeks. However, the effect of the substrate to move forward from the lag phase (hydrolysis, acidogenesis, acetogenesis) to the log phase (methanogenesis) has limited understanding. Therefore, the present study was carried out to determine the effect of substrate composition on subsequent methanogenesis in the anaerobic reactor. Cow dung was used as the base substrate. The base substrate was co-digested with four different substrate types: *Gliricidia*, kitchen waste, banana peels fermented in sugar, and a mixture of the above three substrates in 650 ml reactors. As a control, one reactor was kept only with cow dung. The reactor with a mixture of all substrate types exhibited a pH drop from 8 to 4 in 3 days, which witnessed accelerated hydrolysis (acid fermentation) and decomposition, while the other substrate combinations took more than 6 days to drop the pH from 8 to 4. Moreover, it was found that the reactor with the mixture of substrates showed the highest gas volume and flame time. Cow dung, kitchen waste, *Gliricidia*, and Banana peels fermented in a sugar substrate mixture can be identified as a substrate combination that effectively performs hydrolysis and subsequent methanogenesis. It can be concluded that the selection of substrate combinations for co-digestion significantly impacts biogas production to reduce the lag phase and increase the efficiency of the log phase.

**Keywords**: Anaerobic digestion, Biogas, Co-digestion, Cow dung

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

# THE ANCIENT TANK CONSTRUCTION TECHNOLOGY IN NORTH CENTRAL DRY ZONE OF SRI LANKA: A HYDRO-ECOLOGICAL ASSESSMENT

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The ancient civilisation of Sri Lanka is known as a "hydraulic civilisation" due to the advanced water management practices associated with the tank irrigation heritages of ancient Sri Lankans. Ancient people selected the dry zone for their settlement by considering the availability of suitable natural and physical resources for agriculture. Tanks were constructed to store water for agriculture even in periods with minimum rainfall throughout the dry zone. Historical records indicated from the 3rd century B.C., that tanks have been built by constructing an earth dam, across a valley, employing technical devices such as sluices, canals, and spillways. Although there are several studies on irrigation technology, sufficient attention has not been paid to analysing the hydrological and ecological dimensions of these techniques. The objective of this study is to make an attempt to fill this gap of knowledge. For this purpose, data were collected basically from literature citing Journal articles, scholarly work, google images, and institutional reports in addition to field verifications. In-depth field studies were conducted covering two large tanks, two medium and six small tanks selected from the North Central Province. Further, structured interviews were conducted with senior farmers and key local officers to understand the significance of hydro-ecological features. The study revealed that sluice technology, including *besokotuwa* and sluice front ridge, spill and outside spill, *kulu-wewa* system, and the cascading nature exemplify specific hydrological requirements. Some ecological devices, such as tank reservations and *olagam-wewa* system, were linked with the sustainability of irrigation tanks. These ecological devices have also contributed to purifying water and ensuring sustainability. Further, these techniques also contributed to wildlife impact management strategies in the dry zone of Sri Lanka. The findings of this study reflect that ancient tank construction technology and devices performed significant technical roles in hydrological and ecological management.

**Keywords**: Ancient technology, Dry Zone, Hydrology, Sustainability, Tank Systems

***Abstract No: 65*** ***Earth and Environmental Sciences***

# ADSORPTION OF LEAD (II) IONS ON MAGNETITE/MAGNESIUM OXIDE NANOCOMPOSITES

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The effective removal of heavy metal ions, particularly lead(II) [Pb(II)], from contaminated water sources remains a pressing environmental concern. This study explores the potential of magnetite/magnesium oxide ($Fe_3O_4$/MgO) nanocomposites as an efficient adsorbent for selective Pb(II) removal. The $Fe_3O_4$/MgO nanocomposites were synthesised using a controlled sol-gel method and characterised using various techniques. XRD analysis confirmed the presence of cubic MgO and cubic $Fe_3O_4$. Pb(II) adsorption induced a crystallographic transformation, forming hexagonal $Mg(OH)_2$ crystals, indicating interaction with the adsorbent. SEM analysis revealed rod-like and spongy spherical morphologies. Rod-like structures provided a larger surface area and active sites for effective Pb(II) interaction, while spongy spherical particles, representing magnetic $Fe_3O_4$, contributed to stability and dispersibility. EDS analysis showed Fe, O, and Mg presence with weight percentages of 28.97%, 25.55%, and 30.0%, respectively. VSM results confirmed superparamagnetic behavior with a saturation magnetisation of 32.02 emu $g^{-1}$, indicating potential for magnetic separation and recovery in various wastewater treatment applications. Adsorption experiments utilised optimised conditions: initial concentration of 600 mg $L^{-1}$, adsorbent dosage of 0.25 g $L^{-1}$, pH of 7, and 120 minutes reaction time. $Fe_3O_4$/MgO nanocomposites exhibited exceptional performance with a remarkable 99.98% removal efficiency and a high adsorption capacity of 2399.44 mg $g^{-1}$. These impressive results underscore the outstanding adsorption potential of the nanocomposites. Adsorption kinetics followed the pseudo-second-order model ($R^2$ = 0.99), confirming suitability for Pb(II) removal. The Freundlich model indicated a heterogeneous surface with different adsorption sites. These comprehensive findings support efficient Pb(II) removal using $Fe_3O_4$/MgO nanocomposites, paving the way for advanced adsorption strategies in water treatment. Overall, $Fe_3O_4$/MgO nanocomposites exhibit potential as a cost-effective, environmentally friendly adsorbent for removing Pb(II) ions, providing a promising water purification and environmental remediation solution.

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**Keywords**: Adsorption capacity, Environmental remediation, Heterogeneous surface, Superparamagnetic behavior, Sol-gel method

***Abstract No: 68*** ***Earth and Environmental Sciences***

# ASSESSMENT OF SOIL BACTERIAL DIVERSITY IN ORGANIC AND CONVENTIONAL AGROECOSYSTEMS VIA HIGH THROUGHPUT SEQUENCING

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Soil bacterial diversity is a vital regulator of fundamental ecosystem processes. Using synthetic inputs in agriculture alters the microbial community structure and its functional capacity. The alpha diversity of soil measures the species diversity within an ecosystem or area. The Chao1 diversity index measures species richness, and the Shannon diversity index measures species richness and evenness. High throughput sequencing (HTS) is an ideal way to gain information on microbial communities in heterogeneous environments such as soil. This research is intended to compare soil bacterial diversity in organic and conventional farms in different agroecological zones of Sri Lanka by accessing soil metagenome. To this end, the metagenomic sequencing data of the V4 region of the bacterial 16S rDNA extracted from six organic and conventional agricultural lands located in Nuwara Eliya, Mawathagama, and Labuduwa (Wet zone), Makandura and Padiyathalawa (Intermediate zone) and Maha Illuppallama (Dry zone) of Sri Lanka were analysed using the QIIME2 2022.2 (Quantitative Insights into Microbial Ecology) pipeline. Samples were rarefied at a sequencing depth of 15,000, and the alpha diversities (Chao1 and Shannon) were calculated. The Chao1 diversity of the organic fields in Nuwara Eliya, Mawathagama, Labuduwa, Makandura, Padiyathalawa and Maha Illuppallama were 1397.17, 659.37, 594.67, 1025.50, 814.08 and 733.94 respectively and Chao1 diversity of the respective conventional fields were 592.47, 357.83, 1030.51, 762.02, 666.47 and 568.00. The Shannon diversity of the organic fields in Nuwara Eliya, Mawathagama, Labuduwa, Makandura, Padiyathalawa and Maha Illuppallama were 9.13, 8.57, 8.32, 9.20, 8.62 and 8.43 respectively and the Shannon diversity of respective conventional fields were 8.55, 7.72, 8.95, 8.51, 8.49 and 8.22. Except for the farm in Labuduwa, the results showed that organic farms had higher Chao1 and Shannon diversity. Thus, this study suggests that organically cultivated agricultural fields may have more alpha diversity than conventionally cultivated fields.

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**Keywords**: Agroecosystems, High throughput sequencing, Soil microbial diversity

***Abstract No: 71*** ***Earth and Environmental Sciences***

# REMOVAL OF LEAD (II) FROM AQUEOUS SOLUTIONS BY PEELS OF BANANA VARIETY AVAILABLE IN SRI LANKA

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Lead (II) is a water pollutant released from industrial and agricultural activities to the environment. It is non-biodegradable and tends to bio-accumulate, which causes environmental contamination. This study investigated the removal of Pb (II) ions using peels of the Puwalu banana (*Musa acuminata* Colla), a banana variety available in Sri Lanka. Banana peels (BP) are waste material that could be used as an environmentally friendly adsorbent. The dried ground Puwalu BP were characterised by a Scanning Electron Microscope, which illustrated the surface morphology of the BP, and pattern of the Powder X-ray diffraction of the BP showed the amorphous nature of the adsorbent. Fourier Transform Infrared spectroscopy analysis was conducted for the BP before and after Pb (II) adsorption to determine the functional groups involved in removing Pb (II) ions. Parameters such as particle size, adsorbent dosage, contact time, and pH were optimised, and the concentrations of Pb (II) ion in solutions were determined using a Flame Atomic Absorption Spectrometer. Under optimal conditions, the maximum Pb (II) removal percentage was 87.19%. Langmuir and Freundlich isotherm models were applied to determine the adsorption behaviour between the metal ion and the adsorbent. Both isotherm models showed a correlation coefficient where $R^2$ values were close to one ($R^2 \approx 0.99$), and the maximum adsorption capacity for Pb (II) was 11.42 mg $g^{-1}$. The present study suggests that ground Puwalu BP can be used as a cost effective adsorbent for removing Pb (II) ions from aqueous media.

**Keywords**: Adsorption, Banana peels, Isotherms, Pb (II), Puwalu

***Abstract No: 93*** ***Earth and Environmental Sciences***

# PRELIMINARY STUDY ON DIVERSITY OF LEPIDOPTERANS IN TWO DISTINCT HABITATS IN THE DUNUMADALAWA FOREST RESERVE, KANDY, SRI LANKA

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The present study investigated the diversity of lepidopterans (Class Insecta, Order Lepidoptera) at Dunumadalawa Forest Reserve, Kandy, a sub-montane forest in the wet zone of Sri Lanka. Sampling was done in two selected habitat types: a mixed forest habitat above the Rosnith Lake and a habitat dominated by the invasive Yakadamaran trees (*Myroxylon balsamum*). The study was conducted for one year, from February 2019 to March 2020. In each habitat, butterfly and moth species and their abundance were recorded while walking along a 50 m line transect extending 5 m on either side of the mid-line and a maximum of one hour at each transect. Five such transects were sampled from each habitat. Field identification of butterflies and moths was done using standard guides, and photographs were taken to document the species encountered. A total of 31 species, including six endemics belonging to 15 families, were recorded from the mixed forest, whereas 21 species with two endemics belonging to eight families were recorded from the habitat with Yakadamaran trees. The butterfly family Pieridae was dominant in the mixed forest habitat above the Rosnith Lake, while the moth family Erebidae dominated the Yakadamaran forest habitat throughout the study period. The Shannon diversity index (H′) of lepidopterans in the mixed forest habitat above the Rosnith Lake and in the Yakadamaran forest habitat were 2.53 and 1.33, respectively. Species evenness (E) was 0.77 in the mixed forest above the Rosnith Lake habitat and 0.44 in the Yakadamaran forest habitat. According to the Shannon diversity index, the mixed forest above the Rosnith Lake habitat had a higher diversity of butterflies and moths compared to the Yakadamaran forest habitat. Moreover, the lepidopteran species are more evenly distributed in mixed forest habitats compared to the Yakadamaran forest habitat. According to the study, habitat homogeneity and associated conditions directly influence the lepidopteran diversity.

**Keywords**: Diversity index, Habitat homogeneity, Lepidopteron, Species Evenness, Transect

***Abstract No: 95*** ***Earth and Environmental Sciences***

# A PRELIMINARY INVESTIGATION ON THE QUALITY OF MUNICIPAL COMPOST PRODUCED IN KANDY, KURUNEGALA AND MAWANELLA

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Municipal compost is a product derived from municipal solid waste. Local government authorities in Sri Lanka produce municipal compost as a part of their solid waste management program. The compost product is then marketed without a proper label that includes necessary information for the consumers on the packaging. Municipal solid waste is highly susceptible to contamination because of the non-segregation of waste. Thus, the safety and effectiveness of municipal compost is decidedly questionable. Five compost samples per composting facility were obtained from three separate municipal composting facilities located in Kandy, Kurunegala and Mawanella according to simple random sampling. The samples were air-dried and analysed for soluble nutrients extracted using a 0.01 mol $dm^{-3}$ $CaCl_2$ solution. The orthophosphate molybdenum blue method was used to determine soluble phosphate, the cadmium reduction method was used to determine soluble nitrate, and AAS was used for the soluble magnesium ion detection. A 2 mol dm-3 KCl solution was used as the extractant, followed by the Indophenol blue method to measure soluble ammonium ions. Compost samples digested in aqua regia were analysed for the presence of heavy metals. Heavy metals, lead, chromium, and cadmium were measured using AAS. Although most measurements were within tolerable limits, the results indicate nitrate levels of more than ten times the expected value of 500 mg $kg^{-1}$ and cadmium content exceeding the 10 mg $kg^{-1}$ limit. Further, it was observed in all the compost samples that there was a significant presence of plastics along with other impurities. Non-segregation of waste material was observed in all three composting facilities. For future studies, sample count should be increased to minimise the variance. Further, incorporating a broader set of test parameters on par with international standards and microplastic analysis can better understand the municipal compost produced in Sri Lanka.

**Keywords**: Heavy metals, Microplastics, Municipal compost, Municipal solid waste

***Abstract No: 105*** ***Earth and Environmental Sciences***

# URBAN BIRD DIVERSITY IN SELECTED LOCATIONS OF COLOMBO DISTRICT AND THE ATTITUDES OF RESIDENTS TOWARD BIRDS IN THEIR NEIGHBORHOOD

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Urban green spaces offer many ecosystem services, emphasising the importance of evaluating urban biodiversity and urban community attitudes in planning these environments. This study investigated the avifaunal diversity in selected locations in the Colombo district and the attitudes of residents towards urban birds. Study sites were selected based on the level of urbanisation in different divisional secretariat divisions (DSD) (Kotte and Dehiwala DSDs as highly urbanised areas and Homagama and Padukka DSDs as moderately urbanised areas). A wetland and a woodland habitat from each DSD were sampled. Three-point transects along a single-line transect were surveyed to quantify avifauna, and a social survey was conducted among 115 inhabitants. A total of 78 bird species belonging to 42 bird families were recorded in the study areas during the study period. The species richness and diversity of birds were lower in urban than in suburban habitats. Most respondents (84.3%) observed birds in their neighbourhood, and most of them appreciated the small garden birds and water birds (93.04% and 86.95%, respectively). However, *Corvus splendens* (house crow) was noted by residents for their undesirable behaviour, such as making noisy calls and defecating on properties. Additionally, most respondents fed birds in their homes (83%), and female respondents were more involved in feeding birds compared to male respondents. Most of the respondents were interested in watching birds in their urban neighbourhood (53%) and watching documentaries about nature on television (47.8%). A relatively low percentage of residents (32.1%) reported issues with urban birds. However, 97.38% of respondents agreed with the statement, "Urban birds are important to maintain the natural balance in the city". Since birds in the neighbourhood positively contribute to the people's well-being, it is vital to use data on avifaunal diversity to plan and manage urban natural resources effectively.

**Keywords**: Resident's attitudes, Urban bird diversity, Urbanisation

***Abstract No: 107*** ***Earth and Environmental Sciences***

# PREVALENCE OF ANTIBIOTIC RESISTANCE BACTERIA ALONG THE MAHAWELI RIVER SEGMENT BETWEEN KOTAGALA AND BALAGOLLA

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The release of antibiotics into the environment promotes the selection of Antibiotic Resistant Bacteria (ARB). The objective of the study was to analyse the prevalence of ARB at water inlets and outlets of selected Water Treatment Plants (WTPs) along the Mahaweli River in wet and dry seasons. Two visits were made to 14 WTPs operated by the National Water Supply and Drainage Board along the Mahaweli River between Kotagala and Balagolla in the wet (September 2022) and dry (February 2023) seasons to collect raw and treated water. The membrane filtration technique, using 1 ml of raw water and 100 ml of treated water, was used to separate Fecal Coliforms. Each location confirmed *Escherichia coli* colonies from routine biochemical tests were subjected to Antibiotic Susceptibility Test (AST) using six antibiotics (amoxicillin, ceftazidime, tetracycline, co-trimoxazole, streptomycin and ciprofloxacin) on Mueller Hinton agar medium. Statistical software, SPSS, was used to analyse the data. *Escherichia coli* was absent in all the treated water samples. Eighty-four colonies from both seasons were tested for AST. More than half of the tested colonies (61%) were resistant to at least one antibiotic. A significant seasonal change was observed only in amoxicillin resistance, being high in the wet season (29/35, 83%) and low in the dry season (22/49, 45%) (p=0.014). There were no significant seasonal changes in antibiotic resistance among locations (p=0.410). Multi-Drug Resistance (MDR) was observed at eight WTPs. Only Nawalapitiya and Paradeka WTPs showed MDR in both seasons. The study showed that the inlet water of the WTPs in the Mahaweli River is contaminated with ARB at most locations, as indicated by *E. coli*. The point contaminations play a major role in the accumulation of ARB rather than the season. Patterns of land use and antibiotic usage may act as key factors for this observation. A study on land use data is required to strengthen these findings further.

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**Keywords**: Antibiotics, Antibiotic resistance, *E. coli,* Mahaweli River, Water Treatment Plants

***Abstract No: 118*** ***Earth and Environmental Sciences***

# PHYSICO-CHEMICAL CHARACTERISTICS OF INLET AND OUTLET WATER IN WATER TREATMENT PLANTS ALONG THE MAHAWELI RIVER BETWEEN KOTMALE AND VICTORIA RESERVOIRS

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Mahaweli River, the longest river in Sri Lanka, delivers approximately 165,392 $m^3$ of drinking water daily to the Kandy district. The network of 14 major water treatment plants (WTPs) is positioned between Kotmale and Victoria reservoirs to extract water from the river. The river is notably contaminated due to industrialisation, rapid urbanisation, agriculture, and the discharge of domestic wastewater. The present study aimed to evaluate water quality by analysing physico-chemical parameters (pH, conductivity, dissolved solids, anions, and cations) at both inlets and outlets of the 14 WTPs. During September 2022 and February 2023, 58 water samples were collected and analysed following the methods prescribed by APHA. Concentrations of anions and cations were analysed using IC and ICP/MS, respectively. The maximum and minimum values of the measured parameters at both the inlets and outlets fell within the permissible limits recommended by NEA No.47 of 1980 and SLS 614:2013 guidelines, respectively. However, statistically significant disparities between the inlet and outlet water in $NO_3^-$, $SO_4^{2-}$, $F^-$ and $Cl^-$ concentrations of two distinct seasons were observed. It was evident that the levels of pollutants, such as those originating from industrial (e.g., textile and laundry) waste discharge and agricultural and urban runoff, are more likely to escalate during the wet season. A significant variation was observed among water treatment plants within the same season due to inherent geological variations, anthropogenic activities, and diverse contaminating sources. Notably, the regions characterised by intense urbanisation between Paradeka and Balagolla exhibited higher contamination levels of anions and cations. In contrast, Nanuoya exhibited the most substantial contamination, primarily due to the effluent of Gregory Lake, Nuwara Eliya. Acquiring a comprehensive understanding of the variations in physico-chemical parameters along the Mahaweli River is vital for effective water management practices.

*Financial assistance from the University Research Council, University of Peradeniya* (*Grant No 280:2022*) *is acknowledged.*

**Keywords**: Drinking water, Kandy, Mahaweli River, Physico-chemical parameters

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

# GROSSULAR-GARNET BEARING CALC-SILICATE ROCKS FROM KAMBURUPITIYA, SOUTHERN HIGHLAND COMPLEX, SRI LANKA: IMPLICATIONS FOR PETROLOGICAL SIGNATURES

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Grossular, a Ca-garnet, is a key mineral found in calc-silicate rock in many granulite terranes, which provides important clues on P-T-fluid evolution. In Sri Lanka, grossular is mainly restricted to the southeastern, central Highland Complex (HC) and rarely found in southern and southwestern areas of HC. Here, we report the grossular bearing calc-silicate occurrence at Kamburupitiya, southern HC and its petrological signatures. Rock thin sections were prepared, and Electron Probe Microanalysis (EPMA) and documentation in Back Scattered Electron (BSE) image analysis were done during this study. Grossular occurs as either brown to reddish-brown gem quality massive coarse-grained mono-mineralic patchy or as medium-grained garnet associated with other platy minerals which form the predominant foliation of the rock. Petrologic observations and BSE images show the peak metamorphic assemblage consisting of grossular + clinopyroxene + scapolite + wollastonite ± calcite ± sphene. Grossular are highly fractured and frequently consist of scapolite + wollastonite inclusions without any breakdown reaction textures. Scapolite readily shows breakdown textures forming plagioclase + calcite + quartz symplectites via vapour absent reaction. Other minerals, including wollastonite, do not show any retrograde reaction textures; however, which are commonly recorded in other rocks in southwestern HC—mineral chemistry data of grossular shows $X_{Gr}$- 0.87 and homogeneous in composition from core to rim. The presence of a substantial amount of Fe with Cr and Mn in grossular is probably given its characteristic colour, mainly used as a gem quality hessonite. Scapolite, as well as symplectic plagioclase, are Na poor with equivalent anorthite of scapolite ~81 and anorthite content of plagioclase ~96%, which may indicate the absence of external alkali fluid infiltration as mainly recorded in calc-silicate rocks in southwestern HC during retrogression. Available phase equilibria suggest around 800 - 900 $^{o}$C at 8 kbar at the peak metamorphism. Scapolite + quartz + calcite symplectite developed at a later stage indicates isobaric cooling following peak metamorphism.

**Keywords**: Grossular, Calc-silicate rock, Southern Highland Complex, Isobaric cooling

***Abstract No: 128*** ***Earth and Environmental Sciences***

# THE ROLE OF SELECTED ABIOTIC AND BIOTIC FACTORS IN CHANGING THE ABUNDANCE OF CRITICALLY ENDANGERED, POINT ENDEMIC *PETHIA BANDULA*

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Bandula barb (*Pethia bandula*) is a critically endangered and point-endemic freshwater fish species inhabiting a stream at Galapitamada (7.15801035°N, 80.23963686°E), Sri Lanka. However, our understanding of the habitat characteristics of this species is underdeveloped. The habitat characteristics can be defined by measuring the abiotic and biotic factors, which have the potential to influence the abundance of the species. Twenty-three points, 50 m from each other, were sampled. The abundance of the fish was determined by conducting bank counts within a one-square-meter area for ten minutes. Water temperature, pH, conductivity, light intensity, fractional green canopy cover, water flow, depth and turbidity were measured. In addition, the availability of aquatic plant *Cryptocoryan* sp. was determined. Statistical analysis was performed using R statistical software. The multiple linear regression analysis revealed that the pH, light intensity, and water temperature were significantly correlated with the abundance of *P. bandula*. While pH showed a positive correlation with *P. bandula* abundance, light intensity and water temperature showed a negative correlation. Fisher's exact test indicated that there was no relationship between the availability of *Cryptocoryan* sp. and the availability of *P. bandula*. Accordingly, moderately high pH, less light intensity and low water temperature appeared to be favoured by the *P. bandula*. The study outcomes can be used for the conservation of *P. bandula* and its restricted habitat in Sri Lanka.

**Keywords:** Abiotic and Biotic factors, *Pethia bandula*, Conservation, Critically endangered**,** Point Endemic

***Abstract No: 135*** ***Earth and Environmental Sciences***

# CHARACTERISATION OF HYDROGEN PEROXIDE-INDUCED PROGRAMMED CELL DEATH IN SELECTED MICROCYSTIN PRODUCING CYANOBACTERIA: CYTOTOXIC EFFECTS ON CELLULAR MICROCYSTIN CONTENT

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Cyanobacterial blooms can undergo programmed cell death (PCD) under natural and artificial stress conditions. This study aims to reveal the effects of PCD induced by $H_2O_2$ on cyanotoxin production, cell viability, and morphology of different cyanobacteria: *Microcystis* sp., *Fischerella* sp., *Nostoc* sp., *Pseudoanabaena* sp., and *Leptolyngbya* sp. Cyanobacteria (Initial cell concentration~$1x10^8$ Cells $mL^{-1}$) were grown as batch cultures in BG11 media. The cultures were grown in four different $H_2O_2$ concentrations:10 mg $L^{-1}$,60 mg $L^{-1}$,125 mg $L^{-1}$,250 mg $L^{-1,}$ and four different exposure durations:3 hrs, 6 hrs, 9 hrs and 12 hrs. Methylthiazolyldiphenyl-tetrazolium bromide (MTT) assay was performed to analyse the cell viability by recording the absorbance at 595 nm using a microplate reader (FLUOstar Omega) and compared using $OD_{750}$ values of controls. Microcystin (MC) was analysed using High-Performance Liquid Chromatography with reference to the MC standard (SIGMA ALDRICH 33578). Treatments were observed after 24 hrs using Olympus CKX41 inverted fluorescence microscope. The cultures significantly influenced cytotoxicity at different $H_2O_2$ concentration levels ($p$<0.05). The maximum cytotoxicity was observed within *Pseudoanabaena* sp. and *Leptolygbya* sp., reducing cell viability by 75.34% and 96.19%, respectively. *Microcystis* sp. and *Fischerella* sp. had the highest intracellular MCs content: 0.982 mg $L^{-1}$ and 0.8519 mg $L^{-1}$, respectively. A positive correlation was found between average cell viability (%) and MC-LR content in cells (r=0.518, p>0.05), while a weak correlation was found between average cell viability (%) and total MC content in cells (r=0.329, p>0.05). A dose of 250 mg $L^{-1}$ $H_2O_2$ at 24 hrs caused a decrease in green colour and chlorophyll red fluorescence intensity in cells compared to the controls. The Apoptosis conditions at higher $H_2O_2$ concentrations and extended incubation periods significantly affect cyanobacteria's cytotoxicity, morphology, and MC production and increase cyanotoxin production in cyanobacterial cells. Further investigation through molecular analysis is necessary to study cyanotoxin production in the context of apoptosis.

**Key Words:** Cell viability, Cyanotoxin, Microcystin-producing cyanobacteria, Programmed cell death.

***Abstract No: 145*** ***Earth and Environmental Sciences***

# MICROPLASTIC POLLUTION IN DONDRA LAGOON, SOUTHERN COAST OF SRI LANKA: INFLUENCE ON HABITAT AND FEEDING MODES OF SELECTED FISH SPECIES

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Microplastic pollution is a leading environmental concern across the globe. Microplastics resemble plastic particles that are less than 5 mm in diameter, and primary and secondary forms pose potential impacts on biodiversity within a wide spectrum. Several studies in Sri Lanka have identified microplastic pollution in coastal ecosystems. Dondra Lagoon is a highly impacted site on the Southern coast of Sri Lanka. This study aimed to investigate the impact of microplastic pollution on this particular ecosystem. Surface water samples and bottom sediment samples were collected from thirty sampling sites within the lagoon, along with 37 fish samples for analysis. Microplastic contamination was evident in surface water and sediment samples. Moreover, microplastics were identified in selected fish, as this exposure could be closely associated with their habitats and feeding modes. Notable variation of lagoon hydrology was identified during the rainy season. Although the lagoon opening remained blocked by sand bars during the study period (July 2022), a high variation of microplastic contamination within the study area was not observed. The mean ± SEM microplastic contents ranged between 7.11 ± 1.53 and 9.83 ± 2.56 items per litre in water and between 56.25 ± 12.6 and 116.67 ± 44.9 items per kilogram in dry sediments. The highest mean ± SEM microplastic accumulation (531 ± 155 items per kilogram of body weight) was identified in *Caranx sexfasciatus* species, while the species *Heteropneustes fossilis* showed the lowest accumulation (11.07 ± 5.66 items per kilogram of body weight). The majority of the identified microplastic particles were fibres and fragments. Microplastic particles were identified in blue, green, red, white and black colours, along with some transparent fibres. A notably high impact of microplastic pollution within this ecosystem was identified, and the sources of the microplastics could be linked with fishing practices, households, and improper waste disposal around the lagoon. Hence, implementing better management strategies is of utmost importance for mitigating microplastic pollution in this ecosystem.

*Financial assistance from the FSPI-Sedric project is acknowledged.*

**Keywords**: Feeding mode, Habitat, Lagoon, Microplastic, Pollution

***Abstract No: 152*** ***Earth and Environmental Sciences***

# INVESTIGATION OF RELEASE AND DETERIORATION OF CHRYSOTILE FIBRES IN CORRUGATED ASBESTOS-CEMENT ROOFING SHEETS

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Asbestos sheets have gained popularity as roofing materials in Sri Lanka due to their affordability and durability. The objective of the research is to assess the deterioration of asbestos sheets under tropical conditions and their environmental impact. Samples were collected from Giriulla, Sri Lanka, which experiences a dry climate with slightly acidic rainfall. The collected samples of rainwater directly and rainwater that passed through the asbestos cement sheets during different rainfall events were analysed to measure total hardness and $Mg^{2+}$ concentration using the EDTA titrimetric method and atomic absorption spectrometry, respectively. The findings indicated that the $Mg^{2+}$ concentration in the surface runoff water collected from the roof was higher than that of the direct rainwater in two rainfall events. In another rainfall event, the $Mg^{2+}$ concentration was almost equal in both types of samples. This suggests that the asbestos cement sheets contribute to an increased presence of $Mg^{2+}$ in the runoff water from the roof. The rainwater collected from the surface runoff of the asbestos sheet roofing contained an average of $(6.62 \pm 0.14) \times 10^4$ fibres per square meter per litre. These fibres were observed to have lengths ranging from 40µm to a few millimetres. It is inferred that the dispersal of these fibres into the surrounding areas is facilitated by rain and wind. The optical microscopic imagery of the surface of asbestos sheets also revealed that fibres can be easily removed from the surface of asbestos sheets. The current study suggests that fibrous materials can easily detach from the cement matrix of degraded asbestos sheets upon contact with rainwater and subsequently be released into the environment. These fibres are particularly susceptible to inhalation, which can lead to severe health issues. Applying a sealer as a preventive measure can be recommended to mitigate the deterioration of asbestos sheets.

*Financial assistance from Grant No NRC AB 19-004 is acknowledged.*

**Keywords**: Asbestos-cement sheets, Chrysotile fibres, Total hardness

***Abstract No: 159*** ***Earth and Environmental Sciences***

# QUALITY OF DRINKING WATER SOURCES AND POSSIBLE HEALTH IMPACTS ON THE COMMUNITY IN WILGAMUWA AREA

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Communities residing in the lowland dry zone regions of Sri Lanka have been distressed by distinct health issues that are believed to be environmentally induced. Chronic Kidney Disease with unknown origin (CKDu), Dental and Skeletal Fluorosis are the most common environmental health issues reported so far in the dry zone in Sri Lanka. This study investigates the temporal variation of groundwater and surface water quality in the semi-arid region of Central province - Wilgamuwa, a well-known CKDu hotspot. Groundwater wells (n = 77) and reservoir water (n=5) were selected for monitoring. Samples were analysed for their major anions ($Cl^-$, $F^-$, $HCO_3^-$, $NO_3^-$, $SO_4^{2-}$, $PO_4^{3-}$), cations (Na, K, Ca, Mg, Si), and trace elements. The mean pH and total alkalinity in groundwater were 6.58 and 178 mg/L, respectively. Sixty-five percent of groundwater samples were categorised as hard and very hard water, with a mean of 171 mg/L. Comparatively, elevated $Si^{4+}$ levels were observed. Most trace elements (e.g., As, Cd, Pb) levels were within the acceptable limits of Sri Lankan standards for drinking water. Further, the mean fluoride content in groundwater samples was 0.67 mg/L, which exceeds the permissible level imposed by the World Health Organization (WHO) for drinking water in tropical countries stipulating the vulnerability for dental fluorosis. Reservoirs also showed higher nitrate and phosphate levels than well waters, possibly implying fertiliser application in agricultural fields. The calculated Water Quality Index (WQI) showed that 26% of groundwater samples were of poor quality, indicating possible implications for community health.

*Financial assistance from National Institute of Health, USA is acknowledged.*

**Keywords**: Chronic Kidney Disease in unknown origin, Dry zone, Water Quality

***Abstract No: 164*** ***Earth and Environmental Sciences***

# AIR QUALITY TRENDS AND PATTERNS IN KANDY, SRI LANKA

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Air pollution is one of the leading environmental hazards that causes devastating health effects on human health. Identifying air pollution trends and patterns in a particular geographic area is essential for controlling air pollution. Monitoring air pollution in most low- and middle-income countries using standard air pollution monitoring networks is not affordable. In this study, we aimed to investigate the variations in the mean concentrations of $PM_{2.5}$ that occur at various times of the day, days of the week, and months of the year in Kandy, Sri Lanka, using small sensors. A regression analysis with dummy variables was used to model the relationship between the concentrations of $PM_{2.5}$ and categorical independent variables like the time of day and day of the week. One year of data was obtained from a calibrated real-time small, low-cost air quality sensor called "KOALA" installed at the National Institute of Fundamental Studies, Kandy, for the temporal variation. The study results showed that, for temporal variations, the morning and evening are the times with the most pollution, while the afternoon has the least pollution. The regression analysis model revealed significant hourly variations ($p < 0.05$) in $PM_{2.5}$, with the highest levels observed at 07:00 (coefficient = 13.70), followed by a decrease at 14:00 (coefficient = -1.97), and an increase at 18:00 (coefficient = 9.74) compared to reference hour (00:00). Air quality from Wednesday to Thursday is the worst, while Sundays exhibited the lowest air pollution, obviously due to reduced human activities. The monthly variation showed that December had the cleanest air, while $PM_{2.5}$ were significantly higher (34.87 µg $m^{-3}$) in March 2019. The variation in $PM_{2.5}$ was greatly influenced by wind speed, wind direction, and rainfall patterns. These findings highlighted the significance of maintaining strict air pollution management and monitoring regimens.

*Financial assistance from National Science Foundation (No: RG/2019/BS/01) is acknowledged.*

**Keywords**: Air quality, Low-cost sensors, $PM_{2.5,}$ Trends and patterns

***Abstract No: 165*** ***Earth and Environmental Science***

# DOES SHELF LIFE AFFECT THE LEVEL OF MICROPLASTICS IN BOTTLED WATER

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Microplastics (MPs) have been detected worldwide in freshwater systems and drinking water. This longitudinal study examined the effect of the shelf-life of bottled water on MP levels and their properties over time. Bottled water samples were purchased from the market in the Kandy District and were stored at room temperature with ambient light conditions for 3, 6, and 12 months. Water was then filtered through a 0.45µm membrane filter to separate MPs. The membrane filter was examined and enumerated under the stereomicroscope at 40X 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. Of the 44 bottles analysed, 43 (98%) had MPs, which were mostly found as fibres, followed by films and fragments. About half of the MPs were transparent; others were blue, pink, black, brown, purple and yellow. Twelve types of polymers and sizes ranging from 5 – 5,000µm were identified. There was no difference in the concentration of MPs in bottled water with different storage durations (Two-way ANOVA; $f = 14.54$; $p > 0.05$). However, the number of MPs significantly decreased with the storage time, from a range of 2–28, 2–20 and 5–12 MPs/L in bottles kept for 3, 6, and 12 months, respectively. The results showed that although the shelf life did not increase the amount of microplastics in bottled water, they may break into smaller nanoplastics during longer storage, which has to be further investigated.

*Financial assistance from National Science Foundation (Grant No. NSF/SCH/2019/04) is acknowledged*

**Keywords**: Bottled drinking water, FTIR, Microplastic, Plastic ingestion

***Abstract No: 172*** ***Earth and Environmental Sciences***

# FISH ASSEMBLAGE STRUCTURE AND ASSOCIATED ENVIRONMENTAL FACTORS OF RAWAN-OYA TRIBUTARY OF MAHAWELI RIVER

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Local assemblages of organisms in aquatic ecosystems are associated with environmental factors that determine water quality. This study assessed the fish assemblage structure along the Rawan-Oya Tributary of the Mahaweli River and its association with physicochemical properties and faecal indicator bacteria (FIB) levels. Study sites represented forested, agricultural, rural, semi-urban and urban areas along the river. Within the sites, habitat types were defined as run, riffle, and pool. Fish species were sampled from February 2020 to May 2022, covering wet and dry seasons and identified *in situ*. Physicochemical parameters and FIB were assessed with standard protocols. Fish Species Richness (S) and the Shannon Diversity Index (*H'*) were calculated using R statistical software. A canonical correlation analysis identified the relationship between fish assemblage structure and water quality parameters. Twenty fish species belonging to 17 genera and 11 families were recorded. The family Cyprinidae was the most dominant, followed by Poeciliidae and Danionidae. Fish species *Dawkinsia singhala, Garra ceylonensis* and *Schistura notostigma* are endemic to Sri Lanka. The characteristics of the habitat strongly influenced the fish assemblage structure. The species richness (S) and diversity (*H'*) in pool, run, and riffle habitats were reported as 19, 19, and 5 and 2.5, 2.3 and 1.5, respectively. There was no difference in fish diversity and richness between dry and wet seasons (GLM; $p > 0.05$). *Schistura notostigma* was the most influential species at high altitudes (canonical coefficient = 3.7) and was associated with high dissolved-oxygen content, low levels of nutrients and FIB levels. *Poecilia reticulata*, and *Devario malabaricus* were common in sites with high biological oxygen demand, electrical conductivity, high faecal and nutrient pollution and demonstrated high tolerability towards the reduced water quality conditions. The fish assemblage structure of the tributary exhibited relationships with the habitat characteristics and the water quality parameters.

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

**Keywords:** Abundance, Diversity, Freshwater fish, Richness, Water quality

***Abstract No: 174*** ***Earth and Environmental Sciences***

# A WEB-BASED LANDSLIDE RISK DISSEMINATION PORTAL INCORPORATING BAYESIAN PROBABILISTIC RISK PREDICTION MECHANISM ON LANDSLIDE CAUSATIVE PARAMETERS

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Landslides severely threaten the environment, human life, and infrastructure in hilly regions worldwide. Accurate prediction and identification of landslides are crucial for effective risk management. This study utilises Bayesian probabilities and machine learning techniques with geospatial data analysis to develop a reliable model for landslide identification in Ratnapura district in Sri Lanka, known for its high landslide risk. The study utilised data sources, including SAR images, rainfall data, slope data, aspect data, and land use data, and processed the collected data. Processed parametric data were integrated into a Bayesian probabilistic model. The landslide risk map was created using these probabilistic values to classify the study area into different risk levels. The validation of the Bayesian probabilistic model using data from the NASA Landslide Inventory Catalogue confirms its accurate prediction of risk levels for landslide-occurred locations and known low-risk areas, demonstrating its effectiveness in assessing landslide risk. A machine learning model has been successfully implemented to establish a relationship between rainfall data and geospatial landslide risk, producing an output that accurately reflects their connection. The model demonstrated exceptional performance, achieving a training set accuracy of over 98% and a perfect 100% accuracy on the test set. The developed model was integrated into a user-friendly web application that government agencies and the general public can use to identify high-risk landslide areas. This tool can potentially improve landslide risk management practices in hilly regions worldwide by providing valuable information to stakeholders and decision-makers so they can make informed decisions regarding risk management and emergency response measures. The findings of this research were disseminated through a real-time GIS web application, which facilitated the dissemination of information regarding high-risk areas for landslides to minimise the devastating impact of landslides on communities and infrastructure.

**Keywords**: Bayesian probability, GIS Web application, InSAR, Landslides, Machine learning

***Abstract No: 189*** ***Earth and Environmental Sciences***

# A COMPARISON OF BIRD DIVERSITY BETWEEN THE CORE AREA AND THE BUFFER ZONE OF BODHINAGALA FOREST RESERVE, SOUTHWESTERN SRI LANKA

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Bodhinagala Forest Reserve (BRF) is located in Dhombagaskanda, Ingiriya, within the Kalutara District of south-western Sri Lanka. Based on the floristic composition and structure, it can be defined as a lowland rainforest surrounded by well-wooded home gardens of Bhodinagala village. A rich avifauna has been documented by previous studies conducted in BRF. A thirty-month-long avifaunal survey was conducted from October 2020 to April 2023 using a visual encounter survey with bird calls, and point counts were conducted along a 2,500 m long line transect with 150 m gaps between consecutive points. Birds surveys were conducted between 0600 h and 1000 h, 1400 h and 1800 h. Bird diversity was measured using Shannon (H′) and Simpson's (1-D) diversity indices. A total of 314 birds consisting of 82 species belonging to 19 orders and 46 families were recorded in both transects. The Shannon Index and Simpson's Index, respectively, for the core forest area were 3.91 and 0.97, and for the buffer zone, were 3.96 and 0.97. Thirteen endemic bird species were recorded, such as Sri Lanka Swallow (*Cecropis hyperythra*), Red-backed Flameback (*Dinopium psarodes*), Sri Lanka Junglefowl (*Gallus lafayettii*), Green-billed Coucal (*Centropus chlororhynchos*) and Sri Lanka Gray Hornbill (*Ocyceros gingalensis*), while migrant birds such as Barn Swallow (*Hirundo rustica*), Blue-tailed Bee-eater (*Merops philippinus*), and Asian Brown Flycatcher (*Muscicapa dauurica*) were also documented during the study. Species such as Malabar trogon (Harpactes fasciatus), Black-backed Dwarf-Kingfisher (Ceyx erithaca) and Black-naped Monarch (Hypothymis azurea) are uncommon in the lowland wet zone, were frequently observed. Both areas of the forest reserve and buffer zone showed equally high bird diversity. This study identified a rich avifaunal diversity that has not been extensively studied in this reserve. We recommend conducting comprehensive biodiversity surveys to identify potential threats and develop conservation strategies for both the species and their habitats.

**Keywords**: Bird Diversity, Bodhinagala Forest Reserve, Buffer Zone, Comparison, Core Area

# ICT, Mathematics, and Statistics

***Abstract No: 2*** ***ICT, Mathematics, and Statistics***

# ASSESSING AGREEMENT BETWEEN TWO MEASUREMENT SYSTEMS USING REPLICATED SCALE MIXTURES OF SKEW-NORMAL MEASUREMENT ERROR MODELS WITH VARYING DEGREES OF FREEDOM

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Method comparison studies are commonly conducted in health fields to evaluate the interchangeability of a new method for measuring a continuous variable with an established reference method. The agreement between two methods that measure the same variable but are prone to measurement errors is often evaluated by measurement error models, which are assumed to be normal. However, normality may not hold when dealing with skewed and heavy-tailed data. To address this issue, a replicated measurement error model (RMEM) is proposed for analysing replicated method comparison data with different levels of heaviness in the tails of true covariates and errors under scale mixtures of skew-normal (SMSN) distributions. The model, which includes skew-$t$ (ST), skew generalized-$t$ (SGT), and skew-slash (SS) distributions, is called generalised scale mixtures of skew-normal RMEM (GSMSN-RMEM). The proposed methodology is evaluated through a simulation study using root mean square error measures for sample sizes of $n$ = 50, 100, and 200, and the expectation conditional maximisation approach is applied to fit the model. The simulation results indicate that ST and SGT distributions outperform the skew-normal distribution, possibly due to their heavy-tailed characteristics. Furthermore, the methodology is demonstrated by analysing systolic blood pressure data, and model selection is employed using the Akaike information criterion and Bayesian information criterion. The agreement between methods is assessed using the unconditional probability of agreement, and it is found to be higher for SGT (nearly 0.95) and ST (nearly 0.90) distributions compared to other distributions. The study demonstrates that the proposed method, GSMSN-RMEM under ST and SGT distributions, is an effective tool for evaluating the agreement between two measurement systems when dealing with measurement errors and skewed and heavy-tailed data. This method can be applied in various fields, such as biomedical engineering, clinical research, and medical imaging.

**Keywords**: Assessing agreement, Expectation conditional maximisation, Heavy-tailed distributions, Probability of agreement, Replicated measurement error models.

***Abstract No: 12*** ***ICT, Mathematics, and Statistics***

# A MEMETIC ALGORITHM FOR THE VEHICLE ROUTING PROBLEM WITH MOVING SHIPMENTS AT THE CROSS-DOCKING WAREHOUSE

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Cross-docking (CD), a relatively new technique, is considered an efficient technique to control the inventory flow in logistics. CD can reduce delivery lead times, inventory holding, and transportation costs. This research extends the study on vehicle routing problem with moving shipments at the cross-docking center (VRPCD&MS). The objectives of this study are to obtain near-optimal solutions to the large-scale instances of the VRPCD&MS model using a meta-heuristic algorithm known as the Memetic Algorithm (MA) and compare the performance of MA with the Genetic Algorithm (GA). In this study, MA is hybridised with GA, with an *insertion local search* method. The *elitism method* to choose the best members from the previous population to the next is also considered to structure the proposed MA approach. The tournament selection, order crossover and swap mutation are applied as the operators of the GA. The data for the numerical experiments are extracted from a benchmark problem in the literature. At the preliminary analysis, some parameters of MA, such as population size, number of iterations, termination count, crossover rate, and mutation rate, are tuned by the *Taguchi* method, and the appropriate parameter values are 50, 100, 100, 0.7, and 0.3, respectively. The computational results show that better solutions are found for VRPCD&MS by the MA approach than GA. In all the instances, even the average solutions found by MA are better than the best solutions found by the GA approach. Also, it was observed from the convergence analysis that the MA approach can reach the solution in fewer iterations than the GA approach. Therefore, it can be concluded that MA is capable of providing more accurate solutions than GA, whose average percentage improvement is nearly 6%. Moreover, it can be concluded that the MA approach converges to a better near-optimal solution faster than the GA approach.

**Keywords**: Cross-docking, Memetic algorithm, Moving Shipments, Vehicle routing

***Abstract No: 25*** ***ICT, Mathematics, and Statistics***

# ENSEMBLE LEARNING APPROACH FOR YOUTUBE VIDEO CLASSIFICATION BASED ON THEIR VIDEO CONTENT

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Many individuals use the platform YouTube to share videos with others worldwide. Different content and quality videos are available on the YouTube platform, and it would be beneficial to users if they could assess the content of the video before selecting a video to view. However, deciding and making predictions directly is difficult since different attributes need to be considered. This study is carried out to classify videos using six individual distinct machine learning algorithms and an ensemble learning algorithm as a solution to the above. The algorithms were selected based on the literature review. The gathered data set underwent essential pre-processing and attribute ranking. View count, like count, comment count, number of subscribers, tag count, and total views were identified as the main contributors to the study. For classification, Naive Bayes, Logistic Regression, Support Vector Machine (SVM), Decision Tree, Multilayer Perception (MLP), Random Forest individual algorithms, and Ensemble Learning algorithm that combined five individual algorithms were selected since those algorithms work effectively and efficiently with better results. Among the ensemble learning algorithm techniques, majority voting exhibits the best accuracy. For categorisation, the result was evaluated by 60% training data and 40% testing data. In each method, different parameters were changed for the evaluation and accuracy, recall, f-measure, precision, Root Mean Square Error, and Mean Absolute Error were taken into account. Random Forest demonstrated 96.89% accuracy, and Ensemble Learning showed 97.21% better accuracy than others. These findings indicate that this strategy is appropriate for YouTube content classification. It offers the information required to evaluate video content and make predictions about particular videos. Future research would focus on applying more deep learning algorithms to improve accuracy.

**Keywords**: Classification, Machine Learning, Video Content, YouTube

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

# ON $h$-FUNCTION OF A BOUNDED SIMPLY CONNECTED REGION: DISC WITH DELETED DOUBLE SLITS

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The $h$-function or harmonic-measure distribution function for a region $\Omega$ with a specific fixed point $z_0$ in $\Omega$, gives some information about the shape of the region. For a region $\Omega$ with a basepoint $z_0$, we identify the set $E_r$, which is the intersection of the boundary of $\Omega$ and the closed disc of radius $r$ centred at $z_0$. The $h$-function $h(r)$ is given by the harmonic measure of the set $E_r$ in $\Omega$ at $z_0$. This function $h(r)$ only takes the values in the unit interval $[0,1]$, but $h(r)$ will take the value one only for the regions with bounded boundaries. This study is focused on the behaviour of the $h$-function(s) of a bounded simply connected regions $\Omega$ formed by deleting double slits from the unit disc centred at the origin when both slits lie on the real axis and vary in length. Three cases are considered: keep the size of both slits the same; keep the length of one of two slits as the radius of the disc; keep the length of one of two slits as it is bigger than the radius of the disc. For these regions $\Omega$, the $h$-function will take the value 1 after some values of $r$. That is, the $h$-function $h(r)$ meets the line $y = 1$ at an angle $\psi$, subtended at the line $y = 1$ with the graph of $h(r)$ in the counterclockwise direction. We check how this angle $\psi$ changes for the above three cases when the basepoint $z_0$ lies anywhere in between both slits inside the disc. For the first and third cases, when the basepoint $z_0$ moves between two slits from left to right along the real axis, the angle $\psi$ increases from zero for a while and attains its maximum and then decreases to zero. In the first case, the maximum of the angle $\psi$ has been attained at $\pi/2$. For the second case, when the basepoint $z_0$ moves between the two slits from left to right along the real line, the angle $\psi$ decreases from $\pi/2$ to zero. These findings indicate that the $h$-function of these bounded regions $\Omega$ has interesting behaviour at the point $r^*$ which is the furthest distance between the base point and the boundary of the region. Future research will focus on checking the behaviour at the same point $r^*$, when the basepoint varies along the imaginary axis within these regions $\Omega$.

**Keywords**: Bounded region, $h$-function, Harmonic-measure, Simply connected region

***Abstract No: 44*** ***ICT, Mathematics, and Statistics***

# DECISION TREE ALGORITHMS TO DETERMINE GCE ORDINARY-LEVEL STUDENT PERFORMANCE FACTORS INFLUENCING ENGLISH AS A SUBJECT

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The General Certificate of Education Ordinary Level (GCE O/L) Examination is a milestone in the Sri Lankan Education system. The GCE O/L results are used to screen students for selecting subjects for the Advanced Level Examination. Students' learning strength depends on many factors, such as environmental, mental, and physical factors. Since these factors directly affect the student's learning ability, it is crucial for educators to identify the most important factors among these. Randomly selected student data were used in this study. The questionnaire consisted of questions that were assumed to affect the outcome of the English subject result. Seventy-two Grade 12 students answered the questionnaire. Various decision tree algorithms were used for the classification. J48, LMT and Random Tree were used to build the classification models using WEKA, and their accuracies were compared. During the study, English writing reading ability, family help and contribution of tuition classes showed an association with the student grades. After the model creation, J48, LMT and Random Tree obtained 51%, 47% and 55% accuracy, respectively. The decision tree model with the highest accuracy was then considered, and the decision tree classification rules were converted manually into If-Else statements. Random Tree obtained the highest accuracy. Using the classification rules generated by the Random Tree model, the performance factors related to English as a subject were identified.

**Keywords**: Decision Tree, J48, LMT, WEKA

***Abstract No: 47*** ***ICT, Mathematics, and Statistics***

# COMPARISON OF THE PREDICTIVE PERFORMANCE OF LIU-BASED ESTIMATORS.

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Logistic regression is one of the most widely used statistical methods for predicting a binary outcome by analysing the relationship between one or more existing independent variables. Although the maximum likelihood estimation technique is a commonly used method to estimate the parameters, their predictive performances may be affected by a problem called multicollinearity. To reduce the effect of multicollinearity, different biased estimators have been proposed as alternatives to the Maximum Likelihood Estimator (MLE). According to the literature, the superiority of the existing estimators based on Liu estimators was examined using the Mean Square Error Matrix (MSEM) and Scalar Mean Square Error (SMSE) criteria. However, the researchers did not compare the prediction performance of these existing estimators. Therefore, the present study is aimed to compare the prediction performance of Liu-based estimators in logistic regression using balanced accuracy. The prediction performance of the Maximum Likelihood Estimator (MLE), Logistic Liu Estimator (LLE), Almost Unbiased Liu Logistic Estimator (AULLE), and Modified Almost Unbiased Logistic Liu Estimator (MAULLE) are considered for comparison. To evaluate the balanced accuracy of the above estimators, the dataset was split into two so that 70% belongs to the training set and 30% to the test set. The model was trained using the training set, then the testing set was used to evaluate the balanced accuracy. A Monte Carlo simulation study was done to understand the prediction accuracy by setting different levels of correlation among the predictors and sample sizes. Further, a myopia real-world dataset was utilised, and it was observed that the related results tally with the results of the simulation study. Finally, it was noticed that the estimator MAULLE has the best prediction performance when multicollinearity is present, and then LLE performs well. Additionally, the prediction performance of AULLE was significantly better for some selected values of shrinkage parameters. However, the MLE performs well with small sample sizes.

**Keywords**: Balanced accuracy, Logistic regression, Multicollinearity, Prediction performance.

***Abstract No: 53*** ***ICT, Mathematics, and Statistics***

# EXPLICIT FINITE DIFFERENCE METHOD FOR THE VALUATION OF AMERICAN PUT OPTION WITH DIVIDENDS USING LOGARITHMIC FRONT FIXING TRANSFORMATION

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The most traded options are American options due to their early exercise features. An American option is a type of financial derivative contract that gives the holder (buyer) the right, but not the obligation, to buy (call option) or sell (put option) an underlying asset at a pre-specified time before the expiration date of the option. However, pricing American options has an intriguing problem. The early exercise behaviour makes the American option pricing problem become a free boundary problem. Logarithmic front fixing transformation is a class of transformation used to transform the American free boundary problem into a fixed boundary problem. Numerical methods are used to solve the transformed fixed boundary problem. The effects of dividend payments on American put option pricing valuation were studied, and the explicit finite difference method was used to obtain the numerical solution. Dividends can significantly impact the price of an underlying asset and, consequently, the pricing of American options. When a company pays a dividend, it reduces the value of the stock because the cash is transferred to the shareholders. For put options, which give the holder the right to sell the underlying asset, dividends can increase the option's value because the holder is protected from the drop in stock price caused by the dividend payment. The inclusion of dividends guarantees stability by the numerical experiments, and numerical results confirm that increase in the American put option price and the optimal exercise price. Thus, dividend yields early exercise of the American put option less likely.

**Keywords**: American put option, Finite difference method, Front fixing transformation, Optimal exercise boundary

***Abstract No: 59*** ***ICT, Mathematics, and Statistics***

# FUZZY INFERENCE SYSTEM TO IDENTIFY DISASTER RISK LEVELS IN SRI LANKA

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Various uncontrollable factors influence natural disasters. Natural events, for instance, floods, occur during periods of extreme rainfall and can pose significant challenges and risks to Sri Lanka's agricultural sector. They threaten crop production and overall food security in the country. It is crucial to identify potential flood and drought threats related to rainfall to mitigate these risks. The Standardised Precipitation Index (SPI) is used to measure rainfall, but it alone cannot determine the risk levels for floods and droughts because it lacks clear definitions for prolonged periods and disaster thresholds. In this study, we have developed a fuzzy expert system that assesses the impact of rainfall fluctuations, as measured by the SPI, on the Disaster Risk Level (DRL) while considering uncertainty through fuzzy membership functions. This decision support system is a single-input, single-output model, with the SPI as the input variable and DRL as the output variable. Linguistic terms like Extremely Dry, Dry, Moderate, Wet, and Extremely Wet are used to describe SPI categories, while No Disaster, Disaster, and High Disaster are used for DRL. We calibrated this fuzzy expert rule-based system using historical records of floods and droughts in 1983, 2003, 2011, 2016, 2017, and 2020. The resulting fuzzy inference-based decision support system, which evaluates DRL based on SPI data, offers a practical and valuable solution for proactive disaster management and preparedness.

**Keywords**: Disaster risk level, Droughts, Floods, Fuzzy rule-based system, SPI.

***Abstract No: 73*** ***ICT, Mathematics, and Statistics***

# MANUFACTURERS AND BUYERS INTEGRATED PRODUCTION INVENTORY MODEL WITH BETTER SYNCHRONISATION

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Coordinating inventory between multiple manufacturers and buyers is a common practice in the current economic environment. It gives several advantages for both manufacturers and buyers. In the literature, more studies focused on single manufacturer and single/multi buyer(s) integrated production inventory models with various factors. However, limited studies have investigated multi-manufacturer and multi-buyer scenarios. This study investigates multi-manufacturer and multi-buyer integrated production inventory systems. Here, we assume manufacturers produce a homogeneous product and deliver a lot just after its production. Moreover, manufacturers supply their products to all buyers to satisfy buyers' demands. A multi-manufacturer and multi-buyer integrated production inventory model was developed by considering realistic factors and a combination of equal and/or unequal size batch transferring policies. It is assumed that batch sizes follow geometric series whose common ratio is less than 1—subsequently, an optimal solution technique to the proposed model was derived to obtain minimal total cost. Finally, a real-world problem is used to illustrate the analytical findings of the study.

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**Keywords**: Equal and/or unequal batch size, Integrated production inventory, Multi-buyer, Multi-manufacturer

***Abstract No: 80*** ***ICT, Mathematics, and Statistics***

# THE ROLE OF BILINGUALISM IN THE REVIVAL OF A DEAD LANGUAGE: MANX IN ISLE OF MAN

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The survival of many languages in the modern world is at risk due to the quick pace of globalisation and the dominance of a few languages. To explain language dynamics in the context of the aforementioned problem, the academic community has used mathematical models. In particular, the literature has attempted to explain the disappearance of languages like Manx, Celtic, Gaelic, Welsh, and Quechua by focusing on how more advantageous languages draw people and decrease the number of speakers of less advantageous languages. This study focuses on the decline and subsequent revival of the Manx language on the Isle of Man, which was introduced by Irish raiders around AD 500. Historical accounts suggest that the shift from Manx to bilingualism occurred by the early 19th century, and the transition from Manx to English primarily took place throughout the 19th century, with a significant acceleration towards the end of the 19th and beginning of the 20th century. The death of the last native Manx speaker was reported in 1974, causing the extinction of the informal transmission ways of the Manx language. However, efforts were made to revive the language in schools and educational institutions, leading to Manx being categorised as a revitalised language. To understand this scenario, the study employs a three-dimensional language model proposed in a previous work that incorporates the concept of bilingualism in a well-mixed bilingual society. The model was tested on the real-world data of the population fractions speaking Manx from 1901 to 1974. The results suggested that a 'hidden' bilingual minority (speaking both Manx and English) must have persisted despite the declared extinction of Manx in 1974, possibly due to the stigma attached to speaking the language. This bilingual minority may have contributed to the recent revival of Manx.

**Keywords**: Differential equations, Language competition, Language death, Manx, Revitalised language

***Abstract No: 85*** ***ICT, Mathematics and Statistics***

# A NEW METHOD USING THE GEOMETRIC MEAN TO SOLVE TETRAD FUZZY TRANSPORTATION PROBLEMS

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Globally, the transportation problem is employed in the concrete obstacles. A transportation problem is crucial for the production business, where optimisation techniques are functional for solving multi-objective problems and network flow analysis. However, in real-world problems, Fuzzy Transportation problems (FTP) are accurate and widely used in engineering applications and fields such as Operation Research, management science, and control theory. The main goal of this research is to determine the lowest transportation cost of moving certain goods through a capacitated network where supply and demand for nodes, as well as the capacity of edges, are represented as tetrad (trapezoidal) fuzzy numbers. The ranking method is one of the most common methods for solving fuzzy transportation problems (FTP). Instead of using the ranking method to get the best solution to the FTP, a new method is proposed using geometric means to solve a tetrad FTP, where demand and supply are all represented as tetrad fuzzy integers. This approach is easy to understand and applicable to real-life transportation problems.

**Keywords**: Fuzzy Transportation Problem, Geometric Mean, Initial Feasible Solution, Tetrad Fuzzy Transportation Problem.

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

# GENERALISED LAMBDA DISTRIBUTION-BASED QUANTILE REGRESSION MODEL TO ANALYSE THE EXCHANGE RATE MOVEMENTS IN SRI LANKA

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Exchange rates play an important role in currency trading in the financial market. Hence, this study examines the relationship and forecasts close price values of USD, EURO and GBP against LKR using the previous day's low, high and open price values, lags of close price and moving average values. This is the first study that implements quantile regression (QR) incorporating Generalised Lambda distribution (GLD) to model exchange rates due to the non-normal behaviour of the residuals with the presence of heteroscedasticity in Sri Lanka. Daily data was collected from the Yahoo Finance website from 1st January 2008 to 28th February 2022. The current daily close price of exchange rates was modelled using the previous day's low, high and open price values, lags of close price observed in the Autocorrelation function (ACF) plot and moving average (MA) values of MA7, MA14, MA28, MA84, MA168 representing the moving average values for one week, two weeks, one month, one quarter and six months respectively. For heteroscedastic data, QR models were obtained by Case I) fixing the intercept or Case II) allowing all the coefficients to vary using the Nelder-Mead simplex algorithm. The Cramer-Von Mises and Anderson-Darling tests were used to evaluate whether the residuals follow a GLD in the GLD-based QR models. Further, the goodness of fit of these QR models was evaluated using Pseudo-$R^2$. This study considered upper, median, and lower quantiles in fitting the QR models. The forecasted accuracy of the QR models was evaluated using mean absolute error (MAE) and mean absolute percentage error (MAPE). It is found that the effects of the input variables on the close price of the exchange rate at different quantiles are different. The minimum MAE and MAPE of 1.3246 and 0.00587 were observed for the 50th QR model with a Pseudo-$R^2$ value of 0.4432 in EURO/LKR, for USD/LKR minimum error values (MAE of 1.1369 and MAPE of 0.0057) were observed under Case I in 50th QR model with Pseudo-$R^2$ of 0.7541. Similarly, for GBP/LKR, the better-performed model was under Case I in the 10th QR model (MAE of 1.2253 and MAPE of 0.0045) with Pseudo-$R^2$ of 0.9255. Overall, this study indicates that QR models can emphasise the complete conditional distribution of the response variable at different quantiles.

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**Keywords**: Exchange Rates, Generalised Lambda Distribution, Heteroscedasticity, Nelder-Mead, Quantile Regression

***Abstract No: 110*** ***ICT, Mathematics, and Statistics***

# COMBINING FASTTEXT EMBEDDINGS WITH NEURAL NETWORKS FOR SHORT TEXT CLASSIFICATION

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Using embedding representation is a critical step to improve the classification accuracy of a text dataset. Even though Bag of Word (BOW) models are used with past research work, usage of word2vec, Glove and FastText as embedding techniques helps to represent the features of text documents in a distributed manner, hence improving the accuracy of such models. The latest research work used a combination of embedding techniques and enhanced neural network models to improve the classification accuracy of text documents. FastText as an embedding unsupervised model and CNN, LSTM, and RNN as neural models were used extensively in the latest research work. However, comprehensive analysis with FastText and neural models with text documents has not been undertaken thus far. As a result, it is hard to compare the existing research work, and it is unclear which combination of neural model with FastText performs well over the other techniques. Therefore, it is necessary to investigate the impact of neural networks when the features were represented with the FastText embedding model. A famous movie review dataset was used for the experiment. CNN, LSTM, RNN, NN, and variations of those neural networks were used as neural networks. Hold out stratified Training and testing set was taken with 70 % to 30% split. Seventy per cent of training data was split as 80% of training and 20% of validation set. We compare classification accuracy across a range of neural network models, and our results show that the RNN model outperforms other neural network models with FastText embeddings with 86% accuracy. Moreover, out of various neural networks, the combination CNN-LSTM outperforms all other neural network models with 88% accuracy. The outcomes of this study can be a baseline for future research.

**Keywords**: Classification, CNN, FastText, LSTM, RNN

***Abstract No: 140*** ***ICT, Mathematics, and Statistics***

# CONVERGENCE OF THE FINITE DIFFERENCE METHOD FOR AN AGE-STRUCTURED TWO-SEX POPULATION DYNAMICS MODEL OF THALASSEMIA TRANSMISSION

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Thalassemia is an inherited blood disorder that affects the production of haemoglobin and red blood cells. Symptoms include anaemia, jaundice, chest pain, and breathing problems. It is an autosomal recessive disorder, meaning both parents must have the disease or be carriers for it to be passed down to the next generation. Thalassemia is native to a wide but restricted geographical area. Nevertheless, migration is spreading to formerly unaffected areas. Consequently, tracking and forecasting disease prevalence is important for effective healthcare planning. Structured models are essential for studying multicellular organism populations and hereditary diseases in which age and sex play a role. The previously published work established and analysed a two-sex age-structured continuous type population dynamics model for thalassemia transmission that describes the genotype composition of the population resulting from the thalassemia trait and is based on the Fredrickson-Hoppensteadt model, which is a system of semi-linear partial differential equations with nonlocal boundary conditions. To make projections about a population, we must generate numbers from them to compare with data. The model's answer must then be approximated using numerical methods. The objective of this research is to present a numerical algorithm for approximating the solution of the model and to demonstrate that this method converges ideally to the exact answer. The Crank-Nicolson form of the finite difference method of characteristics, combined with the trapezoidal rule for the quadrature of the integrals that describe births and densities of married individuals of each sex, is developed to approximate the solutions of the model. The optimal rate of convergence of the numerical method is discussed to the maximum norm. The work presented here can potentially be beneficial in both mathematical and biological contexts.

**Keywords:** Age structured, Finite difference, Numerical methods, Thalassemia, Two sex

***Abstract No: 146*** ***ICT, Mathematics, and Statistics***

# AN ANALYSIS OF SELECTED VARIABLES INFLUENCING CESAREAN SECTION OF PREGNANT MOTHERS ADMITTED TO THE AMPARA GENERAL HOSPITAL

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Improving cesarean section as a procedure of safety with notably low fetal and maternal mortality rates is one of the most crucial developments in modern perinatal. Most of the local population in the Ampara region predominantly rely on agriculture and fishing; therefore, there may be some gaps in understanding of child safety. Hence, studying the most influencing factors for caesareans is vital to both medical professionals and the local population. Here, the study reported the most influential factors causing Caesareans in the Ampara region using a Binary logistic regression model from secondary data of 224 observations. The results indicated that the emergency cesarean birth patients were in the 20-29 age group. While fatal distress, lack of progress, and dribbling variables had a positive influence, mother's age negatively influenced emergency cesarean section. The patients aged 20-29 were 1.0902 more likely to develop emergency cesarean section than other age groups (Odds ratio = 0.9173); patients with fatal distress were more likely to develop emergency cesarean birth than the patients without fatal distress (Odds ratio = 26.9746), patients with a lack of progress had more risk to develop emergency cesarean birth than the patients without lack of progress (Odds ratio= 32.5027), and the patients with dribbling of emergency cesarean had the more risk to develop emergency cesarean birth (Odds ratio = 13.2761). Delivery by cesarean birth is a difficult health issue and costly. Efforts should be initiated at Ampara General Hospital to reduce cesarean sections. This study concluded that the mother's age, fetal distress, lack of progress, and dribbling were significant predictors of cesarean birth and, therefore, must be considered when addressing the reduction of cesarean rates in Ampara General Hospital.

**Key words**: Binary logistic regression, Cesarean sections, Non-obstetric factors, Obstetric factors, Odds ratio

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

# TIME SERIES ANALYSIS FOR MODELING AND FORECASTING TEA EXPORTS IN SRI LANKA

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Tea is the most popular and low-cost beverage in the world, next only to water and the most consumed manufactured drink in the world made from the young leaves and unopened leaf buds of the evergreen shrub *Camellia sinensis*. There are many tea-growing countries worldwide, and Sri Lanka is the fourth largest tea-growing country and the third largest tea exporter to the world market. The tea industry plays a significant role in the Sri Lankan economy regarding foreign exchange earnings, providing employment opportunities and being the main source of government revenue. Therefore, it is vital to predict future fluctuations in tea exports, which affect the country's economy. This study attempted to identify appropriate ARIMA models to forecast tea exports in Sri Lanka by export quantity and export value. Twelve variables namely, Bulk Quantity, Packet Quantity, Bags Quantity, Instant Quantity, Green Tea Quantity, Total Quantity, Bulk Value, Packet Value, Bags Value, Instant Value, Green Tea Value and Total Value were accounted for the study. Initially, it was found that all the data were non-stationary by using the Kwiatkowski Phillips Schmidt Shin (KPSS) test. Therefore, the first differencing was applied, and the stationarity of the data was confirmed. The univariate time series analysis was applied for each variable, and models with the lowest Akaike Information Criterion (AIC) and Bayesian information criterion (BIC) values were used to select the best-fitted models. The Seasonal ARIMA (SARIMA) models were fitted to forecast Bulk Quantity, Packet Quantity, Bags Quantity, Green Tea Quantity and Total Quantity. The ARIMA models were fitted to forecast Instant Quantity, Bulk Value, Packet Value, Bags Value, Instant Value, Green Tea Value and Total Value. It was found that the models fitted to forecast Instant Quantity and Instant Value have Mean Absolute Percentage Error (MAPE) higher than 50%, which indicates the lower predictive ability of the models, while all the other fitted models showed MAPE below 25%, which were relatively better suited to predict the variables.

**Keywords**: ARIMA Models, Forecasting, Kwiatkowski Phillips Schmidt Shin test, Mean Absolute Percentage Error, SARIMA models

***Abstract No: 168*** ***ICT, Mathematics, and Statistics***

# CLASSIFICATION OF SINHALA NEWS USING MACHINE LEARNING APPROACHES

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With the advent of internet technology, the popularity of Sinhala text-based news portals has witnessed a significant escalation. To aid users in efficiently locating news articles relevant to their interests, this study introduces a systematic approach for classifying Sinhala news headlines, leveraging machine learning methodologies. The system curates a dataset of 25,400 news articles from Sinhala news websites, meticulously labelled for training and evaluation purposes. It explores various text embedding techniques, including term frequency-inverse document frequency, Word2Vec, and FastText, while employing classification algorithms such as support vector machines, Naive Bayes, Logistic Regression with multi-class classification, and long short-term memory (LSTM) networks. The experimental outcomes underscore that the most effective combination for classifying Sinhala news headlines is the integration of FastText and LSTM, achieving an impressive accuracy rate of 93.8% for news headlines alone and 95.8% when applied to a mixed dataset encompassing both news headlines and news content. Furthermore, the LSTM classifier demonstrates its ability to capture long-term dependencies within the text, a crucial factor in ensuring the precise classification of Sinhala news headlines. This research highlights that the LSTM + FastText combination yields superior accuracy in classifying Sinhala news, thus making it a noteworthy approach for this purpose.

**Keywords**: FastText, Logistic regression**,** Text embedding

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

# ASYMPTOTIC DYNAMICS OF A PERIODIC TOXIN-PRODUCING PHYTOPLANKTON MODEL

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Harmful algal blooms (HABs) caused by Toxin-Producing Phytoplankton (TPP) have become increasingly common worldwide. Understanding the complex interactions between TPP and other organisms in the ecosystem is crucial. This study focuses on asymptotic dynamics of the plankton interaction between TPP and zooplankton, with an additional mortality factor accounting for zooplankton ingestion of TPP. One of the proposed models assumes constant toxin production by TPP, and the populations being studied are distributed uniformly throughout the space. This assumption results in an autonomous system of ordinary differential equations. To incorporate natural day and night, tidal, or seasonal cycles, the model is extended to a periodic system by including the toxin liberation rate $\gamma$ as a periodic function of the form $\gamma(t) = \gamma(1 + Aq(t))$, where $A$ represents the magnitude of the periodicity, and $q(t)$ is a $\tau$ −periodic function with $\tau > 0$. The study examines the existence of steady states and trivial periodic solutions and analyses the stability of both models. Moreover, using the concept of uniform persistence, we derive sufficient conditions for the coexistence of the periodic system based on the model parameters. The findings of this study demonstrate that increasing the avoidance of TPP by zooplankton enhances the coexistence of plankton populations in both the constant and periodic toxin production systems. The study also discusses Hopf bifurcations in the constant toxin-producing model, providing insights into the system's dynamic behaviour. Numerical simulations are performed to validate the analytical findings of proposed models and their implications.

**Keywords**: Harmful algal blooms, Periodic systems, Toxin-Producing Phytoplankton, Uniformly persistence, Zooplankton

***Abstract No: 185*** ***ICT, Mathematics, and Statistics***

# MODELING THE IMAGE QUALITY ON THE RETINA WITH VARIABILITY OF WAVEFRONT MEASUREMENTS

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Ocular aberrations have been used to describe vision defects caused by refractive errors and measured by aberrometers. In clinical care, these measurements are directly used for wavefront-guided corrections. However, as a single measurement can lead to ambiguous conclusions, multiple measurements are collected from the patient in each sitting. Repeated measurements can induce variations in the readings, potentially resulting in correction errors. In the literature, several studies have therefore been carried out to investigate the importance of variability induced by all sources, and these studies concluded that change in the magnitude of the expansion coefficients of the ocular aberrations is statistically significant. This study aims to provide a more comprehensive and quantitative analysis of the impact of variability in wavefront measurements on retinal image quality (IQ) using the Structural similarity index metric (SSIM), which distinguishes the present study from prior research. For this purpose, as the significance of variations relies on the signal, the variability change is replaced using the signal-to-noise ratio (SNR). In addition, normally distributed small random numbers with different magnitudes have been added to the data sets in such a way that SNR is altered from 24.7876 dB to 70 dB. The SSIM values for each noised data set were calculated using the test images used in image processing. It was observed that the variability reduces the detail of edges in the image. Further, SSIM values against SNR were altered, and a similar pattern was followed for all test images. Particularly, SSIM values were fluctuated up to a certain value of SNR, which is 32.0539 dB for the image of Lena (512×512 pixels). Subsequently, SSIM values gradually increased with SNR and became steady. In this region, the SSIM and SNR were modelled using Gaussian terms up to three with 99.99% accuracy, which can be utilised as a tool to describe IQ on the retina against the variations of measurements.

**Keywords:** Signal-to-noise ratio, Structural similarity index metric**,** Variability, Vision defects

***Abstract No: 188*** ***ICT, Mathematics, and Statistics***

# AN APPLICATION OF GRAPH THEORY IN ASYMMETRIC KEY CRYPTOGRAPHY

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The development of digital communication in many facets of our everyday lives significantly impacts the evolving world we live in today. The rapid growth and evolution of digital communication have become the backbone of how we interact with other people. Therefore, it is imperative to protect information and data from unauthorised activities, such as accessing, using, exposing, damaging, modifying, copying, or deleting them. Safeguarding data from these invalid operations is crucial to ensure its integrity, confidentiality, and availability. Cryptography plays a pivotal role in ensuring the security and privacy of information in various contexts, such as online banking, e-commerce transactions, and communication between governments, military organisations, and businesses. Various types of mathematical techniques are available for application in modern cryptology. The application of graph theory is widely utilised in the field of cryptography due to its straightforward representation in computers as a matrix. In this study, we propose a novel asymmetric key cryptography scheme for secure message transmission using graph theory and matrices. The proposed scheme consists of four algorithms. The key generation algorithm on the receiver side is based on the properties of matrices, which enables us to establish the relationship between private key and public key through matrix operations. On the sender-side graph generation algorithm, a graph theory approach is applied to encrypt the original message, and the message is converted into a splitting graph and its minimum spanning tree. Then, the sender-side encryption algorithm is used to generate a complex final ciphertext using the receiver's public key. The decryption algorithm follows the same process in reverse order, employing the receiver's private key. This system will provide better security while storing data in the financial retail industry and sharing passwords in transactions.

**Keywords:** Asymmetric Cryptography, Cipher text, Cryptography, Decryption, Encryption

***Abstract No: 191*** ***ICT, Mathematics, and Statistics***

# A MATHEMATICAL MODEL FOR THE SPREAD OF COVID-19 IN SRI LANKA WITH THE ENVIRONMENTAL TRANSMISSION OF CORONAVIRUS

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COVID-19 is caused by a new strain of coronavirus called the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2). COVID-19 is mainly transmitted to humans by direct contact with respiratory droplets emitted by COVID-19-infected persons (human-to-human/ direct transmissions). Also, the coronavirus can survive on outside surfaces; hence, COVID-19 can be transmitted by contacting the virus that survived in the environment (environmental-to-human/ environmental transmission). Vaccination programmes are among the most important strategies to prevent and control the COVID-19 pandemic. In this study, a compartmental model was developed to describe the spread of COVID-19 by dividing the population into Susceptible without vaccination ($S(t)$), Vaccinated ($V(t)$), Exposed who are vaccinated ($E_v(t)$), Exposed who are not vaccinated ($E(t)$), Asymptomatic infectious ($I_A(t)$), Symptomatic infectious ($I_S(t)$), Recovered ($R(t)$), and Dead due to disease ($D(t)$) groups. Both direct and environmental transmission of the disease was considered with the threshold level of coronavirus to result in an infection. The transmission rate from susceptible to exposed ($\beta$) is estimated using numerical methods to best fit the simulated result to the available data considering the daily reported new cases of COVID-19 in Sri Lanka when there is no ongoing vaccination programme. The simulation results were compared with the daily reported new cases of COVID-19 in Sri Lanka, when there is an ongoing vaccination programme. These results will be used in further studies to identify the optimal vaccination strategies that can be used to prevent future outbreaks.

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**Keywords:** COVID-19, Environmental transmission, Threshold level of SARS-CoV-2, Vaccination programme

***Abstract No: 193*** ***ICT, Mathematics, and Statistics***

# CHARACTERISATION OF A CLASS OF INNER TORAL POLYNOMIALS VIA BLASCHKE PRODUCTS

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A polynomial $p \in C[z,w]$ is said to have bidegree $(n,m)$ if $p$ has degree $n$ in $z$ and $m$ in $w$. Given a polynomial $p \in C[z,w]$ of bidegree $(n,m)$, the reflection of $p$ at the bidegree $(n,m)$ is defined to be the polynomial $\tilde{p}$ given by $\tilde{p}(z,w) = z^n w^m p(\frac{1}{z}, \frac{1}{w})$. Further, $p$ is called essentially $T^2$ −symmetric if $p(z,w) = c\tilde{p}(z,w)$ for some unimodular constant $c$, and $T^2$ −symmetric if $p(z,w) = \tilde{p}(z,w)$. A polynomial $p \in C(z,w)$ is called an inner toral polynomial if the zero set $Z(p) \subseteq D^2 \cup T^2 \cup E^2, where\ D$ is the open unit disk, $T$ is the unit circle and $E$ is the exterior of the closed unit disk. It had been proven that inner toral polynomials must be essentially $T^2$ −symmetric. A finite Blaschke product is a function of the form $B(z) = \zeta \prod_{k=1}^{n'} \left(\frac{z-a_k}{1-a_k z}\right)^{m_k}$ where $\zeta \in T,\ a_k \in D$, and $m_k$ is the multiplicity of the zero $a_k,\ for\ 1 \le k \le n'$. If $B(z)$ is a finite Blaschke product, then the numerator of $w^m - B(z)$ is an inner toral polynomial, where $m \in N$. We call such polynomials inner toral polynomials generated by Blaschke products. In this work, we prove the converse of this result for a special class of inner toral polynomials. That is if a polynomial of the form $q(z)w^m - \alpha r(z)$ where $\alpha \in \mathbb{C}\backslash\{0\},\ m \in N$ and $r(z)$ and $q(z)$ are relatively prime polynomials in $z$ with the same degree and no repeated zeros, is inner toral, then the rational function $\alpha\frac{r(z)}{q(z)}$ is a finite Blaschke product. In conclusion, a polynomial of the form $q(z)w^m - \alpha r(z)$ with the additional condition as above is inner toral if and only if it is generated by a finite Blaschke product.

**Keywords:** Distinguished varieties, Finite Blaschke products, Inner toral polynomials

***Abstract No: 203*** ***ICT, Mathematics, and Statistics***

# RELATIONSHIP BETWEEN THE KAUFFMAN BRACKET POLYNOMIALS OF TORUS KNOTS: $(T_{3,3n+1})$ AND $(T_{3,3n+2})$

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Knot theory is a branch of topology that studies mathematical knots. New knot invariants were the foundation for the work of many mathematicians. A knot invariant is a property $\alpha$ for a knot $K$, where $\alpha$ is the same for any projection of $K$. A knot polynomial is one such knot invariant. Knot polynomials are polynomials that are assigned to knot projections based on the mathematical properties of the knots. This study is restricted to polynomials of torus knots, knots that lie on an unknotted torus, without crossing over or under themselves as they lie on the torus. Every torus knot is a $(p,q)$-torus knot, where $p$ and $q$ are two relatively prime integers that are represented by the symbol $T_{p,q}$. Most of the research done on this particular area of Knot Theory, has focused on finding polynomial representations such as Kauffman Bracket polynomial, the Bracket polynomial for the $(2,q)$-torus knot and polynomial representations such as Alexander polynomial, Conway polynomial and Jones polynomial for the $(p,q)$-torus knot. With the exception of the complete solution to the Alexander, Conway, and Jones polynomials of $T_{p,q}$, the problem of determining the polynomial for $T_{2,q}$ is almost solved. The study is an attempt to solve the computation problem for the Kaufmann Bracket Polynomial of $T_{p,q}$. The work will provide a relationship between Kauffman Bracket polynomials of the torus knots' $(T_{3,3n+2})$ and $(T_{3,3n+1})$ for $n \in N$.

**Keywords:** Knot invariants, Knot polynomials, Skein relations, Torus knots

***Abstract No: 204*** ***ICT, Mathematics, and Statistics***

# MAXIMAL EMBEDDING GENUS OF 3-EDGE CONNECTED HARARY GRAPHS

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One of the most prominent problems of topological graph theory is to determine the type of surface a nonplanar graph can be embedded. Almost complete results have been obtained for 4-edge connected graphs. The methods that were used to obtain specific results (finding the maximum and minimum genus embedding) for 4-edge connected graphs do not generalise for 3-edge connected graphs. Graph embedding is an important representational technique that aims to maintain the structure of a graph while learning low-dimensional representations of its vertices. The aim of this research project was to study the embedding of 3-edge connected Harary graphs $H_{3,n}$. Specifically to complete the problem of maximal embeddings of 3-edge connected Harary graphs. The result is proved using Jungerman's study, which showed that for any graph $G$, $G$ is upper-embeddable if and only if it has a spanning tree $T$ such that $G \setminus T$ has at most one component with an odd number of edges. More specifically, a spanning tree for each graph was observed by dividing all 3-edge connected Harary graphs into two groups: odd number of vertices and even number of vertices. The pattern of a set of deleting edges and corresponding spanning trees was generalised in both cases. It was proved that $H_{3,n}$ is upper-embeddable, and the maximum genus of $H_{3,n}$ is given by $\gamma_M\left(H_{3,n}\right) = \lfloor\frac{(2+n)}{4}\rfloor$ for each $n$, by analysing the odd components of the complement of the corresponding spanning trees.

**Keywords:** 3-Edge connected graphs, Harary graph, Spanning tree, Upper-embeddability

***Abstract No: 205*** ***ICT, Mathematics, and Statistics***

# THE RAINBOW CONNECTION NUMBER OF THE EXTENDED VERSION OF THE SANDAT GRAPH

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Graph colouring is a fundamental problem in Graph Theory, with applications varying over diverse domains related to real-world applications such as channel assignment in cellular networks, scheduling and task assignment, and register allocation in computer optimisation. Graph colouring is a special case of graph labelling with assigning colours to edges or vertices of a graph. Assigning colours to each edge in a graph so that no two adjacent edges have the same colour with a given optimal number of colours is the edge colouring of a graph. In an edge-coloured graph, if there is a path with no two edges having the same colour, then that path is called a rainbow path. If every pair of vertices in a graph is connected by at least one rainbow path, then that graph is called a rainbow-connected graph. The minimum number of colours used in a rainbow-connected graph is the rainbow connection number $rc(G)$ of that graph. The Sandat graph on $3n+1$ vertices, denoted by $St(n)$, is a graph with the vertex set $V(St(n)) = \{r, s_{ij}, t_i | 1 \leq i \leq n \; and \; 1 \leq j \leq 2\}$ and the edge set $E\big(St(n)\big) = \big\{rt_i, rs_{ij}, s_{ij}t_i \; | 1 \leq i \leq n \; and \; 1 \leq j \leq 2\big\}$. In this study, an extended version of the Sandat graph $SSt_m(n)$ having $n$ number of petals was obtained using the symmetrical subdivisions of having $2(2+m); m \in \{1,2,3,\dots\}$ vertices for each petal and with the vertex set $V(SSt_m(n))$ and the edge set $E(SSt_m(n))$ denoted by $V\big(SSt_m(n)\big) = \{r, s_{ij}^h, t_i ; 1 \leq i \leq n, 1 \leq j \leq 2 \; , 1 \leq h \leq m+1\}$ and $E\big(SSt_m(n)\big) = \{rt_i, rs_{ij}^h, t_i s_{ij}^1, s_{ij}^k s_{ij}^{k+1} \; ; \; 1 \leq i \leq n, 1 \leq j \leq 2, 1 \leq h \leq m+1, 1 \leq k \leq m\}$. The rainbow connection number of the extended version of the Sandat graph $SSt_m(n)$ having $n$ number of petals is three when $n \geq 2$ was proved. Future study plans to introduce the non-symmetric extended version of the Sandat graph and the rainbow colouring of that graph.

**Keywords:** Edge colouring, Rainbow colouring, Rainbow connection number, Sandat graph

# Life Sciences

***Abstract No: 04*** ***Life Sciences***

# DISTRIBUTION OF THE CRITICALLY ENDANGERED *AXIS PORCINUS* (HOG DEER) (ZIMMERMANN, 1780) IN GALLE DISTRICT, SRI LANKA

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*Axis porcinus* is the rarest deer among the four deer species in Sri Lanka, which is listed as Critically Endangered (CR) according to the 2012 National Red List of Sri Lanka. It has been subjected to few studies and neglected by the ecologists. Thus, the present study intends to investigate the current distribution within the Galle District. A standard questionnaire survey was conducted from December 2021 to December 2022, interviewing more than 500 residents in the Galle, and additional data were collected from the Hiyare Biodiversity Education and Research Center. Indirect signs of *A. porcinus*, including the presence of crop damages, antler rubbings, nesting sites, pug marks, dung piles, casted antlers, and carcasses, were also recorded during the study. A total of 175 locations indicate the distribution of *A. porcinus*. The confirmation was done after triangulating all the collected data. The distribution of *A. porcinus* was restricted to a small area (~255 $Km^2$) in the Galle District bordering to Bentota River from the north, the Gin River from the south, a one to two km inland coastal lines from the west, and the southern highway from the east. They were not recorded in urban areas, including busy towns. Moreover, their distribution is restricted to human-altered lands, *viz*., home gardens, secondary forests, cinnamon, paddy, tea, and oil palm. Since they are present in human-altered lands, they face several threats, including hunting for meat, electrocution due to crop damage, road accidents, habitat destruction, and fragmentation. Hence, appropriate conservation measures must be implemented to ensure the long-term survival of *A. porcinus* in Sri Lanka.

**Keywords**: *Axis porcinus*, Critically endangered, Distribution, Galle District

***Abstract No: 05*** ***Life Sciences***

# ETHNOBOTANY OF MEDICINAL PLANTS IN TREATING DIABETES MELLITUS AMONG INDIGENOUS MEDICAL PRACTITIONERS IN JAFFNA, SRI LANKA

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Diabetes mellitus (DM) is a non-communicable metabolic disease which is caused due to inappropriate elevation of blood glucose levels due to the impairment of insulin synthesis or utilization. The usage of medicinal plants for managing DM differs according to geographical and cultural differences. Ethnobotany is essential to preserve the knowledge of medicinal plants and to discover new chemical entities for treating diseases. Therefore, this study aims to describe the ethnobotany of medicinal plants used in treating DM among indigenous medical practitioners (IMP) in the Jaffna district, Sri Lanka. A cross-sectional descriptive study was conducted among all 31 registered IMPs in the Jaffna Divisional Secretariat (DS). The data was collected using a validated and structured interviewer-administered questionnaire. Descriptive statistics were used to generate the summary of the data gathered. Family Important Value (FIV) indicates the value of a biological plant taxon, whereas Related Frequency Citation (RFC) means the citing percentage of informants for every species. FIV and RFC were calculated to quantitatively determine the common consent between the informants on using endemic medicinal plants in the DS district. The response rate was 87%. A total of 72 species belonging to 47 families have been reported by the 27 respondents from the Jaffna DS. Among them, *Syzygium cumini* (16) was stated as the species with the highest RFC value (0.59), and Myrtaceae (24) was the most dominant family with an FIV value of 88.88. Among the reported medicinal plants 33.3% were trees, while 33.3%, 23.6%, 8.3% and 1.4% were shrubs, vines, grasses, and runners, respectively. Leaf (31.63%) was the most used part for the herbal preparations. The survey also indicated that the powdered form (77.58%) was the most preferred form among the preparations. These findings facilitate the documentation and conservation of medicinal plants used for DM by the IMP in the Jaffna DS, Sri Lanka, and allow the phytochemical screening and identification of antidiabetic active compounds.

**Keywords**: Diabetes mellitus, Ethnobotany, Indigenous medicine practitioners, Jaffna divisional secretariat

***Abstract No: 10*** ***Life Sciences***

# CUTICLE THICKNESS OF LARVAE OF PYRETHROID RESISTANT *CULEX QUINQUEFASCIATUS* MOSQUITOES IN SRI LANKA

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Metabolic resistance and target site insensitivity are primary insecticide resistance mechanisms in *Culex quinquefasciatus* vectors. Cuticle thickness of the larval stages of these mosquitoes is another crucial factor that affects resistance development and, thereby, the control of mosquito vectors. In this study, we investigated the association between the thickness of the cuticle and the resistance developed to deltamethrin in larvae of *Cx. quinquefasciatus* mosquitoes. Early fourth-instar larvae of *Cx. quinquefasciatus* obtained from field-collected eggs were exposed to four different concentrations of deltamethrin, giving mortality between 0-100% (0.0025$mgL^{-1}$, 0.00375$mgL^{-1}$, 0.005$mgL^{-1}$, 0.00625$mgL^{-1}$, 0.0075$mgL^{-1}$). A total of one-hundred larvae were exposed to each concentration in four replicates. Control was conducted for each replicate with dechlorinated water and ethanol. Mortalities were reported after 24-hour exposure period. Using standard protocols, six dead and six live larvae from each concentration were processed for microtomy. Sixty sections were prepared, and microscopic images were taken using the image processing microscopic system (*ZEN-2012*). The average cuticle thickness of each individual was taken by measuring eight points from each image, and the ratio between the thickness and the diameter was calculated to obtain the cuticle thickness index—values of $LD_{50}$ and $LD_{90}$, calculated using log-probit mortality curves for fourth instar larvae of *Cx. quinquefasciatus* were $0.003 mgL^{-1}$ and $0.012\ mgL^{-1}$ respectively. A significant difference in the thickness indices was observed between the susceptible and resistant larvae of each concentration (DF=9, F=16.419, P<0.001). The minimum indices of the survivors were 0.0149, 0.0172, 0.022, 0.0323, and 0.0447, respectively, for each concentration, while the maximum obtained for susceptible were 0.0144, 0.0167, 0.0206, 0.0299, and 0.0402, respectively. The Pearson correlation analysis revealed a significantly positive relationship between the concentration and thickness difference of the cuticle of susceptible and resistant individuals (r=0.937, P=0.019). The results of the study evident the presence of a cuticular resistance mechanism in pyrethroid-resistant *Cx. quinquefasciatus* larvae.

**Keywords**: *Culex quinquefasciatus,* Deltamethrin, LD50, LD90, Microtome section

***Abstract No: 11*** ***Life Sciences***

# MOSQUITOCIDAL POTENTIAL OF ETHANOLIC *ALLIUM SATIVUM* (GARLIC) EXTRACTS AGAINST *AEDES* AND *CULEX* MOSQUITO LARVAE IN SRI LANKA

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In Sri Lanka, mosquito-borne diseases are causing significant mortality, morbidity and economic impediments. Botanical extracts are sustainable and eco-friendly alternatives to synthetic insecticides in controlling mosquito vectors. This study assesses the larvicidal potential of ethanolic garlic extract against mosquito genera *Aedes* and *Culex* from Sri Lanka. The efficacy of garlic was determined by exposing ten late 3rd to early 4th instar *Aedes* and *Culex* larvae to six predetermined concentrations of ethanolic garlic extract (250 ppm-5 ppm) for 72 hours. The experiment was replicated four times with controls, and daily mortalities were recorded. Lethal concentrations needed to kill 50% ($LC_{50}$) and 90% ($LC_{90}$) of larvae exposed to 24 h, 48 h and 72 h were obtained by regression analysis. A qualitative phytochemical analysis was conducted to screen the presence of phytochemicals in the ethanolic garlic extract. A positive correlation between the garlic concentration and percentage of mortalities was observed at each exposure period for both *Aedes* (24 h: r=0.956; 48 h: r=0.819; 72 h; r= 0.706) and *Culex* (24 h: r=0.711; 48 h; r=0.592; 72 h: r= 0.557). The $LC_{50}$ values obtained for 24 h, 48 h and 72 h for *Aedes* larvae were 45.5 ppm, 28.0 ppm and 14.4 ppm, respectively, and the corresponding $LC_{90}$ values were 140.0 ppm, 91.0 ppm and 42.9 ppm. Corresponding $LC_{50}$ values for 24 h, 48 h and 72 h exposure of *Culex* larvae to the treatments were 26.3 ppm, 9.4 ppm and 4.4 ppm, while the respective $LC_{90}$ values were 169.8 ppm, 30.7 ppm and 17.6 ppm. Phytochemical analysis revealed the presence of flavonoids, saponins and reducing sugar in the garlic ethanolic extract even after 12 months of extraction. Less than 50 ppm $LC_{50}$ values evident the high toxicity of the garlic extract against mosquito larvae. The results of this study, therefore, suggest the use of garlic extracts in developing a larvicide against vector mosquitoes.

**Keywords:** *Aedes*, *Culex*, Garlic extract, Larvicidal, Lethal concentrations, Phytochemical analysis

***Abstract No: 15*** ***Life Sciences***

# EVALUATION OF TOXICITY OF AQUEOUS EXTRACT OF *HEMIDESMUS INDICUS* R. BR. (*IRAMUSU*) USING BRINE SHRIMP ASSAY

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*Hemidesmus indicus* R. Br. [*Iramusu*], belongs to the family Apocynaceae and is used in various ayurvedic preparations in Sri Lanka. Even though the medicinal value of the plant has been extensively studied, the toxicity of the plant remains unknown. Therefore, it is vital to identify the toxicity for dosage determination of formulations. This study aimed to identify the minimum toxic concentration of the crude extract of *H. indicus* using a brine shrimp assay. Using the maceration technique, the air-dried plant material was powdered and extracted into distilled water in a 1:3 ratio. The dilution series was prepared with two-fold dilution, 1g of bark aqueous extract powder dissolved in 4 ml of distilled water, starting from 1g $mL^{-1}$ to 2 $\times 10^{-3}$ g $mL^{-1}$ concentration and observed the ability to kill a cultured larva (nauplii). Ten larvae were exposed to plant extract for 24 hours, the number of live larvae was observed using the naked eye, and the mortality percentage and $LC_{50}$ were calculated using GraphPad Prism 9.5.1 software according to a log concentration and percentage mortality graph and compared with Meyer's or Clarkson's toxicity scale (if $LC_{50}$ < 1000 µg/ml considered as toxic, if $LC_{50}$ > 1000µg/ml considered as non-toxic). The study was triplicated. The highest mortality percentage (100%) was observed among $63\times10^{-3}$ g $mL^{-1}$ - 1g $mL^{-1}$. The resulting $LC_{50}$ was = 0.0482 g $mL^{-1}$ (48,200 µg/mL) for the aqueous extract. The results confirmed that the plant extract has not shown toxic properties according to Meyer's or Clarkson's toxicity scale. In conclusion, the concentration range from 1g $mL^{-1}$ to 2 $\times 10^{-3}$ g $mL^{-1}$ has not shown any significant toxicological activities with regards to the toxicity scale; the minimum toxic concentration of *H. indicus* in the brine shrimp assay is 0.0482 g $mL^{-1}$ (48,200 µg/mL). Therefore, it is recommended to determine further by an activity-guided fractionation to identify less toxic, active compounds present in the plant extract. However, "*Iramusu*' is a safe Ayurvedic preparation according to the results of the toxicity assay conducted (according to Meyer's or Clarkson's initial threshold set < > 1000 ug/mL).

*Financial assistance from the KIU undergraduate research fund is acknowledged.*

**Keywords**: Brine shrimp assay, *Hemidesmus indicus*, Medicinal properties, Toxicity

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

# CULTURALLY RELEVANT PAIN COPING SKILLS GROUP INTERVENTION FOR CHRONIC KNEE OSTEOARTHRITIS PAIN: DELPHI CONSENSUS

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Knee osteoarthritis is a highly prevalent musculoskeletal condition associated with chronic pain in Sri Lanka. While biomedical procedures effectively address the biological aspects of chronic pain, there is a scarcity of interventions targeting its psychological dimensions. A culturally relevant pain-coping skills group intervention was developed to bridge this gap. The development of the intervention was informed by phase one of the more extensive study. A literature search was done on existing psychological interventions for chronic illnesses, pain, and psychological issues faced by patients with chronic pain. The study aimed to ensure culturally appropriate content by establishing the content and consensus validity of the newly developed intervention using Delphi consensus. A multidisciplinary expert panel consisting of clinical psychologists, a rheumatologist, a physiotherapist, and an occupational therapist was invited to review the developed intervention, worksheets, and homework assignments. The intervention sessions and worksheets were analysed for (1) usefulness in learning pain coping skills, (2) appropriateness for use with patients with pain, (3) cultural relevance for use in Sri Lanka, and (4) self-explanatory nature when used by physiotherapists and occupational therapists. Experts provided ratings and feedback using a 9-point Likert scale, where zero denoted complete disagreement and nine denoted complete agreement. The threshold for consensus was set at a minimum of 70% of the number of respondents with a level of agreement $\geq 6$ (agree or strongly agree). Statements that reached the pre-established cutoff were included in the final recommendations, while those that fell short underwent revision. In the second Delphi round, consensus ($\geq$70%) was achieved for all six sessions, and consensus-based validation was performed for the intervention. The experts' feedback refined the intervention further. In conclusion, a culturally relevant psychological intervention was developed to meet the needs of individuals with chronic knee osteoarthritis pain in Sri Lanka. A randomized controlled trial will be conducted to examine the effectiveness of this newly developed intervention.

**Keywords**: Chronic pain, Coping, Delphi consensus, Psychological intervention, Knee osteoarthritis

***Abstract No: 22*** ***Life Sciences***

# OVICIDAL AND OVIPOSITION DETERRENCE PROPERTIES OF *TABERNAEMONTANA DIVARICATA* (APOCYNACEAE) AGAINST *AEDES ALBOPICTUS* AND *CULEX QUINQUEFASCIATUS* IN SRI LANKA

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The global incidence of mosquito-borne infectious diseases has increased dramatically in recent decades due to the limitations of current vector mosquito control approaches. Plant-based insecticides are increasingly demanded to control vector mosquitoes, mainly because of their eco-friendly nature. In this study, the ovicidal and oviposition deterrent properties of *Tabernaemontana divaricata* (Crape Jasmine) leaf extracts were evaluated against two medically important vector mosquitoes: *Aedes albopictus* (dengue vector) and *Culex quinquefasciatus* (lymphatic filariasis vector). Bioactive components of the plant leaves were extracted using ethanol. Ovicidal bioassays were conducted to determine the lethal concentrations required to kill 50% and 90% ($LC_{50}$ and $LC_{90}$) of mosquito eggs. The oviposition deterrent activity of the plant was evaluated using 1% treatment solutions prepared by directly dissolving dried leaf powder in distilled water. The number of eggs laid in treatments and controls was recorded for seven days under field conditions. $LC_{50}$ and $LC_{90}$ for *Ae. albopictus* were 626.6 ppm and 892.5 ppm, respectively. For *Cx. quinquefasciatus*, the respective values of $LC_{50}$ and $LC_{90}$ were 553.2 ppm and 621.1 ppm. A strong positive correlation between egg mortality and the concentrations of treatment (*Ae. albopictus* r=0.993, p=0.001; *Cx. quinquefasciatus*, r=0.992, p=0.001) was observed. Deterrent properties were high during the first few days of the treatment (99.8% for *Ae. albopictus* and 100% for *Cx. quinquefasciatus*). A gradual reduction of the deterrent properties of the treatment was observed after the second day for *Ae. albopictus* and the fifth day for *Cx. quinquefasciatus*. The oviposition activity index (OAI) ranged from -0.97 to -0.12 for *Ae. albopictus*, while it was between -1 and -0.53 for *Cx. quinquefasciatus*. The results show that the leaf extracts of *Ta. divaricata* has great potential to be used as eco-friendly ovicides and oviposition deterrents against *Ae. albopictus* and *Cx. quinquefasciatus* mosquitoes.

**Keywords:** Bioactive compounds, Plant-based insecticides, Plant secondary metabolites, Vector mosquitoes

***Abstract No: 26*** ***Life Sciences***

# EFFECT OF PHYSICOCHEMICAL PARAMETERS OF BREEDING WATER ON FITNESS OF DENGUE VECTOR MOSQUITOES

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The quality of mosquito breeding grounds significantly affects mosquitoes' growth and fitness. The present study aimed to determine the association between characteristics of the breeding environment and the fitness of dengue vector mosquitoes. Sampling was conducted in Kandy, Matale, Anuradhapura, Rathnapura, Kegalle, and Gampaha districts. The physicochemical properties of the breeding sites were measured, and larval density was recorded. Each larval sample was separately reared under insectary conditions, and body measurements were taken upon adult emergence. Of 152 potential breeding sites, 88 were positive for the presence of *Aedes* larvae. *Aedes albopictu*s was the dominant species (93.2%), as only 6.8% of breeding sites were positive for *Aedes aegypti*. The study revealed that *Aedes* larvae can survive in a wide range of physicochemical parameters. The temperature of breeding sites ranged from 23.0–39.1 ˚C. The total dissolved solids were in a broader range (1-3000 ppm), while dissolved oxygen levels ranged from 0.38–8.81 ppm. A high density of larvae was reported at a pH ranging from 5.27 to 10.42. Larvae could tolerate low conductivity (10 µS) to extremely high conductivity (6000 µS). Larval density ranged from 1–1885 larvae/L. A one-way ANOVA test confirmed a significant difference in wing lengths of mosquitoes from different breeding habitats (**female**: p=0.001, F=15.98, DF=19, **male**: p=0.001, F=19.82, DF=13). The Principal Component Analysis showed that 87% of the variance among variables is explained by four PCs (PC1-water temperature, total dissolved solids; PC2-dissolved oxygen, pH; PC3-larval density, pH; PC4-pH, water temperature)**.** According to correlation analysis, body size variations in mosquito populations are independent of the physicochemical parameters of the breeding water, suggesting the effect of unknown factors. A wider distribution of *Ae. albopictus* in a broader range of microhabitat conditions suggests the high tolerance and adaptability of this species.

*Financial assistance from the Multi-Disciplinary Research Grant (Grant no 136), awarded by the University of Peradeniya, is acknowledged.*

**Keywords:** *Aedes albopictus*, *Aedes aegypti*, Breeding sites, Physico-chemical parameters

***Abstract No: 33*** ***Life Sciences***

# PESTICIDAL ACTIVITY OF CRUDE SOLVENT EXTRACTS OF PODS AND LEAVES OF *PSOPHOCARPUS TETRAGONOLOBUS* (WINGED BEANS) AGAINST BLACK APHIDS

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Economically important stable food crops are frequently and heavily infested by hemipteran pests. *Aphis fabae* (black aphids) is one of the most common pests that can cause severe damage to food crops, and controlling these pests has been challenging due to their resistance to commonly used insecticides. Environmentally friendly natural pesticides are one of the best alternatives for chemical pesticides. In this study, pesticidal activity of hot water, cold water and acetone-water (1:1) crude extracts of pods and leaves of *Psophocapus tetragonolobus* (winged beans) were tested against black aphids. Stock solutions were prepared using each crude extract dissolving in distilled water, and 10000, 5000, 2000, 1000, 500, 250 and 100 ppm concentration series were prepared to investigate the level of toxicity of winged beans on black aphids. Distilled water was used for the control experiment. Percent mortalities of the exposed 25 *Aphis fabae* were observed in 6-hour time intervals until 24 hours. Three replicates were done for each concentration. Lethal dosage, which needs to kill 50% of the pest populations, was calculated using Origin software. Acetone-water extracts showed the highest toxicity, with 100% mortality at 10000 ppm for both pods and leaves of winged beans. The cold water and hot water extracts of pods of *P. tetragonolobus* also showed high toxicity. Cold water extract of leaves of *P. tetragonolobus* showed 80% to 90% respective mortalities after 12 and 24 h exposure to the 10000 ppm concentration, while 75% and 90% mortalities have resulted for hot water extract of leaves. The mortalities were positively correlated with the concentrations of the treatments and the exposure time (r =0.9414, 0.9911, 0.9811, 0.9828, 0.9391, 0.9253 for hot water, cold water and acetone-water extracts of pods and leaves of *P. tetragonolobus* respectively). The lowest $LD_{50}$ values were obtained from acetone-water extract of *P. tetragonolobus* leaves ($LD_{50}$= 162.26 ppm after 24 h exposure) followed by acetone-water extract of *P. tetragonolobus* pods ($LD_{50}$= 202.82 ppm). $LD_{50}$ values of cold water extracts of pods and leaves were 2186.86 and 1868.72 ppm, respectively. The hot water extracts of pods and leaves showed $LD_{50}$ of 1350.50 and 714.39 ppm, respectively. The results suggest the presence of pesticidal properties in the leaves and the pods of *P. tetragonolobus* for black aphids. The outcomes further suggest that the active components of acetone-water extracts are relatively stronger compared to cold water and hot water extracts.

**Keywords**: Aphids, Pesticidal activity, Pests, Plant extract, Winged bean

***Abstract No: 39*** ***Life Sciences***

# TOXICITY OF *HYLOCEREUS POLYRHIZUS* SEEDS USING BRINE SHRIMP ASSAY

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*Hylocereus polyrhizus* is grown commercially in Asian countries and belongs to the Cactaceae family. The plant has shown many medicinal properties in previous studies. Even though the medicinal value of *Hylocereus polyrhizus* has been extensively studied, no toxicity assays are related to *Hylocereus polyrhizus* seeds. The objective was to identify the minimum toxic concentration of the crude extract of *Hylocereus polyrhizus* seeds using a brine shrimp assay. The brine shrimp lethality assay of the aqueous extracts of the *Hylocereus polyrhizus* seed was used to determine the toxicity of the seed's aqueous extract. The air-dried plant material was powdered, and 36g seed powder was poured into the 108ml distilled water and extracted using the maceration technique. The dilution series was prepared with two-fold dilution, starting from $1\times10^6$ ppm to $2\times10^3$ ppm 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 $\mu gml^{-1}$ is considered toxic, if $LC_{50}$ >1,000 $\mu gml^{-1}$ is considered as non-toxic). The resulting $LC_{50}$ was = 0.0406 $gml^{-1}$ for the aqueous extract. The results confirmed that the seed extract is toxic, and the minimum toxic concentration of *Hylocereus polyrhizus* seeds in the brine shrimp assay was 0.0406 $gml^{-1}$.

**Keywords**: Brine shrimp assay, *Hylocereus polyrhizus* seeds, Toxicity

***Abstract No: 42*** ***Life Sciences***

# HIGH-QUALITY GENOME OF AUSTRALIAN FINGER LIME

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High-quality reference genomes provide a critical resource towards understanding the structural and functional basis of a genome, which can further support plant breeding. Currently, a few genomes are available for citrus with different accuracy and completeness levels. Australian finger lime (*Citrus australasica*) is a native citrus species in Australia with a high natural genetic diversity and tolerance to Huanglongbing (HLB) disease. A reference genome is not currently available for finger lime. Therefore, we have developed a high-quality, chromosome-level genome assembly for Australian finger lime to identify the genes related to disease resistance and other essential traits related to fruit quality. The genome was assembled using highly accurate PacBio HiFi long reads and Hi-C scaffolding technology and mapping against the previously published Australian wild round lime genome. The finger lime genome is diploid and heterozygous. The genome of finger lime was assembled into pseudochromosomes with high assembly contiguity and completeness (Benchmarking Universal Single-Copy Orthologs - BUSCO). Two haplotypes were assembled into chromosome levels using the Hi-C integrated Hifiasm option. The assembled genome will be structurally and functionally annotated to identify genes related to disease resistance and other essential traits in citrus. Five different accessions of finger lime have also been sequenced by Illumina short read sequencing (28X – 39X coverage of the genome) and will be compared for their genetic variation corresponding to pigmentation, volatile compounds synthesis and disease resistance. The newly assembled haplotype resolved finger lime genome will be a valuable genomic resource in understanding the genetic basis of HLB resistance and will provide an enhanced definition of evolutionary relationships with other Australian citrus species.

*Financial assistance from the National Tree Genomics program for Horticulture (Grant No AS17000) is acknowledged.*

**Keywords**: Haplotype resolved genome, Hi-C scaffolding technology, Huanglongbing (HLB) disease, PacBio Hifi long reads

***Abstract No: 43*** ***Life Sciences***

# USE OF FRACTIONS ISOLATED FROM CRUDE LYSATE OF *LEISHMANIA* IN SEROLOGY AND ANALYSIS OF CLINICAL EPIDEMIOLOGICAL DATA: A PRELIMINARY STUDY

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Cutaneous Leishmaniasis (CL) is the predominant local leishmaniasis. Established serological assays (rK 39 dipstick assay) result in a lower response, making it less specific for local patient diagnosis. This demanded a local Enzyme-Linked Immunosorbent Assay (ELISA) based on the whole cell lysate of the local parasite. However, using whole cell lysate of *Leishmania* species can result in non-specific binding with the ELISA plates, leading to unreliable results. The current study was carried out to obtain a fraction better than whole cell lysate. The *Leishmania donovani* parasites were cultured following established in-house protocols. Cell pellets were prepared from mass cultures and fractionated initially by cell lysis, freeze-thawing, vigorous agitation when required, and centrifugation to obtain F1- whole crude lysate and F2-Soluble fraction, F3-total soluble fraction, and F4-integral membrane antigens. Protein was estimation following a modified micro-Lowry procedure. ELISA was carried out following established in–house protocol for 60 serum samples (n = 30 laboratory-confirmed CL positive and 30 controls). Ethical approval (EC-14-154) was obtained from the Ethics Review Committee, University of Colombo. F1 (0.476) and F3 (0.444) reported the highest absorbance values. The clinical-epidemiological data study was carried out. Data was collected from patients recruited and analysed based on the absorbance values of the current study. The highest ELISA absorbance was reported from the Southern area from early reported lesions, less than 3 months. Early lesions were ulcerated and were 2-3 cm found in the body except the head, neck, and limb areas. Absorbance values of control samples of F1 (0.210) are higher than F3 (0.177), indicating F3, a better fraction than F1. However, this can be confirmed with further analysis of antigen profiling. The findings from the clinical epidemiological data study were compatible with the findings of previously published local studies indicating higher seropositivity for lesions identified from Northern Province with early and 2-3 cm long ulcerated lesions.

**Keywords**: Clinico-epidemiological data, Enzyme-linked immunosorbent assay, Fractionation, *Leishmania donovani*, Whole crude lysate.

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

# *IN VITRO* SCREENING OF ANTAGONISTIC ACTIVITY OF SOME BACTERIAL ISOLATES AGAINST *COLLETOTRICHUM* SP. CAUSING ANTHRACNOSE DISEASE IN TOMATO

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Tomato anthracnose is a destructive postharvest disease worldwide where the application of synthetic fungicides is the only control measure. The efficacy of seven selected bacterial antagonists in bio-control of the tomato anthracnose pathogen *Colletotrichum* sp. was evaluated in this study. Tomato anthracnose pathogen was isolated from an infected tomato fruit sample collected from a home garden in Colombo. The pathogen resembled *C. truncatum* according to phenotypic characters, and its pathogenicity on tomato fruit was confirmed through Koch's postulates. Healthy tomato rhizosphere and phyllosphere samples were used as potential sources to isolate antagonistic candidates. Extracts of rhizosphere soil samples and crushed phyllosphere samples were serially diluted to obtain bacterial isolates, and single colonies were obtained by subculturing. Twenty-four bacterial isolates underwent a two-step screening procedure: co-cultivation and dual culture plate assays. Seven different bacterial isolates coded as RA 8, RA 12, RA 17, RA 18, RA 29, PA 4, PA 12 showed significant ($p<0.05$) inhibition in the mycelial growth of *C. truncatum* and RA 8, RA 12, RA 17 and PA 4 isolates of *Bacillus* and *Pseudomonas* genera which showed highest suppression were selected for further testing of biocontrol efficacy. Spore germination of *Colletotrichum truncatum* was also suppressed up to 70 % by the selected antagonists. Morphological deviations and abnormalities in the protruding hyphae of the pathogen could be observed in the presence of the bacterial antagonists. The cellophane overlay technique indicated that all seven antagonists produced diffusible antifungal compounds against the pathogen. As the mycelial growth test revealed, hyper-parasitism and competition are also antagonistic mechanisms the selected antagonists extend. These findings direct further investigations on the *in vivo* biocontrol efficacy in mitigating the tomato anthracnose pathogen.

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**Keywords**: Anthracnose, Bacterial antagonists, Biological control, *C. truncatum*, Tomato

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

# SRI LANKAN MEDICINAL PLANTS WITH POTENT TYROSINASE INHIBITORY ACTIVITY: A PRELIMINARY REVIEW

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Various cosmetic treatments are used to decrease the concentration of melanin to achieve a reduction in the physiological pigmentation of the skin. Tyrosinase is a multifunctional copper-containing enzyme that acts as a key regulatory enzyme that influences the process of melanogenesis. Using tyrosinase inhibitors is the most demanding and reliable method for melanogenesis inhibition. According to statistics, approximately 15% of the world's population uses skin whitening products. However, many countries have banned a range of skin whitening products available in the market because of their toxicities and pose risks to human health and the environment. According to information available in Sri Lanka, many whitening creams available in the market contain dangerous levels of mercury with no warning signs. In this situation, the demand for natural or eco-friendly cosmetics has been increased. As the global demand for natural cosmetics increases, there are ample opportunities for Sri Lanka to expand its manufacturing and global exports, plant varieties, and unique traditional medical knowledge**.** Hence, this study aimed to identify the Sri Lankan medicinal plants with tyrosinase inhibitory potential for the sustainable development of the natural cosmetic industry in Sri Lanka and address the vital knowledge gaps. A comprehensive literature search was conducted through different databases, authentic Ayurveda texts, and scientific journals. Data assessments were guided by the PRISMA checklist. According to findings, 58 medicinal plants were identified with tyrosinase inhibitory action. Further, tyrosinase inhibitory action positively correlates with the total flavonoid content and free radical scavenging activities. According to the literature analysis, all collected data concluded that most of the phytoconstituents present in these medicinal plants act as potential agents in complexion improving process as significant tyrosinase inhibitors, thereby acting as modulating agents of different cellular signalling pathways on the melanogenesis pathway.

**Keywords**: Medicinal plants, Melanogenesis, Skin whitening, Tyrosinase

***Abstract No: 49*** ***Life Sciences***

# COMMUNITY AWARENESS ON CUTANEOUS LEISHMANIASIS AND IT'S VECTOR IN FIVE DISTRICTS IN SRI LANKA

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Cutaneous leishmaniasis is one of the notifiable vector-borne diseases in Sri Lanka, with increasing cases island-wide. The poor knowledge of the public on the vector (Sandfly: *Phlebotomus argentipes*) and the disease affects the success of the intervention programs. A questionnaire survey was conducted to assess public awareness about leishmaniasis and its vectors in selected districts in Sri Lanka. Six MOH areas in five districts (*i.e.,* Rambukkana and Kegalle from Kegalle District, Kadugannawa from Kandy District, Dambulla from Matale District, Kekunadura from Matara District and Kurunegala from Kurunegala District) were covered. The questionnaire gathered information about respondents' socioeconomic-demographic details, environmental observations, risk factor analysis, knowledge, and attitudes on leishmaniasis and the vector. A total of 258 respondents (27% Dambulla, 20% Kegalle, 20% Rambukkana, 20% Kadugannawa, 8% Kurunegala, and 7% Kekunadura) participated with 60% females and 40% males. Approximately 50% of the study population knew about the disease mainly via peers, healthcare workers and media (including the five people previously diagnosed with leishmaniasis). Only 16% of the respondents knew the relationship between vector sandflies and the disease. However, it was noticed that three fourth of respondents were unaware of the disease symptoms. Individuals who knew about the disease and the vector had at least primary education and were within the 35-55 age group. According to the one-way ANOVA analysis, there is a statistically significant difference in disease awareness among different age groups ($p = 0.003$, $F = 4.05$, $df = 4$). Individuals in the age group of 35-55 demonstrated a moderate level of understanding about the disease and its vector. 22% of the sample could be considered at high risk as they work outside during the peak active hours of sandflies. Out of the 75% of the population who used mosquito nets, the majority were aware that the use of mosquito nets helps to prevent the disease. Only 36% of the participants use insect repellents, while 25% do not use any protective measures. The results showed that respondents, especially those who live in areas with high disease prevalence, had less understanding of the disease and the vector, highlighting the importance of proper awareness programs about leishmaniasis.

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**Keywords**: Awareness, Leishmaniasis, Risk, Sandfly, Vector,

***Abstract No: 52*** ***Life Sciences***

# COMPARATIVE EVALUATION OF RT-PCR KITS AVAILABLE IN SRI LANKA FOR DIAGNOSIS OF SARS-CoV-2

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Identifying the gene targets by real-time reverse transcriptase PCR (RT-PCR) is considered as the gold standard in diagnosis of severe acute respiratory syndrome coronavirus 2 (SARS CoV-2) infection. Although many commercial RT-PCR kits are currently used in Sri Lanka, analytical performance of these kits have not been investigated adequately. The current study aimed to evaluate the analytical performance of five commercially available COVID-19 RT-PCR kits that have been widely used in Sri Lankan clinical settings. The evaluation was carried out, using the CDC 2019-nCoV Real-Time RT-PCR Diagnostic Panel as the standard reference. The selected kits for this study were TaqPath™ COVID-19 CE-IVD RT-PCR kit, Real Star® SARS-CoV-2 RT-PCR kit, STANDARD-M nCoV Real-Time PCR kit, COVID-19 Real-Time PCR (HBRT-COVID-19) kit, AccuPower® SARS-CoV-2 Multiplex Real-Time RT-PCR kit. SARS-Cov-2 positive (n=62) and negative respiratory samples (n=32) collected from symptomatic individuals and asymptomatic healthy individuals, respectively were used for the study. The sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and Cohen's kappa coefficient were analyzed. Based on pairwise t-test statistics, the comparison of Ct values for individual gene targets among the five commercial kits revealed heterogeneity ($p$<0.05). Discrepancies were observed between the manufacture declared value and tested values for sensitivity and specificity, while all the evaluated kits demonstrated an acceptable range of performance, with sensitivity and specificity both exceeding 90% and a near-perfect agreement value (>0.81) for the kappa coefficient. Among them, the TaqPath™ COVID-19 CE-IVD RT-PCR kit showed the highest sensitivity (98.4%), and inter-rater reliability (0.976). The Hybribio COVID-19 Real-Time PCR kit showed the lowest sensitivity (91.9%), specificity (93.7%) and inter-rater reliability (0.838). Although the five RT-PCR kits exhibited varying sensitivity, specificity, and Ct values, it can be concluded that all of them are suitable for the routine diagnosis of COVID-19 as all values are above 90 %.

**Keywords**: COVID-19 diagnosis, Ct value, SARS-CoV-2 RT-PCR, Sensitivity, Specificity

***Abstract No: 57*** ***Life Sciences***

# FIRST ATTEMPT TO DETERMINE MOLECULAR PHYLOGEOGRAPHIC AFFINITIES OF SAW-SCALED VIPER OF THE GENUS *ECHIS* (SERPENTES: VIPERIDAE) FROM SRI LANKA

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Saw-scaled viper is a member of the genus *Echis* within the Viperidae family and has a long history of taxonomic confusion. The taxonomy of the Sri Lankan *Echis carinatus* population has not been extensively studied, and this study represents the first attempt to infer the phylogenetic relationship of Sri Lankan *E. carinatus*. Sequence data from four mitochondrial gene fragments (*Cytb*, *NADH4*, *16S* and *12S* rRNA) obtained from the specimens collected from Northern Sri Lanka were compared with the same species from other localities and other species within this genus. Bayesian Inference analysis using these four mitochondrial gene fragments divided the populations of the genus into four main clades: the *E. ocellatus, E. carinatus, E. pyramidum* and *E. coloratus* clades. While *E. carinatus* is recovered as one of the monophyletic clades, the inter-relationship between the *E. carinatus* lineage and its sister group remains uncertain. Taxa within the *E. carinatus* were further divided into two groups. Samples from Sri Lanka closely clustered with populations of the species from South India, representing the subspecies of *E. carinatus carinatus*. A shallow genetic divergence between Sri Lankan and Southern Indian *E. carinatus* and the geographical connectivity strongly suggests that the Sri Lankan *E. carinatus* originated from the mainland of Southern India and, therefore, can be synonymized with *E. carinatus carinatus* existing in South India. Further molecular and morphological studies involving diverse samples from the Southern, Western and Eastern regions of India are required to delineate the geographical boundaries of the distribution of the subspecies *E. carinatus carinatus*. This information is vital for effectively choosing species-specific anti-venom to treat *E. carinatus* in the region.

*Financial assistance from the National Research Council* (*Grant No20-78) is acknowledged.*

**Keywords**: Bayesian inference, Biodiversity, Mitochondrial DNA, Molecular systematics, Reptilia

***Abstract No: 72*** ***Life Sciences***

# DETERMINATION OF GLYCAEMIC INDEX AND MARKET POTENTIAL OF COCONUT TREACLE AS AN ALTERNATIVE SWEETENER AMONG A SELECTED GROUP OF UNDERGRADUATES IN SRI LANKA

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The progressing prevalence of diabetes (8.5%) among Sri Lankans, as reported by WHO in 2015, highlights the urgent need to address the contributing dietary factors. Refined sugar, mainly used as a sweetener in Sri Lanka, is one of them. This study aimed to determine the glycaemic index (GI) and market potential of coconut treacle (CT) to assess its probability as a low GI alternative sweetener. Initially, the total sugar content was determined by the Lane-Eynon method (AOAC,2000). GI was determined by standard clinical method as three separate sessions at 3-day intervals among 30 healthy undergraduates (Age: 18-26 years, BMI: 18.5-23.5 kg/m$^2$). In session 1, following an 8-hour fasting, blood glucose level (BGL) was measured. Then, participants consumed 50 g glucose (standard) with 150 ml water. BGL was measured after 15$^{th}$, 30$^{th}$, 45$^{th}$, 60$^{th}$, 90$^{th}$, and 120$^{th}$ minutes. The same procedure was repeated with 74.9 g CT in session 2 and session 3 (duplication). A cross-sectional study through google forms was performed among 365 undergraduates examining consumers' consumption habits, preferences, knowledge and perceptions regarding CT. The total sugar content was 66.68 g per 100 g CT. The GI of CT was 53.6. Purity (57.0%), texture (17%) and taste (14%) were identified as important factors influencing purchasing decisions, and 52.6% opted for supermarket purchases. Ninety-seven percent of consumers exhibited adequate knowledge regarding the health attributes of CT, and 35.9% preferred CT for health benefits. The majority of students (74.2%) displayed a genuine interest in including CT in their diets, and 72.6% perceived that CT can replace refined sugar. The study concluded that the CT belonged to the low GI category with a moderate amount of total sugar. However, further studies are recommended to analyze the sugar profile in the CT to determine its association with GI.

*Financial assistance from KAATSU International University (KIU) and Ceylon Coconut Company (Pvt) Ltd. (CCC) is acknowledged.*

**Keywords**: Alternative sweetener, Coconut treacle, Diabetes, Glycaemic index, Market potential

***Abstract No: 74*** ***Life Sciences***

# EFFICIENCY OF ENRICHED MICROBIAL CONSORTIA FROM DIFFERENT NATURAL SOURCES ON CONSOLIDATED BIOETHANOL PROCESSING COMPARED TO SEQUENTIAL FERMENTATION

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The efficiency of enriched microbial consortia from compost, cow dung, and coir retting water to degrade lignocelluloses, i.e., rice straw, corn straw, sawdust and their potential to produce bioethanol via Sequential Fermentation (SF) and Consolidated Bioprocessing (CBP) were investigated in this study. The microbial consortia were obtained by repeated four-day enrichment culturing of compost, cow dung and coir retting water in a basal medium containing the respective alkaline pretreated (1% NaOH) lignocellulosic substrate as the only source of carbon. Pretreated lignocelluloses were incubated with the three enriched microbial consortia separately and a mixture of the three (in equal proportions). The extent of lignocellulose biodegradation (w/w) was estimated by treating the filtered residue from the culture broth with acetic acid-nitric acid reagent after 5 days of incubation. Since rice straw exhibited the highest degradations of 66.70% and 58.12% by enriched microbial mixture and compost, respectively, rice straw was used to compare SF and CBP. For the SF, the culture broths were inoculated with 1% (w/v) yeast after 5 days of incubation, and for CBP, no inoculation was done. The bioethanol content (v/v) of both SF and CBP experiments was estimated on the eighth day after the initial inoculation by solvent extraction-dichromate oxidation method following absorbance at 595 nm using a UV spectrophotometer. Statistical analysis was done by one-way ANOVA ($p<0.05$) and Tukey's pairwise comparison using Minitab version 19.2. The highest bioethanol yield of 6.85% was detected by an enriched microbial mixture on rice straw via the SF pathway, probably due to the higher saccharification. Bioethanol yields of SF by enriched coir retting water, compost, and cow dung were 2.98%, 1.96% and 0.32%, respectively. Bioethanol production was not detected in CBP by any of the enriched microbial consortia. This could be mainly due to the absence of ethanologenic microbes in the enriched microbial consortia. Further research on microbial consortia having cellulolytic and ethanologenic properties is needed to compare CBP's efficiency with SF.

**Keywords:** Bioethanol, Consolidated Bioprocessing, Lignocellulose Biodegradation, Sequential Fermentation

***Abstract No: 79*** ***Life Sciences***

# EFFECT OF PH ON THE GROWTH AND DEVELOPMENT OF IMMATURE STAGES OF DENGUE VECTOR MOSQUITOES; *AEDES ALBOPICTUS*

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Dengue has been prevalent in Sri Lanka for almost seven decades. Controlling the growth of vector mosquito larvae is still a widely researched area. pH index in breeding sites plays a significant role in the growth, development, and survival of larvae of vector mosquitoes. This study aims at identifying the effect of pH on the growth and development of *Aedes albopictus* larvae. *Aedes albopictus* larvae hatched from eggs of established colonies were used for the experiments. Ten 1st instar larvae were exposed per replicate to pH 5, 6, 7, 8, and 9 with buffer solutions of $KH_2PO_4$, $Na_2HPO_4$/ $NaH_2PO_4$ and Tris HCl, respectively (three replicates per each pH). Dechlorinated tap water was used as the control. Development, mortality rate and emergence rate were recorded daily. Further, wing lengths of emerged adult mosquitoes were measured to relate the effect of treatments on body size. Results showed that pH 7 and 8 have a higher survival rate (90%). Significantly higher mortalities were observed in pH 5 (86.6%) and 9 (66.6%) ($p<0.05$). This can be attributed to the fact that pH 7 and 8 are often seen in natural breeding conditions of vector mosquitoes. However, results indicated the adaptability of these larvae to a broader pH range. The highest growth rates were observed in pH 7 and 8, with the least time to pupate (an average of 8 days). A significant difference between the overall time taken to transition from 1st to 4th instar was seen between pH 7 (7.66 days) and 8 (4.66 days) ($p=0.035$). Respectively, 43.3%, 60%, 46.6% of adults emerged from pH 6, 7 and 8. There was a notable difference in the wing size of adults between the pH treatments ($p= 0.038$). Larger body size was observed in 6-8 pH treatments. Results revealed the significance of pH on larval growth and development, which can be implemented in better vector control approaches.

*Financial assistance from University research grant year 2023* (*Grant No. URG/2023/31/S is acknowledged.*

**Keywords**: *Aedes albopictus*, Breeding habitats, Dengue, Mosquito control, pH

***Abstract No: 82*** ***Life Sciences***

# PCR-BASED APPROACH TO ASSESS THE RETAINED MICROFLORA AND THE PRESENCE OF HUMAN DNA ON USED TOOTHBRUSHES

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Toothbrushes, the most common article used to maintain oral health, are constantly subjected to contamination with the oral, environmental microflora, oral fluids and epithelial cells during storage and usage. The favourable atmosphere created by the residual moisture and food debris facilitates microbial growth, leading to biofilm formation. Retained microflora on toothbrushes potentially influences both oral and systemic health. The present study was designed to assess retained microflora and the presence of human DNA on used toothbrushes by a group of Sri Lankans. Used toothbrushes were randomly collected from 20 volunteers (male=10, female=10) within 24 hours of their last use. Total DNA from the brush head and the bristles were extracted using modified phenol: chloroform protocol. The presence of human DNA was assessed using the B2M primer pair, while the clinically important bacteria *Porphyromonas gingivalis*, *Helicobacter pylori*, *Staphylococcus aureus*, and *Escherichia coli* were detected using specific 16S rRNA primers. DNA from the reference isolates of each tested bacteria and DNA from human blood were used as controls. To visualize the biofilm, a toothbrush bristle was coated with gold under vacuum for 40 mins and then examined with SEM at 20 kV. PCR demonstrated that the used toothbrushes harbour *P. gingivalis* (2/15), *H. pylori* (1/15), *S. aureus* (2/15), and *E. coli* (4/15). Human DNA was confirmed in (3/15) toothbrushes. SEM revealed bacteria attachment and biofilm formation on the used brush bristles compared to the unused ones. Hence, toothbrushes are a potential reservoir for clinically important bacterial species and can be useful sources of genomic DNA for forensic application. SEM suggests that the retained bacteria exist in biofilm form, and it is advisable to maintain toothbrush hygiene to gain satisfactory oral and general health, especially regarding immunocompromised individuals.

**Keywords:** 16S rRNA, Bacteria, Microbial biofilms, Oral health, Scanning electron micrographs

***Abstract No: 84*** ***Life Sciences***

# ANAPLASMOSIS IN DOGS: A REVIEW ON SOUTH AND SOUTHEAST ASIAN COUNTRIES

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Anaplasmosis affects dogs worldwide, varying from asymptomatic infection to a severe illness. Despite the high prevalence and socioeconomic impact, canine anaplasmosis is often neglected. This review provides insights into existing information and identifies knowledge gaps and future directions for research. All studies published on anaplasmosis in dogs from 2011 to 2023 in South and Southeast Asian countries were identified by searching scientific databases PubMed, Springer, Elsevier, Google Scholar, and Web of Science with 'anaplasmosis in dogs', 'seroprevalence of anaplasmosis in dogs', canine vector-borne diseases, 'canine vector-borne diseases' with country names. Forty-five articles were reviewed. Anaplasmosis in dogs was reported in all countries in these regions except Afghanistan, Bhutan, Brunei, Cambodia, and Timor-Leste. Twenty-six and nineteen articles were retrieved from Southeast Asian and South Asian regions, respectively. Thirty-six studies were based on dogs, three on the tick vector collected from dogs, and six on both dogs and ticks. Most (73%) of the articles were published between 2017 and 2023. *Anaplasma platys* was the predominantly identified *Anaplasma* species infecting dogs, and the brown dog tick, *Rhipicephalus sanguineus,* as the vector of *A. platys,* the most common dog tick species. Only three studies have been conducted in Sri Lanka on the prevalence, clinical, and laboratory findings of anaplasmosis in pets, stray, and working dogs reporting *A. platys* infections. The prevalence of anaplasmosis varied widely from 39% in Malaysia to 0.25% in Myanmar. Most studies (80%) were based on molecular identification and prevalence estimation, including PCR (62%) of the studies, ELISA in 8.8%, microscopy in 15.5%, and 13.3% combination of the above tests. The available studies provide only basic research instruments; many significant knowledge gaps on the pathogen and tick transmission were identified. A better understanding of these will improve immunological mediations, aiding the design and production of effective vaccines and alternative pharmacological interventions against the pathogen.

**Keywords**: Anaplasmosis, *Anaplasma platys*, South Asia, Southeast Asia

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

# POTENTIAL USE OF THE JELLYFISH *ACROMITUS FLAGELLATUS* VENOM AS A BIOINSECTICIDE AGAINST RICE WEEVIL, *SITOPHILUS ORYZAE* (L.) (COLEOPTERA: CURCULIONIDAE)

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Dense aggregations of jellyfish are known as jellyfish blooms. A remarkable increase in jellyfish blooms has recently been reported around the world. Despite their adverse effects, the benefits of jellyfish have been reported in many industries, including agriculture. Given this background, the potency of jellyfish *Acromitus flagellatus* venom against *Sitophilus oryzae* was investigated in this study for stored-product protection. Venom was extracted from frozen marginal lappets of *A. flagellatus* into a phosphate buffer, and three concentrations (100%, 75%, and 50%) were prepared. Cohorts of mixed-sex, 4-7 days *S. oryzae* adults selected from ongoing cultures were used for the experiments under ambient laboratory conditions. The effect of *A. flagellatus* venom on *S. oryzae* was investigated for repellent, insecticidal, and anti-feedant activities. Biochemical responses of *S. oryzae* on jellyfish venom were tested using enzyme assays where adult insects (n=100) were exposed to three different venom concentrations via the topical application and kept at room temperature for 48 hours. After exposure, reduced glutathione (GSH), oxidized glutathione (GSSG), catalase activity, and peroxidase activity of *S. oryzae* were assessed. *Acromitus flagellatus* venom extract reported >95% repellency and toxicity against *S. oryzae* at the highest concentration upon 48 and 72 hours of exposure, respectively ($p<0.05$). Poor feeding of *S. oryzae* on treated flour disks at the highest concentration resulted in reduced growth and survival than the control. GSH activity of *S. oryzae* was significantly inhibited by jellyfish venom at 48 hours of exposure period ($p<0.05$). Although a significant increment of GSSG content and peroxidase activity was reported in exposed rice weevils ($p<0.05$), changes in catalase activity were not significant ($p>0.05$). The results of this preliminary study reveal the potential of using *A. flagellatus* as a bio-insecticide for stored product protection, however, further studies are recommended to bring this to a commercial scale.

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**Keywords**: *Acromitus flagellatus*, Bio-insecticide, Jellyfish, *Sitophilus oryzae*

***Abstract No: 88*** ***Life Sciences***

# CHALLENGES IN CONTROLLING INSECT PESTS OF STORED GRAIN PRODUCTS IN SRI LANKA: INSIGHTS INTO INSECTICIDE METABOLIZING ENZYMES AND TARGET-SITE ALTERATIONS

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*Sitophilus oryzae* (rice weevil) and *Callosobruchus maculatus* (cowpea weevil) are major pests that cause severe post-harvest losses in stored grains in Sri Lanka. Awareness of the pesticide-resistant status is necessary since chemical control is the main pest management strategy practised in the country. This research aimed to determine the activity profiles of insecticide-detoxifying enzymes, carboxylesterases, monooxygenases, and glutathione S-transferases (GSTs), and alteration in the target-site, Acetylcholinesterase (AChE) in *Si. oryzae* and *Ca. maculatus.* Two hundred individuals from each species were subjected to bio chemical assays using standard procedures. Both species had higher amounts of carboxylesterases where the mean specific activity value for *Si. oryzae* (0.490 ± 0.06 μmol/mg/min) was higher than that of *Ca. maculatus* (0.104 ± 0.03 μmol/mg/min). Respectively, 86% and 92% of *Si. Oryzae* and *Ca. maculatus* had insensitive AChE target-sites. The development of resistance in both pests for the most commonly used organophosphates, malathion and pyrimiphose methyl might be due to these elevated levels of esterases and insensitive target-sites. Both populations had slightly higher GST levels [Mean specific activities for *Ca. maculatus* = 0.193 ± 0.001 mol/mg/min, *Si. Oryzae* = 1.425 ± 0.007 μmol/mg/min], which favours developing resistance against pyrethroids to a considerable level. The excessive use of organophosphates and deltamethrin as the main pesticides in controlling these pests is also evident by the presence of significantly elevated levels of monooxygenases (mean specific activity value for *Si. oryzae* = 0.784±0.021 μmol/mg/min for *Ca. maculatusc*= 0.350 ± 0.0032 μmol/mg/min). Results conclude that both *Si. oryzae* and *Ca. maculatus* populations have developed resistance mechanisms to thrive successfully against synthetic insecticides that belong to any group, making it extremely difficult to control their attack on rice and other stored grains. Therefore, the continuous effort towards novel and eco-friendly alternatives is essential to replace the currently used pesticides.

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**Keywords**: Cowpea weevil, Rice weevil, Sri Lanka, Stored grains

***Abstract No: 96*** ***Life Sciences***

# MANGROVE-ASSOCIATED *KOCURIA FLAVA* PUTS1_3 AS A POTENTIAL FUNCTIONAL PIGMENT PRODUCER FOR THE TEXTILE INDUSTRY

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*Kocuria flava* is a Gram-positive coccus known for its yellow carotenoid pigments. Carotenoids can have potential biotechnological applications, especially in the textile industry. The current study was conducted to isolate and characterise the carotenoids produced by *K. flava* PUTS1_3. Further, the antibacterial potentials of the crude pigment and dyed fabrics were evaluated. PUTS1_3 was isolated from the sediments of the Puttalam mangrove forest, and 16S rRNA sequencing results revealed its close relation to *Kocuria flava* (GenBank accession no: OQ 442354.1). Isolate was grown in nutrient broth supplemented with 1.5% dextrose, and after 5-7 days of incubation, the pigment was extracted using methanol. UV-visible spectroscopy, Thin Layer Chromatography (TLC) and column chromatography were conducted to characterize and purify the pigment. Antibacterial activity of the pigment extract of the bacterium was tested against six standard bacterial cultures (three Gram positives and three Gram negetives), by the agar well diffusion assay. The application of the pigment in the textile industry was investigated by dyeing ten types of fabrics, each exhibiting different dyeing abilities depending on the fibre type. The antibacterial activity of the dyed fabrics was analyzed according to the ISO 20645:2004 method against *Staphylococcus aureus* and *Escherichia coli*. UV-visible analysis confirmed the presence of carotenoids with three absorption maxima at 409 nm, 437 nm, and 466 nm. Three spots were observed (Rf of 0.88, 0.78 and 0.61) in the TLC analysis conducted using butanol: ethanol: water (9:1:2) solvent system. Pigment extracts resulted in inhibitory zones against *Bacillus subtilis* ATCC 6633 (14.89±0.16 mm), *Staphylococcus aureus* ATCC 25923 (15.55 ± 0.32 mm), and *Listeria monocytogenes* NCTC 11994 (17.00 ± 0.00 mm). The dyed fabrics showed a good antibacterial effect against *S. aureus* and a limited effect on *E. coli*. In conclusion, mangrove isolate *K. flava* PUTS1_3 holds potential as an antibacterial pigment producer for the textile industry.

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**Keywords**: Antibacterial activity, Carotenoid, *Kocuria flava*, Pigments, Textile dy

***Abstract No: 97*** ***Life Sciences***

# VIABILITY OF PROBIOTIC BACTERIA INHABITING TENDER COCONUT WATER UNDER ARTIFICIAL SALIVA AND SIMULATED GASTROINTESTINAL JUICE CONDITIONS

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Probiotics are live microbes that promote human health, with potential benefits. Tender coconut water is an unexplored promising source of probiotics. This study aimed to identify probiotic strains from tender coconut water that can survive under human gastrointestinal conditions. Tender coconut samples from seven districts in Sri Lanka were collected and used for isolation. After biochemical screening, four probiotic strains were identified up to species level by 16S rRNA gene sequencing: *Lactiplantibacillus plantarum* CWJ3, *Lacticaseibacillus paracasei* CWKu14, *Lacticaseibacillus rhamnosus* CWKu12, and *Lacticaseibacillus casei* CWM15. The tolerance of these strains under artificial saliva juice (ASJ) with 0.3% $\alpha$-amylase at pH 6.9, simulated gastric juice (SGJ) with 0.3% porcine stomach mucosa pepsin at pH 2, and simulated intestinal juice (SIJ) with 0.3% Ox-gall, and 0.1% pancreatin at pH 7 was analyzed. To assess their survival rates, overnight cultures of each bacterial strain incubated in deMan, Rogosa, and Sharpe (MRS) broth at 37 °C were used. Washed cells were used to prepare a $10^9$ CFU $mL^{-1}$ suspension. Each strain was then suspended in ASJ for 5 minutes, SGJ for 120 minutes, and SIJ for 120 minutes at 37 °C in sequence, followed by an evaluation of the survival rate. All four strains survived under these gastrointestinal conditions. The results indicated no significant difference ($p > 0.05$) in survival under ASJ among the four strains, with an average survival rate of 96%. However, significant differences ($p < 0.05$) were observed in survival under SGJ and SIJ. Notably, *L. plantarum* CWJ3 exhibited the highest tolerance rate in SGJ (70.69%) and SIJ (74.59%) conditions. The findings of this study provide valuable insights into the survival potential of probiotic strains under gastrointestinal conditions. Further research in this area may contribute to developing functional beverages using tender coconut water to improve gut health and overall well-being.

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**Keywords**: Gastrointestinal conditions, In-vitro, Probiotics, Tender coconut water

***Abstract No: 98*** ***Life Sciences***

# KNIME AND MACHINE LEARNING-BASED PREDICTION OF PDGFRA INHIBITORS FROM PHYTOCHEMICALS AS POTENTIAL CANCER DRUGS

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Cancer is a major worldwide concern and is a heterogenic disease that involves various genes. By inducing cell division and angiogenesis, the Platelet-Derived Growth Factor Receptor Alpha (PDGFRA) gene plays a significant role in the development and progression of cancers like gastrointestinal stromal tumours and medulloblastoma. Tumor development can be inhibited by specifically blocking the activity of mutant PDGFRA using PDGFRA inhibitors. A PDGFRA inhibitor drug discovery approach is high-throughput screening, which is also time-, labour-, and cost-intensive. Thus, Quantitative Structure-Activity Relationship (QSAR), a computational modeling-based technique to determine the structural and biological similarities between chemical compounds, is highly recommended for drug discovery since it is productive and cost-efficient. Potential cancer drugs can be effectively detected with the combination of Machine Learning (ML) and the QSAR technique. In this study, KNIME v4.7.0 was used along with cheminformatics extensions to detect phytochemicals similar to PDGFRA inhibitors by using TeachOpenCADD KNIME. Simplified Molecular Input Line Entry System (SMILES) notations of 394 molecules were retrieved from the ChEMBL database. These molecules consist of 18 PDGFRA inhibitors, eight rheumatoid arthritis medications, and phytochemicals, including the phytochemicals common in Sri Lankan flora. The MACCS (Molecular Access System) fingerprint of molecules was calculated to perform the ML-based modelling to distinguish the active drugs against PDGFRA. Subsequently, the drug-likeliness of predicted compounds was evaluated by Lipinski's rule of five. The accuracy of Artificial Neural Networks (ANN), Random Forest (RF), and Support Vector Machine (SVM) ML models were 91.86%, 92.88%, and 92.2% respectively. The RF model predicted Kaempferol-3-O-P-D-glucoside while Kaempferol-3-O-P-D-glucoside and Kazinol J were predicted as potential PDGFRA inhibitors in ANN. The results of the SVM model included known PDGFRA inhibitors only. Therefore, the ANN model is efficient in drug discovery. However, further *in-vitro* and *in-vivo* experiments will enhance the reliability of using these predicted phytochemicals as cancer drugs.

**Keywords**: Cancer drugs, KNIME, Machine learning, PDGFRA inhibitors, Phytochemicals

***Abstract No: 99*** ***Life Sciences***

# IDENTIFICATION OF POTENTIAL *HER2* INHIBITORS FROM PHYTOCHEMICALS USING COMPUTER-AIDED DRUG DESIGN

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Computer-aided drug Design (CADD) combined with Machine Learning (ML) is a drug discovery technique that is more efficient than nonautomated traditional drug recognition methods. Small molecule Tyrosine Kinase Inhibitors (TKIs) act on Human Epidermal growth factor Receptor 2 (*HER2)* and suppress cell proliferation in breast cancer. Even though many synthetic drugs are available, few natural chemicals have been identified as TKIs for *HER2*. This analysis was carried out to recognize phytochemicals structurally analogous to available TKIs. Modified TechOpenCADD KNIME workflow combined Machine Learning (ML) with Quantitative Structure-Activity Relationship (QSAR). Version 4.7.0 of KNIME with Server Space, Cheminformatics, and RDKit extensions was utilized to examine the input data. A total of 422 phytochemicals were used together with 19 already existing TKIs and 20 drugs of some non-communicable diseases to feed in as Simplified Molecular Input Line Entry System (SMILES). "RDkit fingerprint node" was used to convert the dataset into FeatMorgan molecular fingerprints to make data readable for ML. Fundamental ML techniques Random Forest (RF), Support Vector Machine (SVM), and Artificial Neural Network (ANN) were employed to train the model with 98.26%, 97.18%, and 98.48% accuracy, respectively. Predicted data were tested for drug-likeness using Lipinski's Rule of Five to determine the eligibility as oral drugs. From RF and SVM, one phytochemical each and three phytochemicals from ANN were predicted to be structurally similar to TKIs. The results obtained overlapped in three ML algorithms and followed at least three or more of Lipinski's Rules, indicating the possibility of developing them as TKIs. In several previous studies, two of the three predicted phytochemicals have already been shown to be *HER2* inhibitors. The plant sources of predicted phytochemicals are commonly found in Sri Lanka. However, further studies should be done to ensure the effectiveness and validity of the results.

**Keywords**: *HER2*, KNIME, Machine Learning, Phytochemicals, Tyrosine Kinase Inhibitors

***Abstract No: 100*** ***Life Sciences***

# A COMPUTATIONAL APPROACH TO IDENTIFY BETA-LACTAM-LIKE COMPOUNDS FROM PHYTOCHEMICALS

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Antimicrobial resistance (AMR) is one of this century's most severe global health problems. It has been estimated that AMR is directly responsible for 700,000 deaths annually, which is predicted to be 10 million by 2050. Present antibiotics are failing due to various reasons while phytochemicals are gaining attention due to their favorable attributes as antimicrobials. Many studies have shown the importance of applying Computational Biology to Microbiology. In this context, the KNIME (Konstanz Information Miner) analytics platform was used for our analysis. The primary goals of this research were to develop a KNIME workflow using a Machine Learning approach to discover potential compounds with beta-lactam properties from a set of phytochemicals and to use a 96-well plate assay to screen such candidate compounds biochemically. Compound data were acquired for beta-lactams, non-antibiotic drugs and phytochemicals from ChEMBL. Cells of molecule string column were converted into SMILES (Simplified Molecular Input Line Entry System). RDKit molecule column was generated from SMILES. Fingerprints were generated, and data was prepared for Machine Learning. Machine Learning algorithms were used to train the filtered ChEMBL dataset to discriminate between active and inactive compounds. After comparing the structural similarities, a set of phytochemicals (decanoic acid, alpha-pinene) was identified as hits for beta-lactams with more than 85% overall accuracy. Decanoic acid was screened biochemically. A slight growth inhibition was observed with increasing decanoic acid concentration from 100-700 $\mu gmL^{-1}$. The developed KNIME workflow can identify possible beta-lactam-like compounds from a set of phytochemicals. Ninety-six well plate assay is a significant method to screen a large number of hits simultaneously. In conclusion, the intended KNIME workflow has been successfully developed and seven phytochemicals as hits for beta-lactams were found. As future directions other candidate compounds will be screened and further analyzed.

**Keywords**: Antibiotics, Antimicrobial resistance, KNIME, Machine Learning, 96-well plate assay

***Abstract No: 101*** ***Life Sciences***

# LIGAND-BASED VIRTUAL SCREENING OF POTENTIAL DRUG COMBINATIONS AGAINST AMINOGLYCOSIDE RESISTANCE IN BACTERIA

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Antibiotic resistance in bacteria is an international crisis estimated to have 10 million annual deaths by 2050. Aminoglycosides (AGs) are becoming inefficient with the widespread of multidrug-resistant bacteria. The resistance mainly occurs due to the enzyme modification or inactivation of AGs, increased expression of efflux pumps that remove AG from the cell, reduced drug permeability or alteration in the drug target site. Many studies have determined that one of the fastest routes to evade AG resistance is restoring the effectiveness of existing AGs by combining them with some chemical compounds. The main purpose of this study was to predict the bioactivity of phytochemicals and a few other drugs against AG resistance using Machine Learning (ML) methods and predict their synergy with existing AGs (Amikacin, Tobramycin), using an efficient and less expensive pipeline. Open-source nodes in KNIME software were used to create a pipeline including Random Forest, Support Vector Machine and Artificial Neural Network ML models and RDKit tools. The ChEMBL site was used to retrieve structural data of 500 phytochemicals, 18 AGs, and 18 Non-antibiotic drugs. The drug likeliness of potential drug candidates was determined using Lipinski's rule of five by the CDK toolkit. The synergies were predicted using the bioactivity data obtained from the PubChem site. Eleven compounds resulted as potential drug candidates by the pipeline: Allicin, Aspartic acid, Fosbretabulin, Myoinositol, Lysine, Alpha-pinene, Acetoside, Linoleic acid, Histidine, Choline and Polymyxin B. Out of them only Fosbretabulin and Lysine respectively having 0.033 and 0.36 individual bioactivities showed a higher synergistic effect only when combined with Tobramycin. The synergy scores are 0.24 and 0.78, respectively. Fosbretabulin is a cancer drug, and not known for having antimicrobial properties. This pipeline can screen many molecules to predict potential drug combinations against AG resistance before laboratory experiments, reducing cost, time and resources

**Keywords:** Aminoglycosides resistance, Drug Synergy, Ligand-based**,** Machine Learning, Prediction

***Abstract No: 102*** ***Life Sciences***

# RAPID DETECTION AND MOLECULAR AUTHENTICATION OF SANDALWOOD MARKET SAMPLES USING HIGH-RESOLUTION MELTING ANALYSIS

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Sandalwood (*Santalum album* L.) is a highly valuable plant species known for its aromatic fragrance and medicinal properties. The fragrant heartwood of sandalwood is marketed for more than USD 100 Kg $^{-1}$, which is a relatively high price due to the rarity and limited availability of high-quality sandalwood in the market. The scarcity of sandalwood has led to its adulteration with several similar-scented or visually similar plant materials during the trade. This adulteration endangers the health of Sri Lankans, particularly when sandalwood products are used as herbal drugs. Detecting adulteration or contamination of processed sandalwood in the market using traditional morphological or chemical methods is challenging. DNA barcoding coupled with High-Resolution Melting (Bar-HRM) for adulterant detection is a novel method that provides promising ways of standardization. Due to the low DNA content preserved within the heartwood of sandalwood, DNA isolation from sandalwood samples is exceptionally challenging. The DNA isolated using a newly developed, modified CTAB protocol met the quality standards required for conducting High-Resolution Melting (HRM) analysis. The developed DNA barcodes for sandalwood and its potential adulterants using the *rbcL* universal primers and simulations of melting profiles using the 'uMELT' software produced differentiated melting curves, which affirmed the success of the developed barcodes. To assess the effectiveness of HRM in distinguishing pure sandalwood from adulterated samples, three frequently available sandalwood market samples, including suspected adulterated ones and authentic sandalwood samples, were subjected to HRM analysis. The normalized melting profiles and the Principal Component Analysis demonstrated the ability of HRM to identify adulteration by the variations in DNA melting curves, precisely showing the genetic dissimilarities to the reference authentic sandalwood sample. This research provides a valuable molecular tool for quality control and authentication of sandalwood in the market, offering a more reliable and efficient approach to adulterant detection.

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**Keywords:** Adulterants, Bar-HRM, DNA, Sandalwood

***Abstract No: 103*** ***Life Sciences***

# *IN VITRO* ASSAY OF ANTIOXIDANT POTENTIAL AND TOTAL PHENOLIC CONTENT OF PROBIOTIC *LACTOBACILLUS DELBRUECKII* SUBSP. *INDICUS* STRAINS ISOLATED FROM TRADITIONAL SRI LANKAN BUFFALO CURD

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Sri Lankan buffalo curd prepared through the back-slopping method is a rich probiotic lactic acid bacteria (LAB) source. Most of these LAB species possess antioxidant abilities to reduce the cell damage caused by oxidative activities in the human body. Therefore, the current study attempted to chemically analyse the antioxidant properties of three probiotic *Lactobacillus delbrueckii* subsp. *indicus* strains isolated from traditional Sri Lankan buffalo curd samples. In the present study, total phenolic content (TPC), ferric reducing antioxidant power (FRAP), and free radical scavenging assays against 3-ethylbenzthiazoline-6-sulfonic acid (ABTS) and 2,2-diphenyl-1-picrylhydrazyl (DPPH) were tested at different bacterial cell concentrations of $10^4$,$10^6$, $10^8$, and $10^{10}$ CFU/ml. All three *L. delbrueckii* subsp. *indicus* strains showed antioxidant properties and phenolic contents increasing with cellular concentration. The highest TPC (14.76 µg/mg of gallic acid equivalent) and FRAP (50.54 µg/mg of ascorbic acid equivalent) were observed in the strain SUR_IN-55. Free radical scavenging assays against ABTS and DPPH were also observed to be the highest in the strain SUR_IN-55, with an inhibition rate of 50% and 69.89%, respectively. The *L. delbrueckii subsp. indicus* strain SUR_IN-55 isolated from traditional Sri Lankan buffalo curd had the highest antioxidant properties among the tested strains. Apart from probiotic characteristics, the presence of antioxidant properties can be considered as an added advantage in their use as starter cultures for producing fermented dairy products.

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**Keywords:** Antioxidant activity, Buffalo curd, *Lactobacillus delbrueckii* subsp. *Indicus*

***Abstract No: 108*** ***Life Sciences***

# THE IMPACT OF INCLUSION BODY HEPATITIS (IBH) VIRUS ON IMMUNE ORGANS (BURSA OF FABRICIUS, SPLEEN, AND THYMUS) OF BROILER CHICKENS IN SRI LANKA

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Inclusion Body Hepatitis (IBH) is caused by Fowl adenoviruses (FAdVs) of Family *Adenoviridae*. FAdV-D (serotypes 2, 3, 9 and 11) and FAdV-E (serotypes 6, 7, 8a and 8b) are the causative agents of IBH. It is an acute disease affecting 3-7 weeks-old broiler chickens. The liver is the main organ affected by IBH. The focus of this study was to determine whether there was a significant lymphoid depletion in immune organs affected by IBH using a scoring system. Livers and immune organs (bursa of Fabricius, spleen and thymus) of broilers were collected during postmortem examinations from broiler farms in Central, Western and North-Western Provinces of Sri Lanka (3, 5 and 18 flocks respectively). Six normal/IBH-free broilers who died due to transportation stress were collected from broiler processing plants as controls. Processed organs were stained with hematoxylin and eosin for histopathological study. Livers with large basophilic intra-nuclear inclusion bodies in hepatocytes with hepatocellular degeneration and necrosis were confirmed as IBH. In the normal group, the above mentioned histopathological changes were not detected. Lymphoid depletion was detected by the reductions in the number of lymphoid follicles and the reduction in the germinal centres' size. Statistical analysis was done using the Mann-Whitney test to compare the lymphoid depletion of IBH-positive cases with the normal group, and a $P$ value < 0.05 was considered significant. The results showed a significant lymphoid depletion in IBH cases compared to the normal group ($p$ value for bursa of Fabricius-0.0387, spleen < 0.0001 and thymus -0.0021). Although similar studies have been conducted for Specific Pathogen Free (SPF) birds in other countries, this was the first study conducted in Sri Lanka to detect the lymphoid depletion of commercial broilers under natural infection. The study concluded that IBH significantly reduces the immunity of commercial broilers.

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**Keywords:** Broilers, Immune organs, Inclusion Body Hepatitis, Liver, Lymphoid depletion

***Abstract No: 111*** ***Life Sciences***

# SCREENING OF FUNGAL SPECIES ISOLATED FROM DIFFERENT SOIL SAMPLES FOR EXTRACELLULAR LIPASE PRODUCTION

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Lipases are remarkable biocatalysts that hydrolyze triacylglycerols to glycerol and fatty acids. Along with other reactions like acidolysis, alcoholysis, and aminolysis, these ubiquitous enzymes also catalyze reversible reactions, including esterification, transesterification, and interesterification. Filamentous fungi are excellent extracellular lipase producers, and fungal lipases can function at extreme temperatures and pH, are chemo-selective, stable in organic solvents, and are abundant. Extraction of fungal lipases is relatively easy and cost-effective. Although many studies have been conducted in this area, many more lipolytic fungal species still need to be discovered and studied. The objective of the current work was to isolate and characterize novel lipolytic fungi from oil-contaminated soil. The collected soil samples from four different areas (Normal soil sample from mini Sinharaja area, Faculty of Science, University of Peradeniya, Compost sample from Gampaha area, Oil-contaminated soil sample from coconut oil mill in Gampaha, Oil-contaminated soil sample from coconut oil mill in Kandy) were cultured on PDA medium, and fungal species were isolated. Para-nitrophenyl palmitate assay was used to examine each species' individual lipolytic activity in the fungal strains that tested positive in the phenol red and Tween 20 tests. Following the morphological identification based on colony morphology and microscopic view, molecular identification (sequencing followed by BLAST search and phylogenetic analysis) was done to determine the most efficient fungal species. Out of the 12 isolated species, 10 species gave positive results for lipolytic activity, and based on the results of the para-nitrophenyl palmitate assay, DNA from three species with the highest lipolytic activity were extracted using the phenol-chloroform method and heating method. According to the sequences of ITS regions, the most efficient lipolytic fungal species were identified as *Rhizopus arrahizus* (0.5363) followed by *Aspergillus niger* (0.1980), and *Aspergillus nomius* (0.1963). Enzyme characterization and media optimization are necessary to use these fungal species as potential sources of lipase for industrial use.

**Keywords:** Fungal lipase, Industrial application of lipase, ITS gene, Phenol red test and Tween 20 test, pNPP assay

***Abstract No: 114*** ***Life Sciences***

# EFFICACY OF THE INSECT GROWTH REGULATOR NOVALURON IN THE CONTROL OF DENGUE VECTOR MOSQUITOES

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Sri Lanka is experiencing an alarming rate of dengue incidence with several outbreaks. Vector resistance to synthetic neuro-inhibitory insecticides has become a major problem in vector control programmes. Novaluron is an Insect Growth Regulator (IGR) which inhibits chitin synthesis in immature stages of insects. The present study aimed to evaluate the efficacy of novaluron and determine the dosages to be used in dengue vector control programs. Batches of 25 laboratory-reared third instar larvae of *Ae. aegypti* and *Ae. albopictus* were exposed to formulated emulsifiable novaluron (Rimon ® EC10) (0.00001 ppm - 4ppm) for two fixed exposure periods of 7 days and 14 days to determine $LC_{50}$ and $LC_{99}$ values. Percentage inhibition of adult emergence values ($IE_{50}$ and $IE_{99}$) were determined by exposing a 14-day period to 0.0005ppb-0.00005ppb concentrations. Mortality data and emergence inhibition data were subjected to probit-regression analysis using SPSS. Water storage buckets (10 L) and plastic barrels (200 L) with 25 third instar larvae per 1L were treated with $IE_{99}$, 2x $IE_{99}$ and 10x $IE_{99}$ under semi-field conditions to assess the residual effect of novaluron on larval emergence. For both larval species, $LC_{50}$ values were 0.044 – 0.049, and $LC_{99}$ values were 0.144 - 0.151ppm for the 7-day exposure. For 14-day exposure, LC50 values were 0.002 to 0.005 ppm, and $LC_{99}$ values were 0.006-0.01 ppm. For both species, $IE_{99}$ was 0.001 ppb. Under semi-field conditions, the discriminating dosage, 0.002 ppb (2 x $IE_{99}$) gave 100% emergence inhibition for up to 7 days, >50% inhibition for up to 86 days. After 118 days, it gave 97% adult emergence, declining the IE to 3%. Currently, novaluron Rimon ® EC10 recommended dosage is 200 ppm in Sri Lanka. The results highlight the need for authorities to reduce recommended dosages of novaluron Rimon ® EC10 in minimizing environmental pollution and to preserve non-target insect larvae.

**Keywords**: *Aedes aegypti*, *Aedes albopictus*, Mosquito larval control, Insect Growth Regulator, Novaluron

***Abstract No: 116*** ***Life Sciences***

# *IN SILICO* DRUG DISCOVERY USING THE KNIME ANALYTICS PLATFORM TO IDENTIFY PHYTOCHEMICALS WITH *VEGFR-2* INHIBITORY PROPERTIES

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Conventional drug discovery is a challenging process. Computer-aided drug design (CADD), especially Quantitative Structure-Activity Relationship (QSAR), offers an efficient alternative by correlating chemical structure to biological activity using statistical and computational models. Lately, QSAR has been integrated with KNIME, making CADD straightforward. The Vascular Endothelial Growth Factor Receptor-2 (VEGFR-2) binds to the Vascular Endothelial Growth Factor (VEGF) and promotes angiogenesis, which is crucial for tumour progression. Thus, VEGFR-2 inhibitors suppress angiogenesis, interrupting cancer progression. This study incorporated a modified-TeachOpenCADD workflow of KNIME to identify phytochemicals with VEGFR-2 inhibitory properties. The data of 343 phytochemicals, 12 VEGFR-2 inhibitors, and 10 non-cancer drugs were acquired from the ChEMBL database, and MACCS fingerprints were generated using the RDKit toolkit. The compounds were classified based on activity using Random Forest (RF), Artificial Neural Network (ANN) and Support Vector Machine (SVM), each with 10-fold cross-validations. The predicted phytochemicals' drug likeliness was assessed using Lipinski's rule of five. The ANN, RF and SVM performed with accuracies of 96.36%, 96.64% and 97.20%, respectively, which aligns with existing CADD studies. The root mean square error (RMSE) of RF, ANN and SVM were, respectively, 0.183, 0.191 and 0.167. The multilayer feedforward ANN with one hidden layer (each with 10 neurons) identified three active phytochemicals. With the split criterion as information gain ratio, RF only returned known VEGFR-2 inhibitors. Similarly, SVM with Radial Basis Function (RBF) in the kernel only predicted VEGFR-2 inhibitors. This is because ANN, compared to RF and SVM, excels in decision-making based on training data. All three predicted phytochemicals comply with Lipinski's rule and could be potential VEGFR-2 inhibitors. Notably, two predicted phytochemicals are found in *Butea monosperma* and *Saraca indica* which are native to Sri Lanka. However, subsequent *in vitro* and *in vivo* studies are required before these can be established as anticancer agents.

**Keywords**: Drug discovery, KNIME, Phytochemicals, QSAR, VEGFR-2 inhibitors

***Abstract No: 117*** ***Life Sciences***

# α- AMYLASE, ANTIOXIDANT, CYTOTOXICITY, LIPASE, AND PHYTOTOXICITY STUDIES OF *ALPINIA CALCARATA* AND *GLORIOSA SUPERBA* LEAVES EXTRACTS

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Many natural sources, such as plants, fungi, bacteria, and algae, have been proven to possess pharmaceutical values with fewer adverse effects. Both medicinal and non-medicinal plants have been proven to contain pharmaceutical properties with low toxicity and high efficiency. This study was conducted to determine the bioactivities of the leaves of *Alpinia calcarata* (Zingiberaceae) and *Gloriosa superba* (Colchicaceae) (GS). The plants were collected from home gardens of Kandy district, central province, Sri Lanka. Plant samples were washed, air-dried, and ground into a fine powder. Extracts were obtained using dichloromethane ($CH_2Cl_2$) and methanol (MeOH) by sonication. α- amylase inhibitory activity, cytotoxicity against brine shrimp, and 2-2–Diphenyl-1-picrylhydrazyl (DPPH) radical scavenging antioxidant activity, lipase inhibitory activity, phytotoxicity against germination of lettuce seeds were assessed for dilution series of each crude extract ranging from 1000 mg $L^{-1}$ to 31.25 mg $L^{-1}$. $CH_2Cl_2$ extract of *G. superba* (GSC) showed considerable lipase inhibition ($IC_{50}$= 782± 6.31 mg $L^{-1}$). MeOH extract of *A. calcarata* (ACM) showed the highest antioxidant activity ($IC_{50}$= 0.14 ± 0.24 mg$L^{-1}$). $CH_2Cl_2$ extract of *A. calcarata* (ACC), MeOH extract of *G. superba* (GSM), and GSC also showed strong antioxidant activities ($IC_{50}$= 158.73 ± 12.41 mg $l^{-1}$, 25.03 ± 2.68 mg $L^{-1}$, 192.24 mg $L^{-1}$ respectively). GSC and GSM both showed the highest lethality against brine shrimp ($IC_{50}$= 41.45 mg $L^{-1}$ and 122 mg $L^{-1}$ respectively). ACC and ACM also showed a moderate lethality against brine shrimp ($IC_{50}$= 300.54 mg $L^{-1}$ and 428.95 mg $L^{-1,}$ respectively). GSC extract showed the highest phytotoxicity ability (Root – $IC_{50}$= 203.84 mg $L^{-1}$, Shoot- $IC_{50}$ =97.58 mg $L^{-1}$) and GSM extract also showed a considerable phytotoxicity ability (Root– $IC_{50}$=338.12 mg $L^{-1}$, Shoot-$IC_{50}$= 217.93 mg $L^{-1}$). The results suggest that leaves of *A. calcarata* and *G. superba* can be used as promising sources to isolate therapeutic compounds.

**Keywords:** α- amylase, Antioxidant, Cytotoxicity, Lipase, Phytotoxicity.

***Abstract No: 121*** ***Life Sciences***

# ANTIOXIDANT ACTIVITY OF ENDOPHYTIC FUNGI ISOLATED FROM LEAVES OF *CITRUS AURANTIIFOLIA*

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Endophytic fungi are sources of natural products which can be utilized in medicine, agriculture and industry. The main objective of this study was to isolate endophytic fungi from the leaves of *Citrus aurantiifolia* and determine their bioactivities and molecular identification. Fresh and healthy leaves of *C. aurantiifolia* were collected from the Central Province of Sri Lanka. Segments (5 mm × 5 mm) of leaves were tripled sterilized and placed on the Potato Dextrose Agar and incubated in the dark for seven days at room temperature (27 °C) until the appearance of fungal mycelium. Three endophytic fungi emerged and were labelled as Fungus 10, Fungus V' and Fungus B, and sub-cultured to obtain pure cultures. Pure fungi were cultured on a large scale in Potato Dextrose Broth and kept for 21 days in shakers at room temperature. Subsequently, the medium was filtered, and the broth was extracted using EtOAc (1:1). Mycelium was crushed and extracted with EtOAc and MeOH sequentially. EtOAc extracts of the broth and mycelium and MeOH extract of the mycelium were subjected to antioxidant activity assay using the DPPH radical scavenging method. EtOAc extracts of broth and mycelium of Fungus 10 gave $IC_{50}$ of 52.1± 23.18 mg $L^{-1}$ and 52.61 ± 18.73 mg $L^{-1,}$ respectively. EtOAc extracts of both broth and mycelium of Fungus V' were combined based on similar TLC patterns and $IC_{50}$ value of 23.8 ± 8.98 mg $L^{-1}$ was obtained. MeOH extract of the mycelium of Fungus V' gave $IC_{50}$ of 104.54 ± 63.26 mg $L^{-1}$. EtOAc extracts of broth and mycelium of the Fungus B gave 27.11 ± 0.44 mg $L^{-1}$ and 112.4 ± 14.65 mg $L^{-1}$ $IC_{50}$ values respectively. Fungus V' and Fungus B were identified as *Biscogniauxia capnodes* and *Curvularia dactyloctenicola* by amplifying ITS regions of the rDNA gene, suggesting the potential use of these endophytes as sources of antioxidants.

**Keywords**: Antioxidant activity, *Biscogniauxia capnodes*, *Curvularia dactyloctenicola*, Endophytic fungi

***Abstract No: 123*** ***Life Sciences***

# BIOACTIVITY OF SOLVENT EXTRACTS OF *PIPER NIGRUM* SEEDS

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The spices' history is the history of humankind itself. Spices have been valued for their flavouring and medicinal properties for thousands of years. Among the many spices available, *Piper nigrum*, commonly known as Black Pepper, is used as a food ingredient mainly due to its specific pungent taste of Piperine, which is the main compound of Black Pepper. This study was carried out to determine the bioactivities of different extracts of seeds of *P. nigrum*. Black Pepper seeds were purchased from the local market, air dried and ground to obtain a homogenous powder using a home-use grinder. The powdered sample was sequentially extracted into Dichloromethane ($CH_2Cl_2$) and Methanol (MeOH) by sonicating for 30 minutes. This procedure was repeated twice, and the filtrate was combined and evaporated to dryness using a rotary evaporator. Subsequently, the crude extracts were subjected to DPPH radical scavenging activity, Brine Shrimp lethality bioassay using *Artemia salina*, phytotoxicity against germination of lettuce seeds (*Lactuca sativa)*, and enzyme inhibitory assays against α-amylase and lipase enzymes for 1000 mg $L^{-1}$ to 31.25 mg $L^{-1}$ concentrations for each extract. The results showed that the $CH_2Cl_2$ extract exhibited the highest DPPH radical scavenging activity with an $IC_{50}$ value of 178.33 mg $L^{-1}$ followed by the MeOH extract with $IC_{50}$ 221.25 mg $L^{-1}$. The $CH_2Cl_2$ extract exhibited $IC_{50}$ values of root and shoot inhibition in phytotoxicity assay with 1313.7 mg $L^{-1}$ and 796.51 mg $L^{-1,}$ respectively. The MeOH extract exhibited $IC_{50}$ values for root and shoot inhibition at 914.79 mg $L^{-1}$ and 1524.26 mg $L^{-1,}$ respectively. Both extracts demonstrated 100% cytotoxicity up to 31.25 mg $L^{-1}$. Therefore, an assay was conducted for lower concentrations up to 3.125 mg $L^{-1}$. $CH_2Cl_2$ extract showed 100% inhibition at 3.125 mg $L^{-1,}$ while MeOH extract showed cytotoxicity with $IC_{50}$=133.01 mg $L^{-1}$. None of the extracts showed enzyme inhibitory activity against α -amylase and lipase enzymes. This study suggests the potential bioactivity of *P. nigrum* seeds for medicinal and agricultural purposes.

**Keywords**: Antioxidant activity, Cytotoxicity, Enzyme inhibitory activity, Phytotoxicity

***Abstract No: 125*** ***Life Sciences***

# DIVERSITY OF ICHTHYO FAUNA AT THE UPPER NORTHERN BASIN OF THONDAMANARU LAGOON, JAFFNA, SRI LANKA

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An assessment of fish diversity is essential to maintain ecological stability and the lagoon fisheries. This study examined the fish fauna at the upper northern basin of Thondamanaru Lagoon. Samples were collected fortnightly from November 2021 to October 2022 from three selected sampling sites (L1- beyond the barrage, in front of the fieldwork centre, L2- near the barrage and in front of Selva Sannathikovil and L3-near the sand bar) at the upper northern basin of Thondamanaru lagoon, with the help of fishermen. Collected fishes were identified to the species level at the laboratory by using their morphological characters. This survey showed the occurrence of 45 species belonging to 27 families and eight orders. Perciformes is numerically the largest with 32 species, followed by Clupeiformes with five species, Beloniforms and Cichiliformes with two species each. Beryciformes, Pleuronectiformes, Gonorynchiformes and Siluriformes were represented by single species only. *Sardinella albella* (14%) was the most abundant fish species in L3. *Oreochromis mossabicus* (29%) and *Gerres abbreviates* (55%) were abundant in L1 and L2, respectively. The highest Shannon Diversity index (H') was in L3 (H'= 5.9257), whereas the minimum was found at L2 (H'= 1.0207). At the same time, the highest Simpson's index was in L1 (D = 0.1966), while the minimum was at L3 (D = 0.0561). The highest abundance of ichthyo fauna was recorded in L3, followed by L1, and L2. This study revealed the impact of barrage construction across the lagoon on the diversity, distribution and abundance of ichthyo fauna, supporting the conservation and management of fishery resources in this lagoon.

*Financial assistance from the University of Jaffna by University Research Grant (Grant No: URG/2021/SEIT/23) is acknowledged.*

**Keywords**: Abundance, Diversity, Diversity indices, Lagoon

***Abstract No: 127*** ***Life Sciences***

# CHARACTERISTIC WING VEIN PATTERNS OF COMMON MOSQUITO GENERA IN SRI LANKA

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Mosquitoes play a significant role in transmitting many devastating diseases to humans and wildlife. Proper identification is crucial in understanding mosquito epidemiology and disease transmission. Morphological taxonomic keys which are commonly employed in identification, may not be accurate in differentiating sibling species. The study investigated unique wing vein lengths and fork angles to develop a mosquito identification key. Larvae were collected from breeding sites and reared under laboratory conditions. Adult mosquitoes were collected using animal-baited traps and human landing catches. Right and left wings of 40 individual mosquitoes (females: 65%; males: 35%) representing seven common genera [*Culex* (n = 18), *Aedes* (n = 12), *Armigeres* (n = 12), *Orthopodomyia* (n = 12), *Toxorhynchites* (n = 4), *Coquilletidia* (n = 12), and *Anopheles* (n = 10)] were used for this study. Slide-mounted wings were photographed, and 21 wing vein length measurements and the folk angle were taken in pixels using a microscopic camera (CuA, MCu, MCu cross vein, M3+4, M1+2, M2, M1, R2+3 - M1+2 Cross vein half 1 & 2, R4+5, R2+3, R3, R2, 1A-CuA, CuA-M3+4, M3+4-M2, M2-M1, M1-R4+5, R4+5-R3, R3-R2, R2-R1, R2+3-M1+2). Results of the Multivariate Analysis of Variance (MANOVA) showed a significant difference in the length of selected wing veins between genera ($P < 0.001$). The Canonical Variate Analysis (CVA) suggested that the lengths of the Mcu cross vein, M1+2 vein, CuA vein, McU vein, and R2+3 are specific to each genus. The folk angle of R2+3 – M1+2 was excluded from MANOVA and CVA due to unit discrepancies. Taxonomic keys were generated based on the non-overlapping minimum and maximum values of the length of wing veins. *Toxorhynchites* were characterized by Mcu Cross Vein (range: 0.04 – 0.11 mm), while *Orthopodomyia* was distinguished with the M 1+2 vein (range: 0.86 – 0.95 mm). The identity of *Aedes* was confirmed using the CuA vein (range: 0.39 - 0.56 mm). *Armigeres* was characterized with the McU vein (range: 0.48 – 0.59 mm), while *Coquillettidia* was distinguished with the R 2+3 vein, which ranged from 0.51 – 0.67 mm. The folk angle of R 2+3 – M 1+2 can be used to separate *Culex* (118.74° – 144.63°) from *Anopheles* species (172.52° – 178.72°). These findings provide valuable and cost-effective insights into the taxonomy of common mosquito genera, while further studies are warrented to determine the applicability in identifying mosquito species/sibling-level.

*Financial assistance from the University Research Grant (Grant No: RU/SF/RP/2022/21) is acknowledged.*

**Keywords:** Dichotomous keys, Mosquito Taxonomy, Wing morphology, Wing vein patterns

***Abstract No: 129*** ***Life Sciences***

# PEST AND DISEASE MANAGEMENT STRATEGIES OF VEGETABLE GROWERS IN THE CENTRAL PROVINCE OF SRI LANKA: A SURVEY

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Sri Lanka faces significant obstacles from pests and pathogens in vegetable cultivation, which leads to substantial crop losses. Synthetic agrochemicals used to manage pest and disease outbreaks have many adverse effects on human health and the environment. The objective of the study was to assess the pre- and postharvest pest and disease management strategies used for vegetables through a questionnaire survey. Twenty growers per district in the Central province (Kandy, Matale and Nuwara-Eliya districts) were selected and their responses were recorded. Almost all farmers practice different kinds of land preparation techniques to prepare their lands before vegetable cultivation. Of the 60 farmers surveyed, about 53% responded that different land preparation methods impact pests and disease control. About 98% use synthetic pesticides in disease management. Although all farmers know the health risks associated with synthetic pesticides, about 10% of them still do not take proper precautions when handling them. Even though majority of those surveyed depend on synthetic pesticides for pest and disease management, most of them had a fair knowledge of how to handle them. Farmers used fewer non-chemical pest and disease control methods due to limited knowledge and confidence in these techniques. Government regulations banning agrochemicals have forced farmers towards more organic cultivation, while most of them face problems in crop production and pest and disease management. Integrated pest management (IPM), which has been introduced to minimize pesticide usage, is common among farmers. According to the responses of eight exporters, commodities from IPM-certified farmers are always selected for vegetable exports, as they use a minimal concentrations of synthetic pesticides.

**Keywords**: Pest and disease management, Vegetable cultivation, Vegetable exportation

***Abstract No: 130*** ***Life Sciences***

# INTERROGATION OF *SALTOL* LOCI FROM FL 478 TO ELITE VARIETY BG 352: EARLY SCREENING DATA

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Soil salinization significantly affects local rice production, posing a dual threat to the country's economy and food security due to the high sensitivity of rice to salinity. The cultivation of salt-sensitive rice varieties intensifies the above situation. Thus, genetic improvement of elite rice varieties for salinity tolerance is significant. The *SalTol* Quantitative Trait Loci (QTL) is collocated with the *OsHKT1;5,* a gene encoding a high-affinity Potassium transporter that is associated with salinity tolerance at the seedling stage. The objective of the present study was to introgress *SalTol* QTL from rice variety FL 478 into popular high-yielding rice variety Bg352. A backcrossing program was initiated using FL 478 and Bg 352, respectively, as the donor and the recurrent parent. The plants were manually crossed, and the F1 generation was advanced to BC1F1. Leaf samples were collected from the individual seedlings of the BC1F1 population, DNA was extracted, and Polymerase Chain Reaction was performed using RM 493 (*SalTol* linked SSR marker). The success rate of the manual crossing program was 90.5%. BC1F1 population was similar to the recurrent parent in plant height, architecture, and days to flowering, with a high uniformity within the population. From 38 BC1F1 plants studied, nine were heterozygous for *SalTol*. The nine plants where *SalTol* was successfully introgressed were advanced to BC2F1. The use of QTL linked RM 493 marker was effective, improved breeding efficiency and accuracy, and accelerated the breeding process. Further, backcrossing and marker-assisted selection are needed for the recipient genome recovery.

*We gratefully acknowledge the financial support provided by UNESCO/OWSD for this research project.*

**Keywords:** Marker-assisted Backcross Breeding, Rice, Salinity Tolerance, *SalTol,* Soil Salinization.

***Abstract No: 131*** ***Life Sciences***

# GOOGLE STREET VIEW REVEALS NEW INSIGHT INTO THE DISTRIBUTION OF *PANICUM MAXIMUM* IN SRI LANKA

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The alien invasive species (AIS) *Panicum maximum* causes negative impacts on the ecosystem by out-competing native vegetation, creating fire hazards during dry periods, and blocking access to animals. *Panicum maximum* has a wide distribution in Sri Lanka, while an accurate estimation of its distribution has not yet been determined. Estimating the current distribution of *P. maximum* in the island is vital to develop management strategies to control its spread. Thus, the objectives of the current study were to map and model the distribution of *P. maximum* in Sri Lanka. Google Street View (GSV) images have been used previously as a low-cost method to map the distribution of several animal and plant species. Thus, the mapping of *P. maximum* was conducted using GSV data, Google Earth Pro and QGIS software. The presence and absence data of *P. maximum* covering the entire island were recorded from 50,231 and 30,950 data points from GSV images taken during 2015-2016 and 2020-2022, respectively. The distribution maps were generated separately for each district, depicting the presence and absence of *P. maximum*. The density distribution maps of *P. maximum* were prepared for each district and the entire country using the same data sets. Heat maps can be used to predict the density of the species distribution. *P. maximum* is mainly distributed in the wet and intermediate zones of the country, with a limited distribution in the dry zone. Compared to 2015-2016, a higher distribution of *P. maximum* was observed in 2020-2022. During 2015-2016, the lowest distribution (<10%) was reported in the Northern Province, particularly Trincomalee and Batticaloa districts. The highest distribution of *P. maximum* (>80% of the total area) was reported from Polonnaruwa, Kurunegala. Kandy and Galle districts. A comparison of the distribution of *P. maximum* during 2015-2016 and 2020-2022 revealed a 2-11% increase in the spread of *P. maximum* in 11 districts thus a further spreading of the species can be expected, especially in wet and intermediate zones where its distribution is high.

**Keywords**: AIS, Google Street View, *Panicum maximum*, Range dynamics

***Abstract No: 136*** ***Life Sciences***

# GENOTYPING AND PHENOTYPING OF SELECTED RICE GERMPLASM FOR BLAST DISEASE RESISTANCE UNDER LOCAL CONDITIONS

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Rice blast caused by fungal pathogen *Magnaporthe oryzae* is the most destructive disease in rice cultivation worldwide. Even though the pathogen affects the entire plant, neck and panicle blasts are the most severe forms, causing 100% yield losses in server infections. Zenith and Usen are blast-resistant varieties that are widely used in blast-resistant international rice breeding programs worldwide. This study screened panicle blast resistance genes *Pikh* and *Pita/Pita-2* in local rice varieties Bg352, At362, and Usen and Zenith. Pachchaperumal was used as the susceptible control. Dominant marker *YL155/YL87* and co-dominant marker *Pikh* were used to amplify the *Pita/Pita-2*, and *Pikh* genes, respectively, from the selected rice germplasm. The same varieties were phenotyped for blast resistance in local environmental conditions. Three replicates of each variety were inoculated at two weeks after the heading stages. The plants were inoculated by spraying the mycelium suspension of two isolates of *M. oryzae* that were previously Koch's postulated. After inoculation, plants were incubated for 72 hours in humid chambers to facilitate disease development. A neck blast was observed on Bg352 and At362; however, no symptoms were observed on Usen, Zenith, and Pachchaperumal. Panicle blast symptom development was inconsistent in the replicates in any of the varieties. Hence, these observations need to be verified. The resistant *Pita/pita-2* gene was present in Bg352 and At362. However, *Pikh* resistant allele was not amplified from Bg352 and At362. Verification of resistance phenotypes of Usen and Zenith and identification of allelic variations will assist in identifying potential donor parents for blast resistance in rice crop improvement.

**Keywords**: *Maganaporthe oryzae*, Panicle blast, *Pita/Pita-2, Pikh*

***Abstract No: 138*** ***Life Sciences***

# MICROPLASTICS CONTAMINATION IN INDIAN BACKWATER OYSTERS (*MAGALLANA BILINEATA*) IN THE PANADURA ESTUARY, SRI LANKA

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Microplastics (MPs) are fragments of plastic less than 5 mm in length, and MP pollution in marine environments is widespread. As oysters are sessile filter feeders, they could serve as an indicator species of MP pollution and a proxy for marine environment contamination. The objectives of this study were to determine the effect of different depth strata and attached substrates on the level of MP contamination of the Indian backwater oyster *Magallana bilineata* in the Panadura estuary, Sri Lanka. Oysters were sampled from three depth strata (Surface to 4 m, 4–8 m, 8–12 m depth), according to their soft tissue wet weight class (0 to 4 g, 4 –8 g, 8 –12 g) and substrate type (natural *vs* plastic) in the estuary. The soft tissues of oysters were digested individually in 10% KOH, and MPs were separated using the density separation method (NaCl solution), extracted onto a filter paper (11 µm), and enumerated under the dissecting microscope. The MPs were classified according to colour and shape, and the polymer types were identified using FTIR spectroscopy. The average pieces of MPs were 5.133±4.37 items/individual, and the mean concentration was 1.212±1.188 items/g. Fibres (95%) were the dominant MPs category, and black (52%) was the dominant colour. Polypropylene, Polyethylene terephthalate, and polyvinylchloride were the predominant polymers observed in the oyster tissues. Substrate type did not affect the abundance of MPs (Two sample *t*-test; $t$=-0.33 p=0.743); however, the depth and size of the oysters had a significant effect on the content of MPs (One-way ANOVA, $p<0.05$). According to the post hoc test, the 8 – 12 m depth range had a higher mean content of MPs (9.78±7.26), and the weight class 8 – 12 g had a higher mean content of MPs (10.00 ±7.11). There was an interaction between two factors: depth range and weight class of oysters. The results showed that the larger the oyster and the deeper it lives, the higher the content of MPs. The results suggest that the wild-caught oysters in the Panadura estuary contained a higher number of MPs than those reported globally, with an average of 1.4 pieces per individual.

**Keywords**: Depth, Edible oysters, Microplastics, Size, Substrate

***Abstract No: 141*** ***Life Sciences***

# CALMODULIN-BINDING TRANSCRIPTION ACTIVATOR (CAMTA) GENES IN SOYBEAN AND THEIR EXPRESSION ANALYSIS

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Calmodulin Binding Transcription Activator (CAMTA) genes encode a special class of transcription factors (TFs) in eukaryotes, mainly in plants and animals. CAMTA TFs have been reported to mediate transcriptional regulation of plant stress response genes. However, the functions of CAMTA genes are yet to be well characterized in crop plants such as soybeans. Soybean is the world's fourth-largest commercial crop, which provides primary protein and oil sources. However, yield loss due to various stresses is a rising burden to farmers. It is crucial to employ various strategies to address this problem, including incorporating CAMTA genes into breeding programs. Therefore, it is necessary to characterize these genes in soybeans. However, gene redundancies in soybeans due to recent genome duplications pose a challenge in identifying gene functions. Therefore, finding the recently duplicated CAMTA is imperative to expedite the functional characterization. This study employed phylogenetic and expression analysis to investigate the evolutionary relationship and function of identified soybean CAMTA genes. The evolution of these genes compared to CAMTA genes of closely related species were analyzed. Furthermore, the study explored the expression patterns of these genes in different plant parts. The soybean CAMTA TFs were grouped into six major groups (with bootstrap support 100%), each containing two TFs. Genes in these clusters share a common evolutionary ancestor with *Glycine soja* but form a separate clade with other legumes (with bootstrap values above 60%), indicating they originated from a gene duplication event. Furthermore, two members of the four duplicated gene groups showed no statistically significant difference in expression levels in different parts. This suggests that the duplicated CAMTA gene retained the same expression patterns thus likely retained the same function. The expression data can be used in future studies to identify candidate genes to enhance soybean resistance to different diseases.

**Keywords**: Evolutionary relationship, Expression analysis, Phylogenetic analysis, Stress Response, Transcription factors

***Abstract No: 142*** ***Life Sciences***

# ISOLATION AND IDENTIFICATION OF AN EFFICIENT CELLULOSE-DEGRADING FUNGAL SPECIES, *ASPERGILLUS NOMIUS* FROM SOIL

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Cellulase is a group of enzymes consisting of exoglucanase, endoglucanase, and β-glucosidase that act on cellulose sequentially to degrade to glucose monomers. Due to the high activity, availability, and stability of fungal cellulases, they have many potential applications in industries such as bioethanol, textiles, paper, food and beverage. Since there is limited work on glucose production from leaf litter and plant biomass using fungal cellulases, this study aimed at the molecular-based identification of efficient cellulolytic fungal species. Different fungal species were isolated from soil samples collected from four different locations in Sri Lanka: 1) the "Mini-Sinharaja" premises, 2) Botany Department in University of Peradeniya, 3) a compost soil sample and 4) a leaf litter contaminated soil sample from Nikaweratiya and screened for their cellulolytic activity using Gram's iodine and Congo red tests and identified up to the genus level by observing the colony morphology and microscopic features of fungal cultures. The filter paper assay quantitatively determined the most efficient cellulose-degrading fungal species. During the molecular identification, fungal genomic DNA was extracted, and Internal Transcribed Spacer (ITS) region-based PCR amplification was carried out using ITS1 and ITS2 primer pair followed by sequence analysis. Eleven different fungal species were isolated, and ten species of these gave positive results upon the formation of a yellow colour halo region around the colonies in both Congo red and Gram's iodine tests, thus confirming their cellulolytic activity. The fungal isolate with the highest cellulolytic activity was identified as *Aspergillus nomius* by a phylogenetic analysis. Since fungi have gained attention as prominent cellulase producers, this study contributed to the molecular identification of an efficient cellulose-degrading fungal species in plant biomass-contaminated soil samples. Further research can characterize industrially valuable properties of cellulases and media optimization for *Aspergillus nomius.*

**Keywords**: *Aspergillus nomius*, Cellulolytic fungi, Filter paper assay, Fungal cellulases, ITS region

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

# EVALUATION OF PRIMERS DESIGNED FOR NESTED PCR TO DETECT P2 CLADE OF LEPTOSPIRES CAUSING LEPTOSPIROSIS IN HUMANS AND ANIMALS

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The pathogenic *Leptospira* (P) bacterium can transmit to humans through direct or indirect pathways and cause leptospirosis. This zoonosis is considered endemic in developing countries like Sri Lanka. Each year, more than one million leptospirosis cases, including 60,000 deaths, are recorded globally. Leptospirosis diagnosis is predominantly based on pathogen detection in clinical samples by *flaB* nested PCR. Intermediate *Leptospira* species (P2) can also cause leptospirosis but are undetectable through current molecular tests. Therefore, this study aimed to evaluate the primers designed for nested PCR to detect the P2 clade using extracted DNA samples collected from the Department of Microbiology, Faculty of Medicine, University of Peradeniya, Sri Lanka. The primers used for leptospirosis-related research in the past 10 years were analyzed in the literature survey. Intermediate primers (*I-flaB*) were initially evaluated using the in silico-based method through NCBI (National Center for Biotechnology Information) Primer-BLAST. Both known and unknown samples were used for the wet lab primer evaluation. DNA from 12 *Leptospira* species used in the Microscopic Agglutination Test (MAT), P2 human and animal clinical samples, and intermediate pathogen (P011) were used as the known samples. Seventy-two stored clinical blood samples that were *flaB*-PCR negative were used as the unknown samples. *16s rRNA*-PCR was conducted for the unknown samples to detect the existence of bacterial DNA. The five P2 species, *L. inadai*, *L. broomii*, *L. wolffii*, *L. licerasiae*, and *L. fainei* were explicitly detected by *I-flaB* primers in the 'in silico' evaluation, whereas the detection was non-specific in the wet lab evaluation using known samples where two P2 samples gave negative results. Of the unknown samples, six samples were positive for *16s rRNA*-PCR, implying the presence of bacterial DNA. However, *I-flaB* nested PCR was negative for all these six samples. Therefore, the detection of available *I-flaB* primers is non-specific. The 'in silico' method should be used cautiously. Primer evaluation before the application of newly designed primers is vital.

**Keywords**: *16s rRNA* gene, *flaB* gene, In silico analysis, Intermediate *Leptospira* species, Zoonotic disease

***Abstract No: 153*** ***Life Sciences***

# MORPHOMETRIC ANALYSIS OF GENUS *PIPER* (PIPERACEAE), SRI LANKA

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The genus *Piper* is represented in Sri Lanka by five wild species, three of which are endemic. Five *Piper* species have been introduced for various medicinal and economic purposes. According to the National Red List 2020, three of these species are threatened: *P. hymenophyllum* Miq., *P. walkeri* Miq., and *P. trineuron* Miq. However, due to recent taxonomic revisions, some species have been delimited to specific taxa, causing confusion. As a result, a field-based taxonomic study was initiated to determine the species limits of the genus *Piper* in Sri Lanka. The fieldwork was conducted throughout the country during 2022-2023, encompassing wildlife reserves, forest reserves, and cultivations. The collected specimens were tentatively identified using available published literature and herbarium specimens. The plant specimens were extensively examined, and morphological characters, both vegetative and reproductive, were coded into a data set. A population was coded with at least three mature individuals. Using PAST software (version 2.15), a multivariate analysis was performed on the data set. Hierarchical cluster analysis was performed on data collected from 58 populations using 60 qualitative and quantitative characteristics. The cluster solution was chosen from the most suitable algorithm, which employed Gower Distance to calculate similarity measures with the 'paired group' (UPGMA) option and the Single Linkage Algorithm based on the highest Cophenetic Correlation Value. The hierarchical cluster analysis resulted in 11 phenotypic groups, of which 10 corresponded to already-described species. The most contributing characters for the grouping, based on the SIMPER analysis, were leaf width, leaf length, and inflorescence length. The study suggests that the species limits of the known species remain stable while some possible new species resulting from intraspecific groups are identified, especially in *P. betle*, *P. zeylanicum, and P. nigrum* that need confirmation through molecular studies.

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**Keywords**: Biodiversity, Conservation, Multivariate analysis, Wild Pepper

***Abstract No: 157*** ***Life Sciences***

# MORPHOLOGICAL CHANGES IN EGGS AND LARVAE OF *AEDES AEGYPTI* ADAPTING TO SALINITY

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*Aedes aegypti*, the principal global vector of arboviral diseases, lays eggs and undergoes larval and pupal development in freshwater (FW) and has recently been observed to develop in coastal brackish water (BW) habitats, evolving various physiological mechanisms that enable these mosquitoes to survive and breed in BW habitats. The present study investigates the morphological changes of eggs and larvae of *Ae. aegypti* reared in FW and BW under laboratory conditions. Five different laboratory colonies were used for the subsequent experiments: two freshwater colonies named JFW (reared in 0 g/L tap water) and NFW (reared in tap water purified by reverse osmosis) and one brackishwater colony (reared in 10 g/L water) named JBW and two reversal colonies where FW larvae transferred and continued to reared in BW designated as JBWR colony, and BW larvae transferred and continued to reared in FW designated as JFWR colony. Cuticle thickness of the 6$^{th}$ to 8$^{th}$ abdominal segments of ten mid-L4 larvae from each experimental setup was measured. The results demonstrated that the JBW colony had significantly thicker ($p < 0.0001$) cuticle (JBW; [70$^{th}$ Generation; G70] = 1530 ± 111 nm) than the two freshwater colonies (JFW [G70] = 996 ± 132 and NFW [G20] = 945 ± 75 nm). Where salinity conditions had been reversed, the cuticle thickness differed significantly from the parent JBW and JFW colonies (JBWR [G3] = 1512 ± 132, [G11] = 1167 ± 159, JFWR [G3] = 1196 ± 92, [G11] =1402 ± 122 nm). The maximum length and width of four anal papillae of 40 L4 larvae from each of the five colonies were measured. The mean anal papilla length of JBW larvae [G69] was 0.62 ± 0.04 mm, and this was significantly greater ($p < 0.05$) than the mean anal papilla length of two FW colony larvae (JFW [G69] = 0.49 ± 0.06 mm, NFW [G22] = 0.58 ± 0.05 mm). JFWR colony ([G4] = 0.59 ± 0.05, [G11] = 0.6 ± 0.05 mm) tended to have longer lobes than FW larvae maintained in FW and vice versa in JBWR compared to the JBW colony (JBWR [G4] = 0.54 ± 0.03, [G11] = 0.55± 0.05 mm) and this difference was statistically significant ($p < 0.05$). A total of 100 eggs from ten iso females were analyzed, and the mean egg lengths of all five colonies significantly differed ($p < 0.05$) from each other. It is anticipated that changes to the cuticles of salinity-tolerant *Ae. aegypti* larvae may reduce the effectiveness of insecticides used to control arboviral infections. The morphological changes in anal papillae and eggs may alter ion, water, and gas transport mechanisms to allow *Ae. aegypti* to adapt to increased salinity in natural habitats. The results highlight the necessity for further research on the ultrastructure and physiological mechanism of the cuticle and anal papillae in relation to insecticide resistance and the genomic biology of salt tolerance in *Ae. aegypti*.

*Financial assistance from the Swiss National Science Foundation* (*Grant No IZSTZ0_191762*) *is acknowledged.*

**Keywords**: *Aedes aegypti*, Analpapillae, Brackish water, Cuticle, Dengue

***Abstract No: 161*** ***Life Sciences***

# SOLUBILITY ENHANCEMENT OF THE AHL LACTONASE (jsvC) IDENTIFIED FROM *DERMACCOCUS NISHINOMIYAESNSIS*

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Quorum sensing and quorum quenching are two key phenomena in bacterial cell signalling mechanisms. In many bacterial populations, gene expression is regulated by the quorum sensing mechanism using N-acylhomoserine lactone (AHL) as the signalling molecule. Quorum quenching refers to all processes involved in the disturbance of quorum sensing. AHL lactonase breaks down the AHL and leads to quorum quenching. The gene coding for AHL-lactonase (jsvC), which belongs to the phosphotriesterase family, was identified in *Dermacoccus nishinomiyaensis* isolated from the faeces of Carp fish. For the overexpression of AHL-lactonase (jsvC), the gene was cloned into the pET-28a vector and protein was expressed in *Escherichia coli* BL21 (DE3). However, the expressed protein was obtained as an inclusion body. Considering the codon bias and high GC content ( > 65%) of the coding sequence, the expression host was changed to *E. coli* Rosetta™ and *E. coli* BL21-PGro7, which has additional chaperon vector assisting protein folding. Protein expressions were conducted under different conditions by varying temperatures and IPTG concentrations. Irrespective of these optimization attempts, proteins were obtained as inclusion bodies. A newly modified pET-28a/MBP vector with an in-frame maltose binding protein (MBP) coding sequence was used to overcome the solubility issue. The resulting protein contains an MBP fusion tag at the C terminal of the AHL-lactonase (jsvC) protein. The recombinant MBP-jsvC protein was obtained in soluble form in *E. coli* BL21 (DE3) and purified using the amylose resin. To determine the activity of AHL-lactonase (jsvC), N-hexanoyl-HSL (HHL) was used as the substrate and a soft agar overlay assay was performed with the reporter strain *Chromobacterium violaceum* CV026. HHL degradation by AHL-lactonase (jsvC) was confirmed by the colour chromaticity of violacein production.

**Keywords**: AHL-degradation, AHL lactonase, *Dermacoccus nishinomiyaensis,* Inclusion bodies**,** Quorum quenching

***Abstract No: 166*** ***Life Sciences***

# ETHNOMEDICAL SURVEY ON SRI LANKAN HASTI VEDAKAMA: A STUDY BASED ON ELEPHANT CLUSTER AT THE TEMPLE OF THE TOOTH RELIC

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Today, in a situation where many aspects of the Sri Lankan traditional medical system are facing the risk of losing their knowledge, traditional Hasti Vedakama is still prevalent in the country due to the strong bond of the elephants with the Sri Lankan culture, especially associated with the Esala Perahera, one of the main cultural events of Sri Lanka. *Elephas maximus maximus* being an endangered animal species, the traditional Hasti Vedakama is a branch of traditional medicine that should be preserved. This study aimed to recognize the role of the Sri Lankan Hasti Vedakama in the modern society. The study assessed elephant caretakers' preference for traditional medical practices, examined disease prevalence and treatment approaches of Sri Lankan Hasti Vedakama, catalogued different plant species and minerals commonly used for treatments, and identified challenges to the traditional Hasti Vedakama. The study consisted of in-depth discussions with three traditional practitioners registered in the Ayurveda Medical Council of Sri Lanka and a survey was conducted with 26 mahouts. The results showed that 100% of mahouts preferred traditional Hasti Vedakama to treat diseases of elephants. The frequently encountered ailments were different types of wounds, abdominal disorders, and constipation. The frequently used treatment methods were powders, pills, and pastes out of many other treatment methods, including decoctions, tablets, ointments, surgery, fumigation, oil application, fomentation, enema, and administering of medicine through the trunk. Eighty-two plant species belonging to 45 plant families, six minerals, and six basic oils that are most commonly used to treat elephants were identified.

**Keywords**: Asian Elephants, Ethnomedicine, Hasti Ayurveda, Sri Lanka

***Abstract No: 170*** ***Life Sciences***

# IDENTIFICATION OF *BACTROCERA DORSALIS AND BACTROCERA KANDIENSIS VIA COI* BAR-RFLP

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*Bactrocera dorsalis* (Oriental fruit fly) and *Bactrocera kandiensis* (an endemic) are two common fruit flies in Sri Lanka. When discriminating these two species using their external morphology, there were many taxonomic impediments over the phenotypic mutualism. Conservation and management practices are thoroughly influenced by their overlapping ranges and limited taxonomic approaches. Thus, we present a consolidated molecular tool for identifying these two fruit fly species. It is based on polymerase chain reaction (PCR) amplification of the partial mitochondrial *cytochrome oxidase subunit I* (*COI*) gene, followed by restriction fragment length polymorphism (RFLP) assay, with banding patterns resolved *via* agarose gel electrophoresis. The assay was designed using a large training data set obtained from Genbank. These training data were evaluated using an independent test panel of 12 individuals for both species collected from Kandy, Matara, Galle, and Jaffna using pheromone traps (methyl eugenol), for which species assignments were determined *via* phylogenetic comparison to reference sequences. *Drosophila melanogaster* (Common fruit fly) was considered for high-resolution results of the analysis. Theoretical RFLP interpretations and mapping were performed by the NEBcutterV2.0; New England BioLab® Inc. software. After refining the interpretive framework, the PCR-RFLP assay under *MbO*II enzyme treatment was shown to identify the two co-occurring species accurately. The pairwise genetic divergence within species (intraspecific) ranged from 0.00 - 1.80%, and between species (interspecific) ranged from 6.10 - 7.60%. The average interspecific nucleotide divergence was greater than the intraspecific divergence, and it followed the 2% conceptual divergence of discriminating two individuals as two species. Furthermore, the phylogenetic isolation of two distinct clusters into corresponding species groups revealed the utility of *COI* as a barcoding gene. The *COI* Bar-RFLP assay is both cost and time-efficient and will help to improve taxonomic identifications over conventional sequencing methods.

**Keywords**: *COI*Bar-RFLP, Fruit flies, Identification, Mitochondrial, Phylogeny

***Abstract No: 173*** ***Life Sciences***

# EVALUATION OF THERMAL STABILITY OF NATURAL ANTIOXIDANTS EXTRACTED FROM *EMBLICA OFFICINALIS* SEED AND *ANNONA MURICATA* L. FRUIT PEEL AND SEED ON SENSORY PROPERTIES OF SPONGE CAKE

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Food by-products are rich in natural antioxidants that address health issues effectively. The present study aimed to determine the effect of phenolic antioxidants extracted from *Emblica officinalis* seed (ESE), *Annona muricata* seed (ASE), and *A. muricata* fruit peel (APE) on the sensory properties of sponge cakes. The phenolic antioxidants were extracted using ethanol: water (70:30) solvent system. The total phenolic content (TPC) was determined using Folin-Ciocalteu's method and expressed as grams of gallic acid equivalents (GAE) per kilogram of sample. The antioxidant activity and thermal stability of extracts were evaluated using ferric reducing antioxidant power (FRAP) assay and compared with synthetic antioxidants: butylated hydroxytoluene (BHT), butylated hydroxyanisole (BHA), and tert-butyl hydroquinone (TBHQ) at different concentrations (50, 100, 150, 200 and 250 µg/mL). The effect of antioxidants was determined in sponge cake using a standard recipe with 200 mg/kg of antioxidants. Sensory evaluation was conducted to assess the sensory attributes (i.e. appearance, colour, taste, odour, texture, overall acceptability) of prepared sponge cakes using an 11-point hedonic scale and compared with control without added antioxidants. Results showed that the TPC (g GAE/kg) of ESE (374.22±5.09) was significantly higher ($p<0.05$) than APE (316.44±1.92) and ASE (6.92±0.55). ASE showed the highest antioxidant activity with a reducing power of 188.05±1.42% than BHT (121.23±2.68%) and BHA (135.57±1.12%) at 200 µg/mL. However, the antioxidant activity of TBHQ was higher in all concentrations. More than 80% of the antioxidant activity of ESE, ASE, and APE was retained after heating at 180 $^{o}$C. The ranking order of thermal stability showed as ESE>TBHQ>APE>ASE>BHT>BHA. Sensory scores for all attributes of sponge cakes were not significantly different ($p>0.05$) from the control except for texture and overall acceptability in ESE-added sponge cakes that showed significantly higher scores ($p<0.05$). This research has proven that natural antioxidants are promising alternatives for synthetic antioxidants, considering their thermal stability and effect on sensory characteristics.

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**Keywords**: Antioxidant activity, Phenolic antioxidants, Sensory evaluation, Thermal stability, Total phenolic content

***Abstract No: 175*** ***Life Sciences***

# DAILY DIETARY INTAKE OF TOTAL PHENOLICS AND TOTAL FLAVANOIDS FROM CONSUMPTION OF RICE (*ORYZA SATIVA L.*) VARIETIES COMMERCIALLY AVAILABLE IN SRI LANKA

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Asian rice (*Oryza sativa L.*), the dietary staple of Sri Lanka, contains bioactive compounds such as phenolics and flavonoids with multiple therapeutic benefits. As alterations in the net bioavailability occures during domestic cooking, the analyses should be carried out in cooked, table-ready form to reach precise dietary estimations. Total phenolic (TPC) and total flavonoid content (TFC) were quantified in cooked grains of 25 composite rice samples representing 10 commonly consumed varieties available in Sri Lanka. The best varieties with the highest contribution to recommended dietary intakes was determined. Aqueous extracts of lyophilized cooked grain powder ($n$=25) were quantified for TPC and TFC spectroscopically (triplicates) and expressed as Gallic Acid Equivalents (GAE) and Quercetin Equivalents (QE) mg per 100g portion of cooked rice. Data extrapolated with median rice consumption data by Sri Lankan adults (386.5g person-1 day-1). Percentage contribution of TPC was inferred with mean recommended daily intake values at 1.5g person-1 day-1 while TFC was deduced at 0.5g person-1 day-1 in accordance with dietary recommendations and evaluated across rice varieties; traditional/heirloom (*Pachchaperumal (Siyapath-el), Kaluheenati, Suwandel*)), improved (*Nadu*, *Samba*, *Kekulu*), imported (*Indian Basmati*) and pericarp (red/white) colours. The median (Interquartile Range) TPC and TFC for 100g portion of cooked rice was 72.88 (116.52–58.64) mgGAE and 70.20 (80.61–63.06) mgQE, respectively, showing a significant inter-categorical variation ($p$<0.05). TFC resulted in a similar, non-significant trend ($p$>0.05). TPC and TFC intakes from traditional varieties were significantly greater than improved or imported varieties ($p$<0.05). Red pericarp grains contributed a significantly higher percentage than white pericarp grains($p$<0.05). The median (IQR) % contribution of TPC and TFC from rice was 18.78% (30.02–15.11) and 54.26% (62.31–48.75), respectively. Higher consumptions ($CI_{75\%}$=447g person-1 day-1) yielded a ~2.8-fold increase in % contribution of TPC and ~1.2–fold increase in TFC. The highest % contribution (TPC=52.52%; TFC=79.35%) resulted in *Pachaperumal* (*Siyapath el*) variety, while minimum values (TPC=12.71%; TFC=42.07%) were reported by *white Kekulu* grains. Imported *Indian Basmati* reported 13.26% and 49.41% for TPC and TFC, respectively. Sri Lankan rice is a good source of bioactive compounds, and daily consumption of cooked rice contributed to >18% and >50% of the recommended dietary intake of phenolics and flavonoids, respectively.

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**Keywords**: Cooked grains, Rice consumption, Sri Lankan rice**,** TFC, TPC

***Abstract No: 176*** ***Life Sciences***

# CYTOKINE RESPONSES OF DIFFERENT CATEGORIES OF LYMPHATIC FILARIASIS PATIENTS IN GALLE DISTRICT, SRI LANKA

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Lymphatic Filariasis (LF) is one of the neglected tropical diseases (NTDs) which cause lifelong disfiguring complications. A complex network of innate and adaptive immune responses largely contributes to establishing a wide array of pathologies of filariasis, which are clinically classified into chronic, acute, and asymptomatic categories. Generally, in *in vitro* assays, filariasis infection is characterized by the predominant Th2 response. However, there is limited evidence of immunopathology of filariasis from the *in vivo* setting, particularly from different clinical categories. Therefore, the present cross-sectional study was conducted in Galle District in Sri Lanka during 2021-2022 to evaluate the pro and anti-inflammatory cytokine responses of different disease categories of filariasis: endemic controls, asymptomatic carriers, cryptic, chronic patients, and control groups. A total of 250 individuals (50/group) were included in the study. Participants were recruited based on random sampling frames, and basic demographic information was obtained from a self-administered questionnaire. Serum levels of cytokine (pro-inflammatory (Interferon-gamma: IFNɤ) and anti-inflammatory (Interleukin: IL10) were assessed using a sandwich ELISA procedure. Statistical analysis was done using SPSS software. Chi-square test and one-way ANOVA with the Bonferroni test were done to compare the findings between groups. A higher male preponderance of positivity was observed among disease groups: antigen-positive cryptic patients ($Z=2.3$, $P<0.05$), microfilaria-positive asymptomatic carriers ($Z=4.0$, $P<0.001$), and chronic patients ($Z=1.1$, $P=0.25$). Chronic complications were higher with older ages ($p<0.05$). Serum IFNɤ levels were significantly higher in chronic (273±10.34 pg/mL), endemic control (211.57±5.78 pg/ml), and cryptic (222.37±6.54pg/mL) compared to the non-endemic control (193 ± 6.54 pg/mL) ($p<0.05$). Asymptomatic carrier patients had a significantly higher IL10 level (151.3±23.5 pg/mL) compared to non-endemic control (61.99 ± 2.96 pg/mL) ($p<0.05$). Also, the IFNɤ/IL10 (Th1/Th2) was significantly higher in both cryptic (5.58±0.39) and chronic (7.05±0.47) groups compared to the control (3.59±0.24) ($p<0.05$). This study reports a predominant Th1 response in chronic patients, which contradicts the traditional immune response for exposure to antigens in filarial infection but supports immune response due to chronic complications and the difference in cytokine profile of older patients to younger patients. Thus, expanded studies are warranted for a comprehensive understanding of cytokine responses that could establish biomarkers of the progression of filariasis.

**Keywords**: Cytokines, Filariasis, Interferon-gamma, Interleukin-10, Sri Lanka

***Abstract No: 177*** ***Life Sciences***

# RISK FACTORS OF DENGUE HEMORRHAGIC FEVER AMONG ADULT DENGUE PATIENTS IN THE WESTERN PROVINCE OF SRI LANKA: A CASE-CONTROL STUDY

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Dengue infection has spread rapidly within countries and across regions in the past few decades, resulting in an increased frequency of epidemics. Infection with any of the dengue virus (DENV) serotypes may result in a broad spectrum of clinical symptoms ranging from a mild flu-like syndrome, dengue fever (DF), to the most severe forms of the disease, dengue hemorrhagic fever (DHF), with coagulopathy and permeability. The signs and symptoms of DHF usually arise late in the disease course when the fever has subsided, making it difficult to predict. Hence, identifying risk factors that accurately predict progress to DHF would significantly contribute to implementing proper intervention and treatment strategies for those at greater risk. This case-control study included 136 adult DHF patients (18 years and above) as cases and 136 DF patients (18 years and above) as controls from four leading hospitals of the Western Province in 2022 to identify the independent risk factors of DHF among adult dengue patients. Participants were recruited for the study by applying consecutive sampling techniques, and independent risk factors under the categories of socio-demographic, clinical and serological were assessed using a questionnaire survey with informed consent. Chi-square and binary logistic regression were performed to identify potential risk factors. Though 20 factors were significant in the bivariate analysis, when the logistic regression was performed to adjust the confounding effect, only six independent predictors showed significant associations with the DHF patients compared to DF patients: Demographic factors such as belonging to other ethnic groups (Tamils, Muslims, Burghers) compared to Sinhalese (aOR = 0.143, 95% CI: 0.043 – 0.470), clinical manifestations; such as abdominal pain (aOR = 3.172, 95% CI: 1.381– 7.285), altered consciousness/ confused state (aOR=8.395, 95% CI: 1.527 - 46.161), systolic blood pressure on admission (aOR=1.014, 95% CI: 1.002-1.027), right hypochondrial tenderness (aOR= 10.839, 95%CI: 3.063 - 38.347), and laboratory characteristics; serum creatinine on admission (aOR= 1.028, 95%CI: 1.018 - 1.038) were identified as significant risk factors of progression of DHF of adult patients ($p<0.05$). Collectively, the results of this study strengthen the understanding of the risk factors of DHF adult patients of the Western Province in Sri Lanka that could be identified from the patient's clinical parameters and by results of low-cost routine laboratory investigations.

**Keywords**: A case-control study, Dengue, Hemorrhagic fever, Risk factor, Sri Lanka

***Abstract No: 178*** ***Life Sciences***

# *PANTALA FLAVESCENS* (WANDERING GLIDER) AND *CERIAGRION COROMANDELIANUM* (YELLOW WAXTAIL) AS PREDATORS OF PREIMAGINAL STAGES OF *AEDES AEGYPTI* (DIPTERA: CULICIDAE) IN FRESH AND BRACKISH WATER HABITATS FROM JAFFNA, NORTHERN SRI LANKA.

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The present study aimed to report the efficiency and the potential use of natural predators as biological control agents to control the preimaginal stages of primary dengue vector *Aedes aegypti* in the Jaffna peninsula as preliminary research. Nymphal stages of dragonfly *Pantala flavescens* and damselfly *Ceriagrion coromandelianum* were collected from local ponds. They were acclimatized to the freshwater (0 ppt /g $L^{-1}$) and brackish water (10 g $L^{-1}$) to conduct the experiments against the standard laboratory colonies (0 g $L^{-1}$ and 10 g $L^{-1}$) of mosquito *Ae. aegypti*. The experiment was conducted in triplicates and repeated thrice with different individual predators. Hundred, third instar larva of *Ae. aegypti* were introduced, and the predatory activity was recorded every 24 hours up to 72 hours. The prey density was maintained by replenishing the same number of larvae. The predatory rate (PR), predatory impact (PI), and clearing rate (CR) were calculated for both predators for both salinities. The results indicated that both predators show promising efficacy in controlling the mosquito larvae, where the clearing rate of the *P. flavescens* was significantly high ($p < 0.05$) over *C. coromandelianum* in both freshwater ($p = 0.0003$), and brackish water ($p = 0.0003$) experiments, and the predatory impact and the predatory activity were also exhibited considerably high in the dragonfly *P. flavescens* both in the freshwater and brackish water environments. The damselfly *C. coromandelianum* shows an increasing trend in its clearing rate of prey over time, with slight variations based on salinity. The preliminary results of the study suggest that these natural predators could be introduced as a green solution to control the preimaginal stages of mosquito species in both freshwater and brackish water habitats, and this could potentially aid in reducing the prevalence of dengue and other mosquito-borne diseases in coastal areas like Jaffna Peninsula.

**Keywords***: Aedes aegypti, Ceriagrion coromandelianum,* Clearing Rate, *Pantala flavescens* Predatory impact

***Abstract No: 192*** ***Life Sciences***

# IMPACT OF HABITAT TYPE AND FLORAL RESOURCE AVAILABILITY ON GROUND-NESTING BEE ESTABLISHMENT IN AN AGRO-NATURAL LANDSCAPE

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In agroecosystems, ground-nesting bees are crucial for efficient pollination. Ground-nesting bees are susceptible to habitat degradation and resource loss. Habitat destruction has a negative impact on the bee pollination. The effect of changes in habitat and resource availability on ground-nesting bee species composition remains poorly understood. The present study investigates how changing habitat and floral resources affect the species composition of ground-nesting bees. The research was conducted at Meewathura Farm in Peradeniya, where three distinct habitats were established: peripheral weedy, crop, and ornamental habitats. The ground nests of bees and their species, along with floral resources (number of open flowers), were recorded weekly during three developmental stages of the crop in two consecutive years (2021-2023) during the Yala and Maha seasons. Six ground-nesting bee species: *Lasioglossum serenum, Leuconomia* sp., *Lipotriches exagens*, *L. edirisinghei, L. pulchriventris,* and *Patellapis kaluterae,* (F: Halictidae) were identified. Ground-nesting bee species composition significantly differed among habitats ($p$ = 0.0001). Results revealed that ground-nesting bees were more likely to nest within crop habitats (328 nests) than in peripheral weedy and ornamental habitats (269 and 244 nests, respectively). A weak but significant positive correlation existed between ground nests and their species richness with open flower abundance ($R^2$ = 0.230, $R^2$ = 0.197, respectively). Significant variations in ground nests and ground-nesting bee species richness were observed across seasons and years ($p$ = 0.0001). Ground-nesting bee species composition varied with floral resources, habitats, seasons, and years, but these factors interacted negatively. A high proportion of bare grounds in crop habitats serve as dwellings for ground-nesting bee establishments. This study highlights the importance of habitat types and resource availability to promote the coexistence and composition of ground-nesting bees, thus maintaining their vital role as pollinators in agroecosystems.

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

**Keywords**: Biodiversity, Ground-nesting bees, Habitat loss, Pollination, Resource availability

# Physical Sciences

***Abstract No: 8*** ***Physical Sciences***

# DEVELOPMENT OF AN ELECTRIC VEHICLE FOR THE DIFFERENTLY ABLED WITH SOLAR ASSIST

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A wheelchair is a necessary assistive device for differently abled people to improve their independence, mobility, and quality of life. Manual wheelchairs suffer a huge mechanical efficiency loss with the risk of discomfort and damage to the upper limbs and spine. The best way to overcome the imperfection in mechanical working is to find an alternative using electricity with mobility impartments. A survey-based study suggests that the differently abled suffer in handling the joysticks, thus, reluctance towards such power sources. Indeed, this work is concerned with improving the travelling distance using a solar assist system while introducing a smartphone-based controlling mechanism with the modified version of the joystick application. A research gap has been identified regarding portability while powering them two modes. The difficulties in handling the joystick are also clearly addressed using Bluetooth data transmission. The project aims at achieving a maximum velocity of 12 km/h with solar assist and smartphone control. In construction, a manual wheelchair with an adjustable backrest has been chosen, and a solar panel has been mounted as a roof while incorporating a 24 V motor. The mathematical calculations revealed that the system requires 355 W of motor power and 25 Nm torque while producing 133 rpm. The developed unit has been tested for power usage: battery power alone and dual-powered mechanisms. The maximum speed achievable at the given condition was reported as 8 km/h. The system could cover 24 km using the battery power source and 27 km using both the battery and solar assist. The unit achieved an improved range with the dual-source power supply, thus covering nearly 3 km of additional range compared to a system powered by battery only. This confirms that the power from solar increased the travelling distance while making portable and easily dismantlable solar panel frames. The major limitation noted is the time of charging. It is suggested to investigate improving the charging potentials. Overall, the present study provides an effective method of expanding motorized wheelchair travelling distance. The research suggests the importance of maintenance due to the chain transmission system. Moreover, it opens the area for more investigation in terms of minimizing the weight of the system.

**Keywords**: Battery powered, Electric powered wheelchair, Handicapped assist, Smartphone control

***Abstract No: 18*** ***Physical Sciences***

# TITANIUM / TITANIUM DIOXIDE SCHOTTKY JUNCTION AND HIGHLY PHOTOACTIVE ANTIMONY SULPHIDE PHOTOANODE FOR SOLAR WATER SPLITTING

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Artificial photosynthesis has emerged as a promising solution for producing sustainable chemical fuels, including hydrogen, to address the energy and environmental challenges associated with non-renewable energy sources like fossil fuels. Among the various approaches, photoelectrochemical water splitting, mainly based on metal oxide semiconducting materials, has garnered significant attention. These materials offer suitable band gaps, flat band potentials, low electrical resistance, and excellent corrosion resistance in aqueous solutions, making them ideal for achieving efficient solar conversion efficiency. One such material of interest is $Ti/TiO_2$ nanotube arrays (TNTA) Schottky junction, which is synthesized through electrochemical anodization. This has captured considerable scientific interest due to their simplicity in synthesis, high electron mobility, and controllable dimensional parameters. By employing a facile electrochemical synthesis strategy on a porous Ti metal sheet, the TNTA Schottky junction is synthesized. To enhance its performance further, the concept of an n/n heterostructure is introduced by coating the TNTA photoanode with an n-type stibnite ($Sb_2S_3$) layer. $Sb_2S_3$ is selected for its suitable band gap position and high visible light response. In this study, it was demonstrated that incorporating a thin layer of $Sb_2S_3$ significantly enhances the photoelectrochemical response of the TNTA Schottky junction. The highest photoelectrochemical response of 2.81 mA $cm^{-2}$ was achieved for the $TNTA/Sb_2S_3$ photoanode under AM 1.5 G illumination at 0.8 V vs. RHE in a 0.5 mol $dm^{-3}$ $Na_2SO_3$ aqueous solution. Notably, this response is more than ten times greater than that observed for the bare TNTA photoanode. The improved performance has been attributed to several factors, including a lower recombination rate of photogenerated charge carriers, broadened spectral response, and enhanced charge transfer/transport occurring at the solid/liquid interfaces facilitated by the morphology of $TiO_2$ and incorporation of $Sb_2S_3$.

*Financial assistance from the National Institute of Fundamental Studies (NIFS) is acknowledged.*

**Keywords**: Photoelectrochemical Water Splitting, Stibnite, TNTA.

***Abstract No: 23*** ***Physical Sciences***

# A NANO GRAVIMETRIC APPROACH TO STUDY THE PHOTOCATALYTIC ACTIVITY OF NANO TITANIA THIN FILMS

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Self-cleaning photocatalytic nanocoatings have garnered considerable attention due to recent global public health crises, such as the COVID-19 pandemic. Nevertheless, most of the evaluations validating the efficacy of such coatings have focused on solid-liquid interfaces. There is a scarcity of real-time, *in situ* information that sheds light on the photocatalytic degradation occurring on titania thin films at the solid-air interface. In this particular investigation, a titania nanocoating was fabricated on a gold surface of a quartz crystal microbalance (QCM) sensor using a spin coating technique. To serve as a representative organic molecule, methyl orange (MO), a potent environmental pollutant, was added to these nanocoatings. Subsequently, the sensor was subjected to ultraviolet (UV) light irradiation while continuously monitoring the mass changes at the solid-air interface in real-time. Results indicated that when the mass of the dye was lower than approximately 3% of the mass of the catalyst, MO could be photocatalytically degraded in approximately six hours of continuous UV irradiation. Conversely, higher MO loadings only exhibited partial degradation. The morphology and elemental compositions of the QCMs were characterized before and after irradiation using Scanning Electron Microscopy (SEM), Energy Dispersive X-ray Spectroscopy (EDX), and X-ray Photoelectron Spectroscopy (XPS). This study offers ample comprehension and profound insight into the molecular-level phenomena taking place during photocatalytic degradation at the solid-air interface, thereby enabling successful modelling and evaluation of the effectiveness of self-cleaning photocatalytic coatings.

**Keywords**: Methyl orange, Photocatalytic degradation, QCM, Thin films, Titania

***Abstract No: 24*** ***Physical Sciences***

# ASSESSMENT OF CYTOTOXICITY OF SELECTED EDIBLE LEAFY PLANTS OF SRI LANKA

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This study was carried out to assess the cytotoxicity of extracts of leafy plants, namely *Premna procumbens* Moon (*Le-kola pala*: LE), *Memecylon umbellatum* (*Kora kaha*: KK), *Polyscias scutellaria* Fosberg (*Koppa*: KO), *Stevia rebaudiana* Bertoni (*Stevia*: ST) and *Atlantia ceylanica* (*Yaki naran*: YK) using brine shrimp (*Artemia salina*) lethality bioassay. According to traditional knowledge, these plants may be believed to have medicinal properties. However, scientific evidence is scarce on their biological properties. Therefore, these plants were selected to assess their cytotoxic property. Plant leaves were sequentially extracted with hexane, ethyl acetate (EtOAc), and methanol (MeOH) as solvents. Brine shrimp eggs were hatched and the active nauplii were used in the bioassay. The cytotoxicity of plant extracts was reported as lethal concentration ($LC_{50}$). A concentration series (62.5-2000 mg $L^{-1}$) of crude extracts was prepared by dissolving the crude plant extracts in artificial seawater. Ten active nauplii were added to each 1 mL of extract in 24 well semi microplate and kept at room temperature for 24 h under illumination. The lethal concentration ($LC_{50}$) was determined by counting surviving nauplii after 24 h. Among hexane extracts, the strongest cytotoxicity was observed for YK ($LC_{50}$ = 190.98 ± 4.92 mg $L^{-1}$), while KO and ST showed moderate cytotoxicity with $LC_{50}$ of 500.00 ± 0.00 mg $L^{-1}$ and 1724.70 ± 80.65 mg $L^{-1}$, respectively. No cytotoxicity was observed for hexane extract of LE and KK. Among EtOAc extracts, the strongest cytotoxicity was displayed by YK ($LC_{50}$ = 234.18 ± 13.79 mg $L^{-1}$), while lower cytotoxicity potential was observed for KO and ST. EtOAc extracts of LE and KK did not show any cytotoxicity. All MeOH extracts showed moderate to weak cytotoxicity. Among them, the strongest activity was observed for KO ($LC_{50}$ = 486.16 ± 30.23 mg $L^{-1}$). When compared with all plant extracts, the positive control ($K_2Cr_2O_7$) showed significantly ($p < 0.05$) higher cytotoxic activity ($LC_{50}$ = 14.62 ± 0.87 mg $L^{-1}$). This study concludes that YK and KO have higher cytotoxicity when compared to other leafy plants. Therefore, YK and KO maybe sources of anti-cancer compounds and can have the potential to be used to develop drugs against cancers.

**Keywords**: Brine shrimp lethality, Cytotoxicity, Edible leafy plants, Lethal concentration

***Abstract No: 31*** ***Physical sciences***

# DETERMINATION OF BRINE SHRIMP LETHALITY OF DIFFERENT SOLVENT EXTRACTS OF SOFT STEMS OF DIFFERENT BANANA (*MUSA SP.*) CULTIVARS

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Banana stems are a waste product once the fruit bunches are harvested, and they have also lost their significance among the current generation due to the lack of awareness of their values. In this study, the soft stems of the Ambulkesel, Seenikesel, Suvandel, and Alukesel cultivars of the *Musa sp.* (banana plant) were investigated for their brine shrimp lethality effect against *Artemia salina* nauplii. Powdered soft stems of four cultivars were sequentially extracted with dichloromethane (DCM), ethyl acetate (EtOAc), and methanol (MeOH). The crude extracts were tested for brine shrimp lethality (BSL) using *A. salina* nauplii of the second instar. This work used seawater and 1% dimethyl sulphoxide (DMSO) as the negative control and potassium dichromate ($K_2Cr_2O7$) as the positive control. The soft stems of four banana cultivars showed moderate toxicity ($LD_{50}$ < 2000 mg $L^{-1}$) toward *A. salina*, according to the results of the BSLA, while the overall lethality percentage was discovered to be dose-dependent of the crude extract within the chosen range of 62.5–2000 mg $L^{-1}$. The toxicity properties of DCM, EtOAc, and MeOH extracts of these soft stems showed $LD_{50}$ values ranging from 891.1-1071.4 mg $L^{-1}$, 1246.8-1428 mg $L^{-1}$, and 696.5-822.2 mg $L^{-1}$, respectively. The DCM crude extracts of banana soft stems of the *Ambulkesel, Seenikesel, and Alukesel* cultivars and the MeOH extracts of all four cultivars showed toxic activity against the second nauplii of *A. salina* in accordance with literature, that classified crude extracts and pure substances into toxic ($LD_{50}$ value 1000 mg $L^{-1}$) and non-toxic ($LD_{50}$ > 1000 mg $L^{-1}$). The BSL assay showed that the most active fraction is the methanol fraction of the *Seenikesel* cultivar, with an $LD_{50}$ value of 696.5 mg $L^{-1}$. Compared to potassium dichromate, DCM and MeOH extracts of four cultivars displayed moderate toxicity against *A. salina*. No lethality percentage was detected in the negative control. The $LD_{50}$ values of soft stems of banana plant extracts to brine shrimps indicate the presence of potent components, which will be explored further.

**Keywords**: *Artemia salina*, Brine shrimp, Lethal concentration, *Musa spp*., Soft stems

***Abstract No: 48*** ***Physical Sciences***

# REMOVAL OF MAGNESIUM IONS BY FUNCTIONALIZED CARBON NANOTUBE

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Functionalized carbon nanotubes (CNTs) have been extensively studied for various applications, including environmental remediation. One such application is the removal of magnesium ions ($Mg^{2+}$) from water. The physicochemical characteristics of carbon nanotubes make them suitable for ion adsorption. The functionalization of carbon nanotubes involves modifying their surface properties by attaching different functional groups or molecules to enhance their performance. Magnesium can be removed from water through various treatment processes. In specific industrial applications, such as manufacturing or chemical processes, magnesium in water becomes necessary to ensure the quality and functionality of the products or processes. Carbon nanotubes were synthesized from camphor by chemical vapour deposition at 700 ℃.. Carbon nanotubes were characterized and confirmed with SEM, PXRD, Raman spectroscopy, and UV-Vis spectroscopy. Carbon nanotubes thus synthesized were functionalized with carboxylic and hydroxyl groups by using $KMnO_4$ solution, characterized and confirmed by using FT-IR analysis. The magnesium removal efficiency of functionalized carbon nanotube was examined with different concentrations of magnesium solution such as 1000, 800, 600, 400, and 200 mg $L^{-1}$ showed removal efficiency 28.3%, 33.4%, 35.5%, 45%, and 57.5%, respectively. Further, it showed increased efficiency with the increased amount of functionalized carbon nanotubes.

**Keywords**: Carbon nanotubes, Characterization, Functionalization, Magnesium

***Abstract No: 54*** ***Physical Sciences***

# MODEL VALIDATION OF Cu(Ⅱ)- KAOLINITE SYSTEMS BY IN-SITU MEASUREMENT OF FREE METAL ION ACTIVITIES

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Surface complexation modelling methods are extensively used to quantify the chemical speciation at the mineral-water interface. However, the input parameters are often not uniquely defined. In 1-pK modelling of metal ions adsorption, the basic Stern layer model (1-pK SLM) calculations require six parameters, viz., specific surface area, site density, inner and outer layer capacitance, and intrinsic acidity/binding constants. The number of input parameters by introducing free $Cu^{2+}$ ions as an observation to determine its binding constants was reduced by 1-pK SLM. The copper selective electrode (Cu-ISE) was calibrated using ethylenediamine/$Cu^{2+}$ metal ions buffer to extend the Nernstian $Cu^{2+}$ detection limit to $10^{-15}$ M. Spectral data also suggests bidentate complexation of $Cu^{2+}$ with $\equiv AlOH^{-0.5}$ and ion exchange complexes between $Cu^{2+}$ and ≡Si-OH sites as follows, $(\equiv AlOH)_2Cu^{+}$ pK = -2.8, $(\equiv SiO_2)Cu^{0}$pK= - 8.4 and $(\equiv X)_2Cu$ pK = -2.02. The ISE measurements of free $Cu^{2+}$ seem to interfere with the presence of $CuOH^{+,}$ particularly when the solution is pH > 7.0. When the analytical data are corrected for $CuOH^{+}$ interference, the measured $\{Cu^{2+}\}$ of the Cu-kaolinite system is predicted well with 1-pK SLM modelled data. Using this method, the number of input parameters reduced to five while simulating $Cu^{2+}$ - kaolinite interface processes reasonably well is considered a novel method concerning the experiment results. Quantifying chemical speciation at mineral-water interfaces could be done using consistent parameters with reference to the above experiment.

**Keywords**: Copper, Modeling, Surface complexation

***Abstract No: 56*** ***Physical sciences***

# MULTI-TARGET INHIBITORY ACTIVITY OF *SALICORNIA BRACHIATA* AND *SUAEDA MARITIMA* SEED ON α-AMYLASE, TYROSINASE AND LIPASE

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Diabetes mellitus is a complex metabolic disorder that involves enzymes like α-amylase, tyrosinase, and lipase. Since currently used antidiabetic drugs have undesirable contraindications, plant metabolites, particularly seed-based metabolites, has gained special attention in scientific research as a promising source of enzyme inhibitors. With previous reports of promising activities of *Salicornia brachiata* and *Suaeda maritima*, this study aimed to explore the enzyme inhibition potential of extracts derived from the seeds of these two halophytic plant species. The seeds were sequentially extracted using hexane, dichloromethane (DCM), and methanol by cold maceration and tested for *in-vitro* inhibitory activity against α-amylase, tyrosinase, and lipase. The extracts of *S. brachiata* and *S. maritima* seeds effectively inhibited α-amylase activity by 52-83% and 18-73%, respectively, at 0.2 mg $mL^{-1}$. The hexane fraction of *S. brachiata* showed 83.50 ± 1.09% (at 0.2 mg $mL^{-1}$) inhibition activity that was not significantly different from the inhibition activity of acarbose, the positive control (at 0.2 mg $mL^{-1}$, 84.23 ± 0.88%; p=0.05). It is reported that inhibiting this enzyme slows carbohydrate digestion, lowering postprandial glucose levels. DCM fraction of *S. brachiata* and *S. maritima* seeds showed tyrosinase inhibitory activity of 57.90 ± 0.84% and 17.80 ± 0.94%, respectively, at 0.2 mg $mL^{-1}$, whereas Kojic acid, the positive control had an inhibitory activity of 86.00 ± 0.43% (at 0.2 mg $mL^{-1}$). Since tyrosinase inhibitors are directly involved with melanin biosynthesis, the findings are useful in managing hyperpigmentation caused by oxidative stress in diabetic patients. Moderate inhibition of lipase was observed in the hexane and methanol extracts of *S. brachiata* seeds (33-38%, at 0.4 mg $mL^{-1}$), while the DCM fraction showed activity of 54.39 ± 3.40% at 0.4 mg $mL^{-1}$, comparable to orlistat (60.83 ± 0.22%, at 0.4 mg $mL^{-1}$), the positive control. The three extracts from *S. maritima* seeds exhibited 36-43% (at 0.4 mg $mL^{-1}$) inhibition towards lipase, which is important for managing fasting glucose and insulin levels and reducing the risk of obesity-related type 2 diabetes. The obtained results prompt a preliminary conclusion towards the potential use of *S. brachiata* and *S. maritima* seeds as multi-target enzyme inhibitors for the modulation of metabolic diseases such as diabetes and associated complications.

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**Keywords**: Diabetes, Enzyme inhibitors, Halophyte seeds, Hyperpigmentation, Obesity disorders

***Abstract No: 69*** ***Physical Sciences***

# DEVELOPMENT OF HUMIDITY SENSING COMPOSITE MATERIAL USING $SnO_2$ DOPED PHENOL FORMALDEHYDE (PF) DERIVED CONDUCTIVE CHARCOAL

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Humidity sensors play a vital role in various industries and medical applications, necessitating the development of cost-effective sensing materials to meet the increasing demand. This study focuses on creating a low-cost sensor material derived from waste polymer materials and compares its sensing characteristics, including resistance, hysteresis, recovery and response times, and stability concerning relative humidity. By subjecting phenol formaldehyde (PF) to thermal modification at 700 °C, conductive carbon was produced. Subsequently, $SnO_2$ was doped via hydrothermal treatment at 140 °C. The resulting $SnO_2$-doped pyrolyzed carbon composite was deposited onto gold-coated resistive-type electrodes to fabricate the sensor. The composite material underwent characterization using techniques such as scanning electron microscopy (SEM), powder X-ray diffraction spectroscopy (PXRD), thermal gravimetric analysis (TGA), and Raman spectroscopy. Further, the performance of the humidity sensor was investigated. The resistance response demonstrated values of 54188.30 and 27876.50 Ω as relative humidity (RH) increased from 33% to 95%. The recovery time and response were determined to be approximately 11 s and 40 s, respectively. The humidity sensitivity of the $SnO_2$ charcoal composite was found to be 227.55 Ω per percentage RH, attributed to the enlarged specific surface area resulting from its unique nanostructure. These are just a few examples of applications where high-sensitivity humidity sensors are valuable. The sensitivity of the sensor directly affects its ability to detect small changes in humidity levels, making it a key factor in achieving accurate and reliable measurements in these critical domains. These findings indicate that the $SnO_2$ charcoal composite holds promise as an ideal material system for producing high-performance and cost-effective humidity sensors.

*Financial assistance from the National Research Council (Grant No. NRC/19/060) is acknowledged.*

**Keywords**: Humidity sensing, Hydrothermal reaction, Nanotechnology, Pyrolization

***Abstract No: 77*** ***Physical sciences***

# CHARACTERIZATION OF SEED OILS OF FOUR *GARCINIA* SPECIES TO ASSESS POTENTIAL APPLICATIONS IN COSMETICS AND DIETARY SUPPLEMENTS

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Sri Lanka has a wide variety of oil-bearing seeds that often end up in waste without proper utilization. On the other hand, plant seed oils have emerged as a promising avenue for application in cosmetics and dietary supplements. However, most of the plant seed oils found in Sri Lanka are not characterized by their chemical compositions. This study aims to characterize seed oils of *Garcinia zeylanica, Garcinia xanthochymus, Garcinia morella,* and *Garcinia mangostana* by determining fatty acids (FA) composition, constituents in the unsaponifiable matter, and other physical properties. The oil was extracted into hexane using Soxhlet extraction. Ash content of seeds, acid value (AV), iodine value (IV), and smoke point of oils were also determined. Prepared fatty acid methyl esters (FAME) and constituents in unsaponifiable matter were identified and quantified using GC-MS. TGA was performed to assess the thermal behaviour of seed oils. The findings indicated that *G. mangostana* and *G. zeylanica* produced higher oil yields of 53.02% and 48.15%, respectively, compared to the other two. The smoke point varies from 202.1 ± 7.1 °C to 229.6 ± 1.5 °C. The AVs range from 4.43 ± 0.56 to 27.35 ± 0.06 mg KOH $g^{-1}$, while the IVs ranged from 6.62 ± 1.32 to 13.15 ± 0.05 g $I_2$ per 100 g. The ash content varied from 1.12 ± 0.10% to 4.43 ± 0.10%. The yield of unsaponifiable matter of these oils ranged from 0.33 ± 0.01% to 3.30 ± 0.01%. The major FAs in all the oils were long-chain FAs such as Oleic, Stearic, and Palmitic acids. *Garcinia xanthochymus* contained the highest amount of Lanosterol, while *G. zeylanica* contained the highest amounts of Campesterol and γ-Sitosterol. *Garcinia morella* contained the highest amount of Stigmasterol and Squalene. In conclusion, the findings suggest that all four oils exhibit a high potential for use in both dietary supplements and in the cosmetic industry.

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**Keywords**: Cosmetics, Dietary supplements, Fatty acids, Genus Garcinia, Unsaponifiable matter

***Abstract No: 78*** ***Physical Sciences***

# EVALUATION OF INSECT-REPELLENT ACTIVITY OF *PIPER LONGUM* (L.) BASED NANO-EMULSIONS FOR THE CONTROL OF *SITOPHILUS ORYZAE* (L.) (COLEOPTERA: CURCULIONIDAE)

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The rice weevils (*Sitophilus oryzae*) cause significant damage to grains and their milled products during storage, and the control of these insects relies on the use of synthetic insecticides. Due to the deleterious impact caused by these chemicals on biological systems, plant-derived essential oils (EOs) have been used as effective bio-insecticides for managing stored grain insects, providing a safer alternative. Therefore, this study aimed to develop nano-emulsions based on *Piper longum* EO to improve EO's efficacy and evaluate its repellent activity against *Sitophilus oryzae*. GC/MS analysis was conducted for *P. longum* EO, and two combinations, 1:2 and 1:2.5 (EO: Tween 80) of 6% EO concentration, were prepared. Physiochemical characterization of both combinations of *P. longum* nano-emulsions was conducted. Myristicine (61.42%), and caryophyllene (7.98%) were the major constituents of *P. longum* EO. Particle sizes of the nano-emulsions were 10.22 nm and 12.10 nm, polydispersity index (PDI) was reported as 0.438 and 0.292, and zeta potentials were -1.7 mV and -0.80 mV, respectively, for these two combinations. Median repellent concentrations ($RC_{50}$) for the formulated *P. longum* nano-emulsions of 1:2 and 1:2.5 combinations against *S. oryzae* were 0.019 μL $cm^{-2}$ and 0.014 μL $cm^{-2}$ respectively, whereas $RC_{50}$ recorded for *P. longum* EO was 0.123 μL $cm^{-2}$ within 24 hrs. Accordingly, the formulated nano-emulsions were superior over *P. longum* EO. Thus, it can be concluded that the prepared nano-sized *P. longum* EO can be effectively used as an eco-friendly alternative to harmful chemical insecticides to control insect pest infestations in stored grain food commodities successfully.

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**Keywords**: Nano-emulsion, *Piper longum*, Repellent activity, *Sitophilus oryzae*

***Abstract No: 83*** ***Physical sciences***

# DETERMINATION OF PHENOLIC CONTENT AND ANTIOXIDANT POTENTIAL OF A NUTRIENT SUPPLEMENT DEVELOPED USING SELECTED LOCAL GRAIN VARIETIES IN SRI LANKA

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Antioxidant properties of food products are significantly important due to their potential health benefits. This study investigates the antioxidant properties of an extruded composite flour mixture made of selected local grain varieties in Sri Lanka. The mixture was prepared by combining kalu heenati rice (*Oryza sativa*), black gram (*Vigna mungo*), green gram (*Vigna radiata*), meneri (*Panicum miliaceum*), black sesame (*Sesamum indicum*), black seeds (*Nigella sativa*) and cinnamon in statistically designed ratios to create a balanced nutritional profile. Several antioxidant assays were employed in triplicate to evaluate the antioxidant activity of the composite flour mixture, including total phenolic content (TPC), and radical scavenging activity using 2,2-diphenyl-1-picrylhydrazyl (DPPH), 2,2'-azino-bis (3-ethylbenzothiazoline-6-sulphonic acid) (ABTS) radicals and ferric reducing antioxidant power assay (FRAP). The results indicated that the TPC of the flour formulation was 0.45 ± 0.1 mg gallic acid equivalent /g dry weight. DPPH, ABTS, and FRAP assays revealed that the grain extract had antioxidant activities of 0.67 ± 0.3, 0.92 ± 0.1, and 0.72 ± 0.1 in mg trolox equivalent per gram dry weight (mg, TEAC/g dw) respectively. These values were significantly higher than that of a leading extruded composite flour mixture in the market ($p < 0.05$). The TPC of the market sample was 0.19 ± 0.2 mg gallic acid equivalent /g dw. DPPH, ABTS, and FRAP assays of this sample exhibited antioxidant activities of 0.50 ± 0.1, 0.74 ± 0.3, 0.59 ± 0.1 TEAC/g dw, respectively. These findings highlight the potential health benefits of the flour mixture as part of a balanced diet to enhance antioxidant defence. In conclusion, the presence of phenolic compounds, along with effective radical scavenging activity, contribute to the overall antioxidant potential of the composite flour mixture. Further investigations into the specific bioactive compounds of the flour mixture would provide valuable insights into the development of functional food products with enhanced antioxidant properties.

*Financial assistance from the university* (*Grant No ASP/01/RE/SCI/202`/93*) *is acknowledged.*

**Keywords:** Antioxidants, Composite flour, Grains, Phenolic compounds

***Abstract No: 89*** ***Physical Sciences***

# COMPARISON OF X-RAY ATTENUATION IN THE ENERGY RANGE OF 50-80 keV IN ALUMINIUM AND ZIRCON MINERAL ENCASED IN EPOXY MATRIX

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X-rays are ionising radiation that can penetrate and be absorbed in varying degrees by different materials. They are used in a range of applications, including radiography. However, exposure to X-rays can have harmful effects. Hence, the appropriate use of radiation shielding is essential to prevent unnecessary exposure to radiation for radiation workers, patients, and the general public. Lead and lead-based compounds are commonly used as shielding materials. Given the hazards associated with lead-based compounds, there is a growing interest in developing lead-free shielding materials that can offer comparable shielding properties. The project aimed to synthesize a lead-free and cost-effective shielding material that could attenuate X-rays in the energy range of 50-80 keV using locally available minerals. Samples with various thicknesses were prepared using 80 wt% zircon sand with 150 µm particle size and by using epoxy as the matrix. These prepared samples were exposed to X-rays with energies ranging from 50 keV to 80 keV in 10 keV increments, with a standard aluminium step wedge as the reference. Images were obtained using a Fujifilm computed radiography system. Subsequently, grayscale values of the exposed regions of the images were processed by a software tool developed using Python programming language. The grayscale values of the prepared samples at various thicknesses were compared with those of aluminium at various thicknesses for each energy value. For the energy range mentioned above, the prepared composite samples with thicknesses varying from 1 mm to 4 mm exhibited an attenuation comparable to those of aluminium with 9 mm to 33 mm thicknesses. This study presents an opportunity to develop radiation shielding materials containing locally abundant natural minerals, such as zircon, for radiation protection in medical diagnostic procedures.

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**Keywords:** Lead-free materials, Minerals, Radiation protectoin, X-ray shielding, Zircon

***Abstract No: 92*** ***Physical Sciences***

# LOW-COST COUNTER ELECTRODE PREPARED USING ACTIVATED CARBON DERIVED FROM RICE HUSK FOR DYE-SENSITIZED SOLAR CELLS

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Dye-sensitized solar cells (DSSCs) have emerged as promising alternatives for efficient and cost-effective solar energy conversion devices. However, the high cost and limited availability of platinum (Pt), traditionally used as a counter electrode (CE) material, has motivated the search for sustainable and low-cost alternatives. This study explored the potential of using activated carbon synthesized from rice husk to prepare low-cost CE for DSSCs. Rice husk is an abundant agricultural waste product, and the present study reveals that the active carbon synthesized from rice husk can be used to prepare DSSC counter electrodes. At first, dried rice husk was carbonized and then activated by heating to 900 °C for 20 minutes and quenching several times. The spray pyrolysis method was used to prepare activated carbon CEs using polyvinylpyrrolidone binder and isopropanol solvent. A series of experiments showed that CEs prepared using activated carbon derived from rice husk are suitable for fabricating low-cost and highly efficient Pt-free DSSCs. With the usual N719 dye and liquid electrolyte ($I^-$ /$I_3^-$), the DSSC utilizing this biomass-derived active carbon CE achieved an energy conversion efficiency of 5.62%, while that for Pt-based CE is 7.73%. The average open circuit voltage ($V_{OC}$) and short circuit current density ($J_{SC}$) of the active carbon-based cell are 0.68 V, 15.90 mA $cm^{-2}$ relative to the Pt-based cell.

**Keywords**: Activated rice husk carbon, Counter electrode, Dye-sensitized solar cells, Platinum

***Abstract No: 109*** ***Physical Sciences***

# EVALUATION OF THE POTENTIAL OF *CANARIUM ZEYLANICUM* SEED OIL FOR BIODIESEL PRODUCTION

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*Canarium zeylanicum*, Sri Lankan Kekuna is an endemic plant in Sri Lanka with a high amount (around 51.80%) of oil in its seed kernel. The gas chromatography (GC) results showed that *C. zeylanicum* had a promising free fatty acid profile, suggesting that producing biodiesel with *C. zeylanicum* as feedstock was feasible. The acid value and the saponification value of the oil were found to be 1.0 ± 0.1 (mg KOH ⁄ g) and 178 ± 1 (mg KOH ⁄ g), respectively. As the acid value was ~1.0, *C. zeylanicum* oil can be directly converted to biodiesel by transesterification without performing any pre-treatments. Therefore, transesterification of *C. zeylanicum* oil with methanol using potassium hydroxide as the catalyst was performed to produce methyl esters, which can be used as biodiesel. The optimum conditions for the transesterification were investigated by varying the parameters: methanol: oil molar ratio (3:1 – 9:1), catalyst concentration (0.50 – 1.5%), and temperature (303 – 343 K). Periodic acid titrations were carried out to evaluate the free glycerol content. The methyl ester concentration was assessed by mass balancing. The optimal triglyceride conversion (94%) was achieved at room temperature in the presence of 1% potassium hydroxide as the catalyst when the methanol: oil ratio was kept at 6:1. Biodiesel properties including flash point, fire point, calorific value, density, cloud point, pour point and kinematic viscosity at 40 $^{o}$C of *C. zeylanicum* biodiesel were characterized according to the ASTM standards, and the results obtained were 60.0 $^{o}$C, 75.0 $^{o}$C, 40.56 MJ kg$^{-1}$, 0.8370 g cm$^{-3}$, 10.0 $^{o}$C, 6.3 $^{o}$C, and 7.2 mm s$^{-1}$, respectively. As both the flash point and the fire point are lower than the minimum standard value, and the viscosity is slightly higher than the standard range of 1.9-6.0 mm s$^{-1}$, *C. zeylanicum* methyl esters exhibit unpromising biodiesel properties. However, blending with diesel could be employed to improve the properties of the final biodiesel blend.

**Keywords**: Acid value, Biodiesel, *Canarium zeylanicum*, Saponification value, Transesterification.

***Abstract No: 113*** ***Physical Sciences***

# INVESTIGATING THE SOUND ABSORPTION CHARACTERISTICS OF COCONUT SHELL-BASED STRUCTURES

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This study investigates the sound absorption characteristics of structures developed using two filler materials: coconut shell powder and charcoal powder, with natural liquid rubber as the binder. Selected filler material and the binder are readily available in Sri Lanka. The sound absorption coefficient, defined as the ratio of absorbed energy to incident energy indicating the amount of sound being absorbed by a material, was experimentally studied using the impedance tube method in the frequency range of 1000-3500 Hz. Samples were prepared by varying the volume ratio of the binder and the filler. The sound absorption property of the prepared samples was tested by using the impedance tube for different frequencies within the range. The structures were further improved by increasing their thickness and changing the surface roughness by introducing holes with different depths to improve sound absorption. The coconut shell powder structure of 50% volume ratio with 1.5 cm thickness and hole depth of 1.1 cm showed a sound absorption coefficient in the range of 0.80-0.83 for 2500 Hz and the range of 0.85-0.93 for 3000 Hz. This implies that the coconut shell powder structure absorbs over 80% of the incident sound energy with a 2500 Hz or 3000 Hz frequency. Further, the charcoal powder structure of 66% volume ratio with 1.5 cm thickness and hole depth of 1.1 cm exhibited sound absorption of over 60% beyond 2000 Hz within the tested frequency range. Both structures are versatile, cost-effective, and eco-friendly sound absorption structures for various acoustic applications for high frequencies due to their flexibility, ease of preparation, and thin profile.

**Keywords**: Acoustic foam, Sound absorption, Sound absorption coefficient, Sound absorption material, Waste material

***Abstract No: 115*** ***Physical Sciences***

# PREPARATION AND CHARACTERIZATION OF COCONUT SHELL ACTIVATED CARBON BLACK FOR ELECTROPHOTOGRAPHY TONER APPLICATION

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Coconut shells (CS) are one of the main domestic wastes that are abundantly used as a precursor to producing activated carbon black (ACB) for various purposes. This study investigated a low-temperature chemical activation method (LTCA) using NaOH to prepare ACB from CS to apply as the black colourant in toner production. Initially, the cleaned CSs were subjected to a pyrolysis process at 550 °C for 4 hrs, and the resulting coconut charcoal was activated using NaOH at 120 °C. The porosity of the resulting ACB was investigated at different charcoal and NaOH solution volume ratios. The chemical characteristics, surface morphology, surface area and crystallinity of the ACB, and mineralogy of initial coconut ash were examined using Fourier-transform infrared (FT-IR) spectroscope and scanning electron microscopy (SEM) and powder X-ray diffraction (PXRD) analyses. The current study found that the weight percentage of ash in a CS is 0.6% and consists of $SiO_2$, MgO, $CaCO_3$, MnO, $TiO_2$, CaO, $Al_2O_3$, $Fe_2O_3$, $P_2O_5$, and fixed carbon. The PXRD shows the increase of graphitic nature with increasing NaOH volume. The FT-IR proves that ACB consists of carbonyl groups, carboxylic groups, aromatic C=C bonds and aromatic C-H out-of-plane deform bonds as the main functional groups, indicating the formation of aromatic compounds. The SEM images indicate that increasing NaOH volume causes irregular-shaped micropores with large diameters compared to the low NaOH volume exhibiting spherical micropores. Therefore, it concludes that LTCA with less NaOH volume causes the slow removal of C as $CO_3^{2-}$ from the ACB and increases the surface area. In the future, these ACBs will be used to produce toners to identify the eligibility as the colourant for electrophotography toners.

**Keywords**: Activated carbon black, Chemical activation, Coconut shells, NaOH

***Abstract No: 119*** ***Physical Sciences***

# THE ENHANCEMENT OF THERMOELECTRIC PROPERTIES OF COPPER IODIDE THROUGH DOPING

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Thermoelectricity generation, the direct conversion of thermal energy into electricity, is emerging as an efficient waste heat recovery technique and renewable energy harvesting method. Thermoelectricity generation can also be utilized to improve the energy efficiency of devices. The efficiency of thermoelectricity generation depends on the electrical and thermal properties of the thermoelectric materials (TEMs) in the device. TEMs should exhibit high Seebeck coefficients, excellent electrical conductivities, and minimal thermal conductivities for optimal performance. The use of expensive, hazardous, and rare TEMs such as tellurium has hampered the widespread adoption of this technology. Moreover, while numerous n-type thermoelectric materials exist, the availability of suitable p-type materials is limited. Consequently, this study focuses on improving the thermoelectric properties of p-type CuI by means of KI doping. Undoped and KI-doped CuI powders were pressed into pellets to make thermoelectric generators. A 5% KI doping significantly improved the thermoelectric parameters such as electrical conductivity, Seebeck coefficient, and generated power of the thermoelectric generators. The electrical conductivity of CuI increased from 0.256 S $m^{-1}$ to 3.329 S $m^{-1}$, while the Seebeck coefficient of CuI increased from 535.6 V $K^{-1}$ to 6968.8 V $K^{-1}$ due to the KI doping. As expected, thermal conductivity decreased with the doping. At 373 K thermal conductivity of the CuI pellet is 1.51 W $m^{-1}$ $K^{-1,}$ while that of KI-doped sample is 1.10 W $m^{-1}$ $K^{-1}$. The highest Seebeck coefficient of 7061.74 V $K^{-1}$ was observed at the average temperature of 379 K. The generated power in the doped system was 8.24 W at 384 K. The study concludes that 5% KI doping improves the electrical conductivity and Seebeck coefficient of CuI while thermal conductivity decreases, making KI-doped CuI an efficient TEM. At 373 K, the generated power of the doped CuI significantly increased from 0.04 W to 6.15 W due to KI doping.

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**Keywords**: Copper Iodide, Figure of merit, Generated power, Seebeck effect, Thermoelectricity

***Abstract No: 122*** ***Physical Sciences***

# SELECTIVE REDUCTION OF GRAPHENE OXIDE DEPOSITED ON HEAT-SENSITIVE SUBSTRATES

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Laser-assisted reduction of Graphene Oxide (GO) deposited on heat-sensitive flexible substrates has become a popular method for scalable production of flexible conductive interconnects. Reduced Graphene oxide (rGO) has gained interest owing to its improved electrical conductivity compared to GO. Usually, the reduction of GO is achieved by large-area thermal processing. However, most flexible substrates used in electronics are heat sensitive and, therefore, require localized heating approaches to produce rGO. This study extensively studied the laser reduction of graphene oxide deposited on a heat-sensitive polyethylene terephthalate (PET). A statistical Design of Experiment (DoE) was performed to optimize the parameters associated with laser reduction and to achieve the minimum possible resistance for rGO. A 785 nm continuous wave (CW) laser was used to study the dependence of the resistance of rGO on the laser power, scribing speed, and the number of scans. The optimal resistance measured for a 1 cm long laser-scribed rGO line was $9.46 \pm 0.01$ kΩ [$0.430 \pm 0.001$ kΩ/square]. This is over four orders of magnitude improvement in the conductivity compared to oven-dried GO at 110 $^{o}$C, which is close to the glass transition temperature of PET. The laser-induced reduction of GO was confirmed by SEM and FTIR. The optimal laser scanning conditions were 490 mW of laser power, 5 mm $s^{-1}$ of scanning speed, and 5 repetitive laser scans on the same pattern. The average width of laser-reduced rGO lines was $450 \pm 12$ µm. These results suggest that CW laser reduction of GO yields conductive interconnects suitable for the fabrication of chemically inert interdigitated electrodes used in chemi-resistive sensors that change their electrical resistance in response to changes in the chemical environment.

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**Keywords**: Flexible electronics, Graphene, Laser reduction

***Abstract No: 126*** ***Physical Sciences***

# *IN-VITRO* ANTI-OBESITY ACTIVITY OF A POLY-HERBAL MIXTURE USED IN SRI LANKAN TRADITIONAL MEDICINE

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Obesity is announced as an epidemic in the 21st century by the World Health Organization (WHO). The prevalence of obesity has much concern because of its relationship with other noncommunicable diseases in the body. People tend to use synthetic drugs (mainly statins) to prevent obesity because of their quick response. However, due to the side effects associated with these drugs, attention towards natural remedies has increased as they can be more effective with fewer side effects. This study aimed to determine the pancreatic lipase inhibitory activity of a poly-herbal mixture comprised of leaves of *Murraya koenigii* (Curry Leaves), cloves of *Allium sativum* (Garlic), dried rinds of *Garcinia quaesita* (Rath Goraka), and seeds of *Piper nigrum* (Black Pepper), which have been showing well promising anti-diabetic effects and with the poorly explained anti-obese effect. Collected, authenticated, and dried plant parts were mixed in different ratios (1:1:1:1, and each component doubled and tripled separately). Solvent extraction was performed using water, acetone 1:1, and water: acetone 1:9 solvent systems. The anti-obesity effects of the plant extracts were observed using the *in-vitro* pancreatic lipase enzyme inhibitory assay, and the $IC_{50}$ values were calculated. Orlistat drug shows the least $IC_{50}$ value ($4.25 \pm 1.95$ mg $mL^{-1}$) as the positive control. It was observed that there was no significant difference ($p > 0.05$) between $IC_{50}$ values obtained from the plant extracts prepared by water: acetone 1:9 solvent system when *M. koenigii* ($35.11 \pm 4.55$ mg $mL^{-1}$), *P. nigrum* ($45.79 \pm 4.83$ mg $mL^{-1}$), and *G. quaesita* ($68.17 \pm 4.18$ mg $mL^{-1}$) component is doubled separately compared to Orlistat. Similar results were obtained only for the water: acetone (1:1) extract when the *G. quaesita* ($44.21 \pm 6.15$ mg $mL^{-1}$) component is doubled. Obtained $IC_{50}$ values were significantly higher for individual plant extracts and plant mixture prepared using a 1:1:1:1 component ratio and also with a further increment of plant species separately in the polyherbal mixture compared to the positive control. According to the above empirical data, it can be concluded that the maximum inhibitory activity of the polyherbal mixture could be obtained when the correct ratio of each plant part and the solvents are used.

*Financial assistance from the National Research Council.* (*Grant No. NRC-TO-2019*) *is acknowledged.*

**Keywords:** Anti-obese, Inhibition, Orlistat, Pancreatic lipase, Poly-herbal mixture

***Abstract No: 132*** ***Physical Sciences***

# ANTIDIABETIC AND ANTIOBESITY POTENTIAL OF OLEANOLIC ACID DERIVATIVES

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The pervasiveness of nontransmissible diseases like Diabetic Mellitus (DM) and obesity has risen rapidly, causing a universal significant public health problem. Undesirable side effects of the current anti-diabetic and anti-obesity drugs have amplified the demand for natural product-derived therapeutics. Oleanolic acid (3-hydroxyolean-12-en-28-oic acid) is a naturally occurring pentacyclic triterpenoid known to possess anti-diabetic and anti-obesity properties. Hence, the current study was aimed to evaluate the antidiabetic and anti-obesity properties of the semi-synthesized structural analogues of oleanolic acid, including fluorine-substituted compounds. Oleanolic acid was isolated from the methanolic crude extract of roots of *Lantana camara*, and seven derivatives were synthesized by C3-OH and C28-COOH functional group modifications. The chemical structures of oleanolic acid analogues were characterized by FT-IR, $^{1}$H-NMR, $^{13}$C-NMR and HRMS spectroscopic methods. *In-vitro* anti-diabetic and anti-obesity properties were assessed by alpha-glucosidase inhibition and pancreatic lipase, respectively. A significant difference in alpha-glucosidase activity was not obtained ($p > 0.05$) with oxidation of C3-OH ($7.72 \pm 0.02$ mg $L^{-1}$) compared to oleanolic acid ($28.60 \pm 0.84$ mg $L^{-1}$). In contrast, the highest significant decrease in alpha-glucosidase activity ($p < 0.05$) was obtained with esterification of C28-COOH ($232.32 \pm 5.49$ mg $L^{-1}$), esterification of C28-COOH followed by oxidation of C3-OH ($173.92 \pm 14.26$ mg $L^{-1}$), oxidation of C3-OH followed by fluorination of C28-COOH ( $166.63 \pm 9.10$ mg $L^{-1}$) and acetylation of C3-OH followed by fluorination of C28-COOH ( $83.47 \pm 4.65$ mg $L^{-1}$) compared to oleanolic acid ($28.60 \pm 0.84$ mg $L^{-1}$). All seven semi-synthesized derivatives indicate a significant improvement in pancreatic lipase activity ($p < 0.05$) when compared to oleanolic acid ($112.70 \pm 6.85$ mg $L^{-1}$), with the highest activity ($14.04 \pm 1.51$ mg $L^{-1}$) resulted in C3 oxidation followed by fluorination of C28-COOH. The results obtained from the present anti-diabetic study indicated that the modifications at C28-COOH decrease the anti-diabetic potential. The oxidation, esterification and fluorination of C3-OH and esterification and fluorination of C28- COOH showed improved anti-obesity properties. Hence, the current study will be further extended to evaluate the *in vivo* anti-diabetic and anti-obesity properties.

**Keywords**: Anti-diabetic, Anti-obesity, Oleanolic acid, Structural analogues

***Abstract No: 134*** ***Physical Sciences***

# COMPARATIVE STUDY ON NUTRITIONAL COMPONENTS AND ANTIOXIDANT ACTIVITIES OF A LOCAL WILD GRAPE VARIETY, *AMPELOCISSUS INDICA* (L.) PLANCH AND A COMMERCIAL GRAPE VARIETY, *VITIS VINIFERA* L.

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*Ampelocissus indica* (L.) Planch is a locally underutilized wild grape variety that has the potential to be utilized in different industries. Therefore, this research aimed to compare the nutritional components and antioxidant potential of commercial and wild grape varieties that are grown under different climate conditions and habitats. The fruits of the wild grape variety were collected from four locations in Kanneliya Natural Conservation Center, namely, $L_A$, $L_B$, $L_C$, and $L_D$, and two locations in Sinharaja Rain Forest, namely, $L_E$ and $L_F$. The control fruits of the commercial grape variety, *Vitis vinifera* L., were collected from Jaffna cultivators. The fruits were collected at the highest physiological maturity and authenticated before analyses. The maturity indices; pH, total soluble solids, titratable acidity, texture profile; hardness, resilience, cohesiveness, gumminess, springiness, and chewiness; and nutritional components; ash, protein, carbohydrates, fat, and fibre contents were analyzed following standard Association of Official Analytical Chemists methods. The total phenolic, flavonoid content and antioxidant activity were analyzed using standard spectrophotometric methods. Statistical analysis was carried out to compare the compositional differences between the two grape species. Significant differences were observed at 95% confidence levels for hardness, resilience, cohesiveness, and gumminess, while no significant difference was observed in springiness and chewiness compared to the control sample. The fibre content of $L_A$ was significantly different from the commercial variety. Samples $L_A$, $L_C$, and $L_E$ displayed significantly different antioxidant activities against the control ($p \geq 0.05$). The total phenolic contents were not significantly different from the control except for $L_A$, and the total flavonoid content indicated significant differences significantly in $L_A$, $L_B$, $L_C$, and $L_D$, but $L_E$, $L_F$, and control samples belonged to the same statistical group. In conclusion, certain maturity indices, nutritional components, and bioactive compounds in both varieties differed significantly, while those of $L_F$ demonstrated the highest compatibility with the control.

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**Keywords:** *Ampelocissus indica* (L.) Planch, *Vitis vinifera* L, Antioxidant activity, Maturity indices, Nutritional values

***Abstract No: 139*** ***Physical Sciences***

# ANTIOXIDANT ACTIVITY COMPARISON OF COMMON DIFFERENT CURRY LEAVES VARIETIES IN SRI LANKA

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Curry leaves are a common spice used in daily food preparations, and a few varieties of curry leaves are commonly used in Sri Lanka. Even though the radical scavenging ability of curry leaves has a common interest, the exact quantification and comparison of antioxidants in each variety are poorly explained. This study was performed to obtain a comparative antioxidant quantification on the most common curry leave varieties in Sri Lanka. In this study, leaves of *Murraya koenigii* (Type 1) and *Clausena indica* (Type 2) and other sub-variety of *Murraya koenigii* (Type 3), which is commonly known as "Beheth karapincha" were used. Hexane, ethyl acetate and methanol extracts of leaves of all three varieties were prepared by sequential maceration. The antioxidant activity of each variety was measured using DPPH, FRAP, and TPC assay. As the positive control, the least IC50 value for the DPPH assay (higher antioxidant activity) was obtained in ascorbic acid (7.302 ± 0.75 mg L-1). Methanolic extract and the ethyl acetate extract of type 3 curry leaves showed lower $IC_{50}$ values (38.39 ± 1.81 mg $L^{-1}$ and 25.09 ± 0.16 mg $L^{-1,}$ respectively), while hexane extract of the type 3 curry leaves showed a higher $IC_{50}$ value (137.98 ± 0.08 mg $L^{-1}$) compared to ascorbic acid. Methanolic and ethyl acetate extracts of type 1 (66.57 ± 0.12 mg $L^{-1}$ and 176.89 ± 0.09 mg $L^{-1}$) and type 2 (45.69 ± 0.15 mg $L^{-1}$ and 171.81 ± 0.11 mg $L^{-1}$) curry leaves have relatively lower radical scavenging ability compared with control as well as the methanol and ethyl acetate extracts of type 3 curry leaves. Further, higher FRAP and TPC values for type 3 curry leaves were observed in the same methanolic and ethyl acetate extracts, which could correlate to the higher amount of polyphenolic content in the type 3 curry leaves variety.

*Financial assistance from the National Research Council. (Grant No NRC TO 20-19) is acknowledged.*

**Keywords**: Antioxidant, *Clausena indica*, Curry leaves, $IC_{50}$, *Murraya koenigii*

***Abstract No: 144*** ***Physical Sciences***

# ELECTRONICALLY CONDUCTING DONOR-ACCEPTOR (D-A) TYPE POLYMER SYNTHESIZED USING 3,4-ETHYLENEDIOXYTHIOPHENE (EDOT) WITH BERBERINE ISOLATED FROM *COSCINIUM FENESTRATUM*

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The interactions between electron-rich and electron-poor units within a polymer refer to the D-A type behaviour in polymers, which leads to the synthesis of 3rd generation of electronic conductive polymers (ECP). Currently, available D-A type ECPs utilize synthetic D and A materials, although a rich wealth of naturally available materials fulfil requirements as A or D units. Berberine (9,10-dimethoxy-5,6-dihydro-2H-7λ5- [1,3] dioxolo[4,5-g] isoquinolino[3,2-a] isoquinolin-7-ylium) which is an extendedly conjugated cation with an electron-rich methylenedioxy and methoxy donor (D) moieties and electron-deficient isoquinolium acceptor (A) moieties, was isolated from methanolic extract of the stem of *Coscinium fenestratum* and the structure was confirmed by $^{1}$H-NMR spectroscopic data. Electrochemical synthesis is a better strategy than chemical synthesis to obtain conjugated polymers. Herein, we present the study of berberine for copolymerization with EDOT as an ECP, which can be used for future electronic devices. The polymers deposited on the working electrode had similar redox characteristics to the monomers, with potential shifts between 0.0 V- 1.8 V potential range that prove the identity of the respective polymers. In the investigated potential range, irreversible peaks which are lower potential than the monomer were observed at +0.8 V and +1.7 V in the first scan. During successive scans, their height was found to be increased through the subsequent cycles. The morphological structure of the polymer confirmed that the structure of the polymer is different from the monomer structure. Atomic ratios of the synthesized materials were calculated experimentally using energy-dispersive X-ray (EDX) analysis, which confirms the theoretical composition of the polymers. The use of conjugated molecules isolated from natural products for designing D-A type electronically conducting and infrared active oligomers and polymers for applications in the broad area of optronics and photonics is novel and adds value to biomaterials while making the process of D-A type polymer synthesis environmentally friendly.

*Financial assistance from US Airforce Grant No. FA2386-21-1-4096 is acknowledged.*

**Keywords**: Berberine, Electrochemical synthesis, Electronic conductive polymers, *3,4-Ethylenedioxythiophene*, Optronic and photonic devices

***Abstract No: 148*** ***Physical Sciences***

# EFFECT OF QUATERNARY CATIONS ON THE EFFICIENCY OF QUASI-SOLID-STATE DYE-SENSITIZED SOLAR CELLS

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The electrolyte is one of the main components of Dye-Sensitized Solar Cells (DSSCs). In this study, a gel polymer electrolyte (GPE) was synthesized to maintain prolonged stability of the electrolyte and to enhance the performance of quasi-solid state DSSCs by using the mixed counter ion effect, utilizing four iodides which were LiI, CsI, tetra-hexyl-ammonium iodide ($Hex_4NI$) and 1-butyl-3-methylimidazolium iodide (BMII). Ethylene carbonate, propylene carbonate, polyethylene oxide, and 4-tertbutylpyridine were also included in the electrolyte. A series of electrolytes was investigated by varying the molar fraction of LiI and CsI. The investigation of the temperature dependence of conductivity revealed that these samples follow the Voggel-Tamman-Fulture behaviour. The sample in which LiI: CsI: $Hex_4NI$: BMII molar ratio is 72:48:80:25 displayed a maximum conductivity of 12.69 mS $cm^{-1}$ at the ambient temperature. A series of quasi-solid-state DSSCs was constructed by utilizing six-layered $TiO_2$ photo-electrodes, and the photo-current conversion efficiencies of the cells were studied. DSSCs that contain only either CsI or LiI showed lower efficiencies of 3.68% and 3.48%, respectively. The four-salt system, which consisted of LiI: CsI: $Hex_4NI$: BMII in molar ratio 96:24:80:25, showed the highest cell efficiency of 6.36%, even though this was not the composition that showed the highest conductivity. This increase in solar cell efficiency can be attributed to the collective contribution of $Hex_4N^+$, $Cs^+$, $Li^+$, and $BMI^+$ ions because larger cations like $Hex_4N^+$, $Cs^+$, and $BMI^+$ increase open circuit voltage and smaller cations like $Li^+$ improve charge transport and transfer in the system, increasing short circuit current density. This study suggests that LiI, CsI, Hex4NI, and BMII is a novel iodide salt mixture suitable for fabricating highly efficient DSSCs.

*Financial assistance from the University of Peradeniya Sri Lanka, University Research Council (Grant No. 346) is acknowledged.*

**Keywords**: Counter ion effect, Gel polymer electrolytes, High-efficiency DSSCs, Ionic conductivity, Quaternary salt

***Abstract No: 150*** ***Physical Sciences***

# OPTIMIZATION OF EFFICIENCY IN DYE-SENSITIZED SOLAR CELLS BY THE INFUSION OF GRAPHENE TO PHOTOANODE

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This research studies the influence of added graphene on the structure and performance of Dye-Sensitized Solar Cell (DSSC) photoelectrodes. For this purpose, a series of $TiO_2$ multi-layer photoelectrodes were fabricated by infusing graphene into each layer at a time to all six layers. A colloidal paste prepared by mixing $TiO_2$ nanoparticles (13 nm) and 0.1 M $HNO_3$ was spin-coated on a clean FTO glass substrate to prepare the layered photoanodes. Graphene (Sigma-Aldrich) at 1 w% in relation to the $TiO_2$ was added to the colloidal suspension to prepare the graphene-added Nanocomposite layers of the multilayer photoelectrodes. The $TiO_2$ electrodes were sensitized with dye N719 and were combined with the Pt counter electrode and polyiodide-based electrolyte to assemble DSSCs. The results indicate that the efficiency of cells depends on the layer to which graphene has been incorporated out of the six layers in graphene-doped $TiO_2$ photoelectrode. The graphene-doped photoelectrodes efficiency rise with the increase in the layer number which graphene doped and reaches the maximum value at the four$^{th}$ layer. When graphene was added to the four$^{th}$ layer, DSSC showed the best performance with the largest photoelectric power conversion efficiency of 6.99%, resulting in a 19.52% enhancement compared to the undoped photoelectrode-based DSSC (5.85%). The high transparency and conductivity of graphene significantly enhance the photoelectric power conversion properties of DSSCs. This enhancement occurs by improving the light scattering and conductivity of the $TiO_2$ layers and the electron transfer process from the dye molecule to the surface of the $TiO_2$ layer. However, the study continues to investigate the correct mechanism.

*Financial assistance from the Postgraduate Institute of Science (PGIS), University of Peradeniya Research Grant* (*Grant No. PGIS/2022/12*) *is acknowledged.*

**Keywords**: DSSC, Graphene-$TiO_2$ layers, Light harvesting, Multi-layer photoelectrode.

***Abstract No: 155*** ***Physical Sciences***

# ADSORPTIVE REMOVAL OF RHODAMINE B DYE FROM MAGNETIC $MnFe_2O_4$-MONTMORILLONITE NANOCOMPOSITE

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The presence of rhodamine B in water has been connected to several environmental issues and risks to human and animal health. Therefore, effective remediation techniques must be used to remove dyes to prevent contaminating water bodies. Adsorption is one of the most often used and well-liked therapy modalities since it is affordable, straightforward, adaptable, and simple to administer. In this study, manganese ferrite ($MnFe_2O_4$) nanoparticles were co-precipitated chemically with montmorillonite clay (MMT) to combine the increased surface area with the magnetic property. The prepared nanocomposite ($MnFe_2O_4$-MMT) was employed as a magnetic adsorbent to eliminate rhodamine B from aqueous solutions. The successful nanocomposite formation was confirmed by powder X-ray diffractometry (PXRD), Fourier transform infrared spectroscopy (FT-IR), and scanning electron microscopy (SEM) characterizations. The size of manganese ferrite was found to be 50-60 nm. The obtained results from adsorptional experiments indicated an optimal rhodamine B adsorption capacity of 49.97 mg $g^{-1}$ for the $MnFe_2O_4$-MMT composite at pH = 4, an initial dye concentration of 50 mg $L^{-1}$, an adsorbent dose of 0.10 g, and a contact time of 1 h at room temperature. Pseudo-first-order (correlation coefficients, $R^2$ = 0.81) and pseudo-second-order models ($R^2$ = 0.99, calculated adsorption capacity: $q_{e(cal)}$ = 49.26 mg $g^{-1}$, and experimental adsorption capacity: $q_{e(exp)}$ = 49.16 mg $g^{-1}$) were used to analyze the kinetic investigation, and the dye adsorption was best characterized by the pseudo-second-order kinetic model. Therefore, compared to the Freundlich isotherm model ($R^2$ = 0.63), the Langmuir isotherm model ($R^2$ = 0.98) better represented the adsorption behaviour. The thermodynamic study revealed that the main parameters, including ($\Delta G°$ = -11.53 kJ $mol^{-1}$ @333 K, $\Delta H°$ = 3.70 kJ $mol^{-1}$, and $\Delta S°$ = 0.05 kJ $mol^{-1}$), indicated that the adsorption of rhodamine B onto the $MnFe_2O_4$-MMT composite was an endothermic and spontaneous process. High removal efficiency, high dye adsorption capacity, and a low-cost magnetic adsorbent were significant features of the $MnFe_2O_4$-MMT composite for removing rhodamine B.

**Keywords**: Adsorption, Industrial wastewater, Low cost, Magnetic separation, Nanocomposite

***Abstract No: 158*** ***Physical Sciences***

# OPTIMIZATION OF THE SOLUTE DESCRIPTORS FOR CITRONELLAL BY GAS CHROMATOGRAPHY AND LIQUID-LIQUID PARTITION SYSTEMS

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Citronellal is a naturally occurring monoterpenoid aldehyde that has an intense lemon aroma. It is the main compound found in citronella oil that is often used as a natural insect repellant, antifungal agent, flavouring agent, and fragrance in the cosmetic industry. Despite their natural origin, the long-term use of these essential oil compounds can result in considerable health and environmental hazards. To assess such effects, the available conventional methods are costly and require significant human and technical resources. Instead, the Abraham solvation parameter model can be used. This model is based on quantitative structure-property relationships. This has become popular in estimating solute properties and environmental distribution with significantly lower costs by using fewer resources. The model is expressed as $log\,\mathrm{SP} = c + e\mathrm{E} + s\mathrm{S} + a\mathrm{A} + b\mathrm{B} + v\mathrm{V}$ for transfers between two condensed phases. Here, SP is a Free energy-related solute property; lowercase letters are system constants, and uppercase 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 citronellal was carried out using the gas chromatographic technique with six stationary phases including (14% cyanopropyl-phenyl)-methylpolysiloxane, (88% Cyanopropyl)aryl-polysiloxane, and diphenyldimethyl polysiloxane stationary phases. Also, Citronellal was equilibrated in 17 organic biphasic systems, and the partition coefficients were determined. The obtained solute descriptor values and partition coefficient values were then utilized to optimize the descriptor values using the Solver algorithm in MS Excel® such that the standard deviation is minimal. The optimized descriptor values for citronellal are E = 0.279, S = 0.703, A = 0, L = 5.045, B = 0.454, and V = 1.490, respectively, with a standard deviation of 0.049. These descriptor values can be used to estimate the distribution of citronellal in environmental and industrial partition compartments and in toxicological data.

*Financial assistance from the National Research Council (Grant No 20-086) is acknowledged.*

**Keywords**: Citronellal, Descriptors, Solvation parameter model, Gas chromatography

***Abstract No: 160*** ***Physical Sciences***

# ENHANCED SEMICONDUCTING PROPERTIES IN Co-MOF-74 UPON ENCAPSULATION OF ANILINE DERIVATIVES AS GUEST MOLECULES

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Metal-organic frameworks are significant research materials that hybridise organic and inorganic components. The diversified properties like low density, easy tunability, high porosity, and structural properties make MOF a good candidate for the use of semiconductors as well. Among all MOFs, three-dimensional honeycomb-shaped MOF-74, or CPO-27 is unique and forms a one-dimensional hexagonal channel network in which each transition metal ion is bonded to five oxygen atoms. Further, it possesses a specific chemical functionality due to exposed metal sites (EMS), and thereby, MOF-74 records the highest EMS densities among the porous materials but is poor in conductivity. In this study, Co-MOF-74 was synthesized using the room temperature method and tuned up the semiconducting properties by encapsulating -$NH_2$-containing guest molecules to be applied in solar cell applications. The successful formation of the Co-MOF-74 structure was confirmed using the powder X-ray diffraction data for major diffraction peaks at 6.7° and 11.7° (2θ values) arising from (110) and (300) crystal planes, respectively. According to solid-state UV/Visible data records, the direct band gap for Co-MOF-74 was recorded as 2.72 eV. The Kubelka-Munk equations were used to calculate the band gap energies for different concentrations of aniline and aniline derivatives. The calculated band gap energies were reduced from 2.72 eV to 1.98 eV for the lowest moles of (0.0027 mol) of aniline-encapsulated Co-MOF-74. As the amount of aniline increased to 0.0055 mol and 0.0109 mol, the band gap energies were reduced to 1.96 eV and 1.89 eV, respectively. This trend suggests that there is a potential change in the optical and electronic properties of the material with varying aniline concentrations. Further, the band gap energies for different aromatic amines were determined, and the calculated band gap energies were 1.78 eV, 1.92 eV, 1.89 eV, and 1.87 eV for *o*-anisidine, *p*-anisidine, *m*-toluidine, and *p*-toluidine respectively. According to the Mott-Schottky plot analysis, the Co-MOF-74 exhibits n-type semiconductor behaviour. Additionally, the carrier concentration and flat band potential for varied thickened thin films were found to be $6 \times 10^{20}$ $cm^{-3}$ (1 µm), $3.68 \times 10^{20}$ $cm^{-3}$ (3 µm), and -0.48 V (1 µm), -1.00 V (3 µm) respectively. Hence, this study provides evidence of semiconducting property variation upon guest molecule encapsulation.

*Financial assistance from the National Research Council* (*Grant No 20-089) is acknowledged.*

**Keywords**: EMS, Encapsulation, Guest molecules, MOF, Solar cells.

***Abstract No: 163*** ***Physical Sciences***

# ANALYSIS OF AFM IMAGES FOR INVESTIGATING THE MORPHOLOGY AND POROSITY OF FLUORINE-DOPED TIN OXIDE THIN FILMS

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Research in the field of optoelectronic materials optimization is motivated by the growing demand for efficient and transparent conductive materials. This study focuses particularly on the evaluation of porosity in Fluorine-doped Tin Oxide (FTO) thin films. Porosity analysis is pivotal in optimizing the optical, electrical, mechanical, and structural properties in optoelectronic market applications, including solar cells, transparent electrodes, and gas sensors. Researchers and engineers can design and fabricate materials with enhanced performance, efficiency, and reliability for a wide range of optoelectronic devices by characterising and controlling porosity. In this study, a quantitate analyzis of key parameters in a series of FTO layered Atomic Force Microscopy (AFM) images using a combination of analytical software tools, namely Gwyddion and MATLAB, and methods such as adaptive thresholding and Monte Carlo simulations were carried out. The methodology and analytical techniques presented here facilitate a comprehensive characterization of porosity, offering valuable insights into the microstructural features of the films; in particular, the significance of performing such analysis on strictly morphological images obtained using an AFM were denoted. A mean porosity of 0.93% in singly layered FTO is reported; however, in evaluating the porosity of serial layers of FTO thin films, the efficacy of FTO films in various optoelectronic devices with pertinence to porosity may be determined; hence, the defined analytical methods represent a crucial stage in the fabrication, commercialization, and optimization of future optoelectronics.

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**Keywords**: Atomic Force Microscopy (AFM), FTO Thin Films, MATLAB, Optoelectronic Devices, Porosity

***Abstract No: 169*** ***Physical Sciences***

# SOFT TEMPLATE-LESS ASSEMBLY OF A SHEATH OF NANOSTRUCTURED POLYANILINE ON LIGNOCELLULOSIC COIR FIBER: AN APPROACH TO A POROUS COMPOSITE SYNTHESIS BY *IN-SITU* POLYMERISATION

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A synthesis approach for a composite of polyaniline nanoparticles & naturally derived coir fibre (nPAni@Cf) was designed by optimising the processing parameters in the *in-situ* chemical polymerisation of aniline without a soft template. The aim was to develop a facile synthesis route that guaranteed the scalability and purity of the synthesised composite, which would function effectively in carcinogen remediation. The affinity of Cd(II) > Ni(II) > Zn(II) > Mn(II) >> $HAsO_2$ shown to the PAni & fibre composite was found to transcend in this sequence during competitive adsorption at pH 5.00 and 7.00. Variations in aniline and HCl concentrations, oxidant to aniline molar ratio (OX/AN), activation time of the fibre, and the duration of synthesis through classical vs rapid polymerisation technique were observed to impact the adsorption property of the hybrids tested in Cd(II) uptake experiments. The average dimension and size distribution of PAni adjoined to the fibre were resulted to be greater when synthesised conventionally compared to the rapid technique at 3.00 hours. However, in traditional synthesis, via adding the oxidant gradually, PAni was firmly resolved, embodying orderly into an outer layer on the composite. nPAni@Cf was fabricated by activating the fibre in a highly acidic HCl dopant medium containing 40 mM of aniline monomer, *in-situ* polymerised by applying the oxidant at an OX/AN of 0.25. Aniline was successfully polymerised, forming a porous immobilisation of PAni overlaid by the fiber in the porous structured nPAni@Cf, characterised by ATR and SEM analysis. The synthesis was routinely shaped PAni into a spherical form, miniaturised to an average diameter of 37 nm during the determined growth of PAni particles, conveniently ruled in an acidic medium. This methodology, which was adapted via the 'synthesis optimisation strategy,' provided a non-complex, and additive-free pathway guide for assembling nanostructured polyaniline into the easily separable macro-sized nPAni@Cf.

**Keywords**: Adsorption, Composite, In-situ synthesis, Nanoparticles, Polyaniline

***Abstract No: 179*** ***Physical Sciences***

# ADSORPTIVE REMOVAL OF AMOXICILLIN USING MONTMORILLONITE BARIUM TITANATE NANOCOMPOSITE IN AN AQUEOUS MEDIUM

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Amoxicillin, one of the most widely used antibiotics in Sri Lanka, significantly contributes to antibiotic resistance upon discharge into natural water bodies. This emerging concern over antibiotic resistance is expected to impose substantial financial burdens globally in the foreseeable future. Among various methods, adsorption has gained significant attention for antibiotic removal. Among the leading materials for wastewater adsorption, montmorillonite (MMT) emerges as one of the most widely used adsorbents due to its high surface richness and nanolayered structure. In this study, barium titanate (BT), a ferroelectric substance with a polar surface having positive and negative charges, was selected as a potential material for synthesizing nanocomposite with MMT for amoxicillin removal. Four nanocomposites were synthesized by doping MMT with varying percentages of BT (2,4,6 and 8%). The nanocomposites were characterized using fourier transform infrared (FT-IR), powder X-ray diffraction (PXRD), scanning electron microscopy (SEM), and thermogravimetric analysis (TGA) techniques. In addition isothermal studies were conducted. SEM images confirmed the presence of BT nanoparticles layered on the surface of the MMT. The adsorption experiments conducted with 25 ppm amoxicillin samples revealed that the synthesized nanocomposite exhibited enhanced amoxicillin adsorption as the dosage of BT increased from 2% to 8%. The pH study indicated a positive correlation between the adsorbance and pH value, with the average pH value of 7.55 in the hospital effluent falling within a favourable range for adsorption. The isothermal study results were inconclusive due to the presence of nanoparticles in the final test sample for absorbance, which affected the absorbance readings and the overlapping absorbance peak of MMT with that of amoxicillin. Despite these challenges, overall findings suggest that the nanocomposite holds great potential as an effective adsorbent for removing amoxicillin from hospital effluent water. Overcoming the challenges encountered during the isothermal study and optimizing nanocomposite holds promise for the efficient removal of amoxicillin.

**Keywords**: Adsorption, Antibiotic resistance, Amoxicillin, Barium titanate, Montmorillonite

***Abstract No: 180*** ***Physical Sciences***

# CONFINED NANOCRYSTALLIZATION OF ANTHRANILIC ACID IN A MESOPOROUS ZEOLITE MATRIX

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This research investigates the potential of confined crystallization for improving the performance and particle size control of active pharmaceutical ingredients (APIs). The study focuses on the crystallization of anthranilic acid within a zeolite mesoporous matrix and investigates the effects of solvent selection and the nature of the confining material on the crystal polymorphism and morphology of the API. In the process, 245 mg and 115 mg of anthranilic acid were dissolved separately in 1 mL of ethanol and acetonitrile solvents to create saturated solutions. The solutions were heated to 40 $^{o}$C, stirred, and filtered to remove undissolved particles. The saturated solutions were then introduced into the zeolite matrix, with different amounts of zeolite depending on the solvent used (for ethanol 210 mg while in acetonitrile 200 mg). As the solutions cooled, anthranilic acid crystals nucleated and grew within the nanopores of the matrix, gradually increasing in size over time. Advanced characterization techniques such as powder X-ray diffraction (PXRD), scanning electron microscopy (SEM), transmission electron microscopy (TEM), and fourier transform infrared (FT-IR) spectroscopy were used to analyze the changes in the crystal structure and properties during confined crystallization. The PXRD and FT-IR analysis demonstrated that the choice of solvent significantly influenced the polymorphic form of anthranilic acid, with acetonitrile giving polymorph I, whereas ethanol gave polymorph II. From SEM and TEM analysis, confined crystallization within the zeolite matrix resulted in smaller and more uniform needle-like anthranilic acid crystals, which consisted of a diameter of 20 nm, exhibiting a high order and purity. The use of advanced analytical techniques such as PXRD, SEM, TEM, and FT-IR can facilitate the optimization of confined crystallization processes and enable the development of innovative drug delivery systems with improved efficacy and safety. The findings highlight the potential of confined crystallization as a promising strategy for enhancing the performance and control of APIs.

**Keywords:** Active pharmaceutical ingredient (API), Anthranilic acid (2-aminobenzoic acid), Confined crystallization, Mesoporous matrix, Zeolite

***Abstract No: 181*** ***Physical Sciences***

# NANOCOCRYSTALLIZATION OF UREA:4-HYDROXYBENZOIC ACID USING SONOCHEMICAL METHODS

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With the increase in global population, agriculture plays a vital role bounding to consume larger quantities of slow-release fertilizers. Urea is a widely used fertilizer with higher water solubility; crystal engineering has recently gained interest towards the cocrystallization of urea to overcome the premature decomposition of urea. The study focuses on the cocrystallization and nanococrystallization of urea:4-Hydroxybenzoic acid (4-HBA) and their characterization using powder X-ray diffraction (PXRD), fourier transform Iifrared (FT-IR), scanning electron microscopy (SEM) and thermogravimetric analysis (TGA) and optimize the sonication process to improve the quality of nanococrystals. Urea:4-HBA 1:2 cocrystal was synthesized using the liquid -assisted grinding method with acetonitrile and reduced the particle size using the sonochemical method (optimum frequency: 35-40 kHz, Time: 30 minutes) with the employment of hexane, stearic acid, and sodium dodecyl to obtain nanococrystals. The 1:2 ratio was confirmed in the crystallinity data in the Cambridge Structure Database. Successful cocrystallization and nanococrystallization were confirmed by PXRD and FT-IR analysis. PXRD patterns revealed the presence of a new crystalline phase, which is different from the starting compounds. The presence of new peaks in FT-IR spectra validated the formation of new bonding interactions in the cocrystal. SEM micrographs revealed the presence of irregular particles less than 500 nm, despite the presence of agglomerates. Nanococrystals with surfactants demonstrated a smooth surface compared with those without surfactants. TGA highlighted that cocrystal and nanococrystal had improved thermal stability than the parent material (around 150-160 °C). This study represents valuable insights into forming cocrystals and nanococrystals using urea, emphasizing the importance of selecting surfactants sonication parameters for synthesizing urea nanococrystals. Further research with high frequency sonication would improve the properties of nanococrystals, and the effectiveness of the urea nanococrystal could be identified using a soil release study.

**Keywords**: Cocrystallization, Liquid assisted grinding (LAG), Nanococrystallization, Sonochemical method, Urea:4-hydroxybenzoic acid

***Abstract No: 182*** ***Physical Sciences***

# THICKNESS EFFECT ON THE PHYSICOCHEMICAL PROPERTIES OF ELECTRODEPOSITED ZnTe LAYERS

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In this paper, we report the effect of different deposition durations on the physicochemical properties of electrodeposited ZnTe thin films. Varying thicknesses of the films were obtained at deposition durations of 0.25, 0.50, and 1.00 hours. ZnTe thin films were prepared from an aqueous electrolyte comprising 0.1 M $ZnSO_4.7H_2O$ as the Zn ion source and 10 ml of dissolved $TeO_2$ solution as the Te ion source. The physicochemical properties of the electroplated materials were investigated using selected analytical techniques relevant to this study. Properties such as optical, structural, compositional, morphological, and electrical were studied using UV–visible spectrophotometer, X-ray diffractometer, energy dispersive X-ray spectrometer, scanning electron microscope, and current-voltage (I – V) / capacitance-voltage (C – V) analyser respectively. The optical results revealed that the energy band gap of the thin films decreases as the deposition duration increases. The grain sizes and the crystallinity improved with increasing duration. The EDX analysis showed that the Te concentration decreases with increasing deposition duration while the Zn concentration moderately increases. The resistivity of the investigated thin films were within the range of accepted resistivity values for semiconductors, and they were found to be moderately doped based on the result from the C – V measurements. The study revealed that the variation in the deposition duration significantly influences the thin films' physicochemical properties. From the results, it can be concluded that the explored materials have the potential for optoelectronic applications.

*Financial assistance from the Swedish Research Council (grant number, Dnr. 2021-04889) is acknowledged.*

**Keywords:** Band gaps, Doping density, Electrodeposition, Resistivity, Thickness

***Abstract No: 183*** ***Physical Sciences***

# SYNTHESIS OF ACTIVATED CARBON AND TITANIUM DIOXIDE-BASED COMPOSITE FROM COCONUT SHELL FOR OPTIMIZED AND COST-EFFECTIVE SUPERCAPACITORS

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The energy landscape today grapples with two significant challenges - the unsustainability of fossil fuel energy and the mounting costs of energy storage materials. In response, researchers are pioneering the use of economically viable, environmentally benign materials for energy storage applications, with a marked rise in interest in activated carbon, particularly supercapacitor electrodes. In general, the synthesis and raw material cost of activated carbon derived from coconut shell charcoal is lower. The present study aims to prepare cost-effective supercapacitor electrodes by omitting problematic organic binders. This research elegantly employs locally sourced coconut shells, a widely available resource with high carbon content, as an optimized base material for 90 wt.% activated carbon (AC) and 10 wt.% titanium dioxide (AC-$TiO_2$) composite fabrication. The locally sourced coconut shells underwent a series of transformations, heating, grinding, and a chemical activation involving KOH as an activation catalyst and heating process. The surface morphology was examined through the utilization of scanning electron microscopy (SEM) images. The activated carbon was then coated on a fluorine-doped tin oxide coated (FTO) glass slide using an aqueous and slurry, and its performance was evaluated through cyclic voltammetry (CV) tests over a range of scan rates 2, 5, 10, 20, 50 and 100 mV $s^{-1}$, and within a potential window between 0.0 and 0.8 V. The highest discharge capacitance value recorded at these scanning rates was 168.0 F $g^{-1}$ at 2 mV $s^{-1}$, demonstrating robust capacitive behaviour. Notably, the study achieved an impressive peak specific capacitance of 168.0 F $g^{-1}$, an energy density of 13.29 W h $kg^{-1}$, and a power density of 255.85 W $kg^{-1}$ at the current density of 1 mA $cm^{-2}$. The (AC-$TiO_2$) electrodes synthesized in this study outperformed those documented in prior research, exhibiting the highest specific capacitance. The supercapacitors demonstrated exceptional endurance and rate capability, maintaining approximately 95% of their initial capacitance even after a rigorous cycle of 1000 charges and discharges. As confirmed by cyclic voltammetry, this performance underscores their excellent cycling stability. Nyquist plot of the supercapacitor exhibited represented a semicircle with a diameter of about 11 and a low-frequency spike. Therefore, this work makes a meaningful contribution toward advancing sustainable and cost-effective energy storage solutions.

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**Keywords**: Activated carbon, Coconut shell, Electrodes, Supercapacitor, Titanium dioxide

***Abstract No: 195*** ***Physical Sciences***

# LAYERED MARIGOLD-FLOWER-LIKE CdS/$MoS_2$-REDUCED GRAPHENE OXIDE NANOCOMPOSITE AS AN EFFICIENT ELECTRODE MATERIAL FOR SUPERCAPACITOR

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Technological advances have become a fundamental part of everyday life, and the demand for energy-storing devices has grown exponentially. Therefore, the development of energy storage devices is needed to fulfil global energy demands. Consequently, materials and devices for energy storage have long-term clean and renewable energy sources, which are widely accessible owing to their cost-effective and environmentally friendly nature. Transition metal chalcogenides are useful as active electrode materials for enhancing the capacity for energy storage. Considering the requirement of a large surface for energy storage, we have synthesized Marigold flower-like CdS/$MoS_2$ nanoflowers on rGO nanosheets by simple hydrothermal synthesis. The CdS/$MoS_2$-rGO nanocomposite symmetric supercapacitor device exhibited increased capacitance of 102 F $g^{-1}$ at a current density of 0.1 A $g^{-1}$, and 83.4% of the capacitance was retained up to $16 \times 10^{-3}$ cycles at the current density of 5 A $g^{-1}$. The resulting CdS/$MoS_2$-rGO nanocomposite can deliver excellent electrochemical performance. Supercapacitors under study demonstrated high energy storage capabilities, resulting in an efficient device for electrochemical energy storage.

*Financial assistance from Savitribai Phule Pune University, Pune, is acknowledged.*

**Keywords**: Cadmium sulfide, Molybdenum disulfide, Supercapacitor, Symmetric device.

***Abstract No: 197*** ***Physical Sciences***

# $CeO_2/MnO_2$ COMPOSITE MATERIAL FOR ASYMMETRIC SUPERCAPACITOR APPLICATIONS

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Supercapacitors have attracted significant attention to play prominent roles in resolving the energy crisis, global warming, and environmental pollution. $MnO_2$ is the most abundant material on earth, with high theoretical capacitance. It has multiple oxidation states that contribute to redox reactions. $CeO_2$ is a good redox stability, which can help to improve the conductivity of $MnO_2$. $CeO_2$ helps to improve the cyclic stability of the composite material. In the present study, the composite material consisting of $CeO_2$ nanoparticles decorated with $MnO_2$ nanowires was synthesized using the low-cost, wet chemical hydrothermal technique. The synthesized materials were characterized and analyzed by Raman spectroscopy, XRD, SEM, and XPS. XRD pattern and Raman spectroscopy analysis of $CeO_2$ nanoparticles decorated $MnO_2$ nanowires revealed the presence of tetragonal α- $MnO_2$ phase. The electrochemical supercapacitor performance of pristine $MnO_2$, $CeO_2$, and $CeO_2$ nanoparticles decorated $MnO_2$ nanowires are analyzed by cyclic voltammetry, galvanostatic charge-discharge, and electrochemical impedance spectroscopy. The specific capacitance of the composite material was approximately 145.19 F/g. The combination of these two materials in a composite can lead to synergistic effects, resulting in improved electrochemical performance, and it can be an outstanding active electrode material for supercapacitor applications.

**Keywords**: Asymmetric device, $CeO_2$, $MnO_2$, Supercapacitor.

***Abstract No: 198*** ***Physical Sciences***

# HYDROTHERMAL SYNTHESIS OF HGTE THIN FILMS FOR POSSIBLE APPLICATIONS IN THIN FILM CdTe SOLAR CELLS

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HgTe is a compound semiconductor of the II-VI group with the narrowest direct band gap ranging from 0.2 to 1.2 eV. The material has uses in photodetectors and thin-film solar cells. A simple method for synthesizing pure HgTe powder samples using hydrothermal processes is presented in the current study. In double distilled water (DDW), mercury nitrate and tellurium oxide were used as precursors, along with NaBH4 as the reducing reagent. The chemicals were mixed at ambient temperature before being placed in an autoclave at 200 °C for 72 hours. Precipitate was dried at 80 ℃ in a vacuum oven for 12 hours. The obtained solution was washed three times by centrifugation with DDW and ethanol. The optical, structural, and morphological properties of the synthesized powder samples were studied using an X-ray diffractometer, Raman microscopy, scanning electron microscope, and energy dispersive spectroscopy. A highly crystalline pure cubic crystal phase was revealed by XRD analysis. The TO and LO modes observed in Raman spectra at 116 and 137 cm-1 confirmed the formation of HgTe. SEM images showed that the formed agglomerated particle nanoparticles are spherical, uniform, and dense. The elemental composition determined using EDS was found to be 1:1 in stoichiometry. The synthesized material could be utilized to deposit thin films to examine their applications in solar cells and IR detectors.

*The financial support received from SERB, India, and UGC-CSR, Indore, MHAJYOTI, Nagpur, is gratefully acknowledged.*

**Keywords**: Hydrothermal synthesis, Mercury tellurides (HgTe), Powder samples, Solar cells

***Abstract No: 200*** ***Physical Sciences***

# SYNTHESIS OF CERIUM OXIDE NANOPARTICLES BY HYDROTHERMAL METHOD AND INVESTIGATION OF THEIR ANTIBACTERIAL ACTIVITIES

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Metal oxide nanoparticles have been suggested as promising candidates for the development of antibacterial agents. Among metal oxides, cerium oxide ($CeO_2$) nanoparticles have been utilised in different applications due to their physical, chemical and redox properties. Cerium nitrate hexahydrate and sodium hydroxide were used as a precursor and reducing agent for the synthesis of $CeO_2$ using the hydrothermal method. The synthesised samples were characterised using various techniques to understand their structural, optical and antibacterial properties. From XRD analysis, the average crystallite size ~ 25 nm was determined from the Debye-Scherrer relation. Raman peak was observed ($F_{2g}$) at 464 $cm^{-1}$, attributed to the symmetric stretch of the Ce–O vibration. The optical energy band gap of the $CeO_2$ nanoparticles was estimated to be ~ 3.3 eV by the UV- V reflectance spectrum. The FTIR spectrum of the prepared $CeO_2$ nanoparticles identified the chemical bonds as well as functional groups in the sample. Also, the signature bands due to the stretching frequency of Ce–O can be seen in between 400 to 500 $cm^{-1}$, indicating the formation of $CeO_2$ nanoparticles. The antibacterial activity was studied by disc diffusion assay against common pathogens (*Escherichia coli* and *Staphylococcus aureus*), and a strong antibacterial effect against Gram-positive pathogen *S. aureus* was observed.

**Keywords:** Antibacterial activity, Cerium Oxide Nanoparticles, Hydrothermal method, Optical properties, Zone of inhibition

***Abstract No: 201*** ***Physical Sciences***

# PERFORMANCE ENHANCEMENT IN ULTRATHIN CIGS SOLAR CELLS USING PLASMONIC NANOPARTICLES – A FINITE DIFFERENCE TIME DOMAIN ANALYSIS APPROACH

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The plasmonic effect in photovoltaics is gaining attention because of its optical absorption enhancement properties in solar cells. Plasmonic structures exhibit wavelength-selective photon scattering based on their shape, size, and the surrounding dielectric medium. Plasmonic enhancement is achieved through the collective oscillations of the free-electron cloud in metallic materials when the size is smaller than the wavelength of the incident radiation. This study explores the application of plasmonic gold (Au) nanoparticles (NPs) in CuInGaSe2 (CIGS) solar cells using the finite-difference time-domain (FDTD) analysis method for simulation. The study was carried out using ANSYS LUMERICAL to simulate optoelectronic properties, solving Poisson's and continuity equations coupled with Maxwell's equations. Au (NPs) exhibit different resonance frequencies in semiconductor materials, making them suitable for selective wavelength-absorption enhancement. The results demonstrate that the unabsorbed light in the base CIGS was effectively captured in the devices with embedded Au NPs. In particular, when 20 nm diameter spherical Au particles were incorporated into CIGS solar cells, they achieve a higher efficiency increase of 4% compared to CIGS solar cells without plasmonic nanoparticles. This study highlights the effective utilization of plasmonic nanoparticles for efficient light absorption, which enables thickness reduction of high-efficiency thin-film solar cells.

**Keywords:** CIGS, FEM simulation, Gold Nanoparticles, Plasmonics, Thin film solar cells

***Abstract No: 202*** ***Physical Sciences***

# COST-EFFECTIVE CIGS THIN FILMS: ELECTRODEPOSITION AND CHARACTERIZATION FOR EFFICIENT SOLAR CELLS

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The present work explores the electrodeposition of copper indium gallium diselenide (CIGS) thin films using a non-aqueous electrolyte at a higher working temperature of 130 °C. The cyclic voltammetry (CV) experiment revealed a broad potential window beyond -0.8 V relative to the Ag/AgCl reference electrode, suitable for CIGS deposition. X-ray diffraction (XRD) analysis confirmed the formation of a tetragonal chalcopyrite structure in the annealed layers, while secondary phases, such as CuSe and $In_3Se_4$, were observed in as-prepared films deposited at higher potentials. Upon annealing, all layers became highly crystalline, with the removal of secondary phases depicting the formation of the tetragonal structure of CIGS. The annealing process enhanced the crystallinity and confirmed the presence of the $A_1$ mode of the tetragonal structure in CIGSe films. The uniform and compact morphology seen in films deposited at higher potentials suggests their potential for solar cell applications. Furthermore, the annealing process enhanced the crystallinity and supports the formation of nearly stoichiometric CIGS films. These findings contribute to the advancement of cost-effective and efficient thin-film solar cell technology, offering a promising avenue for sustainable and renewable energy solutions.

*Financial assistance from NPDF-SERB is acknowledged.*

**Keywords**: $CuIn_{1-x}Ga_xSe_2$, Electrochemical Deposition, Post-heat Treatment, Rapid Thermal Annealing, Thin Film Solar Cells

# Science Education

***Abstract No: 13*** ***Science Education***

# IMPLEMENTING INQUIRY-BASED LEARNING APPROACH TO IMPROVE SYNTHESIS SKILLS AMONG SCIENCE UNDERGRADUATES

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Analysis, evaluation, and synthesis are higher-order cognitive processes which require the active participation of students and inquiry-based learning (IBL) activities are an efficient means to improve them. IBL involves exposing the students to an issue or a concept, and the students are encouraged to ask questions and generate hypotheses or predictions. This process is followed by experimentation to collect data and analysis of data to draw conclusions. The learning process involves analysis, critiquing, designs, and reflections. An IBL activity was implemented on a group of 19 fourth-year undergraduates enrolled in the Membrane Biology course and were following the BSc Honours degree in Biochemistry and Molecular Biology at the University of Colombo. For the IBL activity, students were provided with several research articles relevant to the taught material. They were requested to conduct a poster presentation on an experiment in the research article, assuming they were one of the authors in the article, providing context to what is already known, gap-in-the-knowledge, hypotheses, experimental method, results, conclusion/s and future direction/s for the study encouraging them to synthesise their own hypotheses and experimental designs. To ensure that students are not developing misconceptions during their inquiry, they were requested to submit a short manuscript on what they are proposing. Following the feedback from the instructor, students conducted their poster presentations, which were evaluated based on predetermined evaluation criteria. A cross-sectional survey involving the students who participated in the IBL activity recorded their positive learning experience, with all agreeing that the assignment helped them to learn how to analyse data presented in a journal article critically. In the study sample, 19% of students strongly agreed, and 76.2% of students agreed that they were able to synthesise their own hypotheses and experimental designs. All students agreed that the assignment led to an increase in their scientific creativity. In conclusion, the implemented IBL activity was highly constructive in developing students' higher-order cognitive skills. Considering the intellectual effort that needs to be invested in an IBL activity, the entire course can be benchmarked by incorporating another IBL-based assignment, such as developing a research proposal forgoing the necessity of an end-semester examination.

**Keywords**: Bloom's taxonomy, Inquiry-based learning, Student-centered learning, Synthesis skills

***Abstract No: 16*** ***Science Education***

# EFFECTIVENESS OF INTEGRATING STEM EDUCATION INTO SCIENCE TEACHING AND LEARNING PROCESS

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Vital elements of STEM education are the integration of Science, Technology, Engineering and Mathematics into the curriculum with a commitment to hands-on learning. Science national cognitive achievement tests were conducted for Grade 8 students in 2005 and 2008, and the lowest mean score was achieved in sub-skill synthesis due to weakness in the application of concepts to real life. Therefore, high scientific literacy can be achieved through STEM-integrated teaching-learning activities. This study aimed to investigate the effectiveness of STEM integration into the science teaching-learning process of Grade 8 students of three selected 1C schools (named A, B and C) in Wattegama Educational Zone. The study employed mixed methods to triangulate information. The soil erosion subunit (15.3) was selected under Natural Disasters (unit 15) of the Grade 8 science textbook. The purposive sampling process was utilised to select 136 Grade 8 students for the study. Quantitative data were collected from pre-test and post-test. Qualitative data were collected using activity sheets, teacher interviews and observations. The quantitative data were analysed using SPSS, and qualitative data were analysed using Thematic Analysis. It was identified that STEM-integrated teaching-learning activities enhanced the performance of students in schools B ($p< 0.05$) and C ($p< 0.05$). However, there was no significant difference in performance of the school A ($p >0.05$). The reason for not increasing student performance in school A may be due to crowded classrooms. An independent sample t-test showed that post-test marks of experimental and control groups of school A ($p> 0.05$) and C ($p> 0.05$) were not significantly different. However, post-test marks of the control and experimental group of school B were significantly different ($p< 0.05$). The highest performance of students was shown in school B, and student performance was not at a significant level in schools A and C. It may be due to various reasons, such as crowded classrooms and differences in teaching qualities in STEM-integrated teaching. It was also revealed that there was no considerable difference in the science performance of students who were taught with STEM integration in schools A, B and C ($p >0.05$). This may be due to similar social and cultural settings in school sub-systems. Furthermore, it was revealed that the highest performing were male students (School B mean = 98.77), the second highest was female students (School C mean= 97.94), and the lowest was School A (mean male =95.71 & mean female = 91.80). The low student number and male students in the classroom is the most influential factor for the highest students' performance in school B, sequentially followed by school C and A. additionaly, the important aspects of STEM-integrated teaching-learning activities were revealed, which are helpful for students and teachers to develop personal qualities in authentic learning for solving real-life problems.

**Keywords**: Authentic learning, Lifelong learning, 21st Century skills, STEM Education

***Abstract No: 17*** ***Science Education***

# THE IMPACT OF SCHOOL RESOURCES ON THE PERFORMANCE OF STUDENTS' G.C.E. O/L (ORDINARY LEVEL) MATHEMATICS RESULTS

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The reports of the Central Bank of Ceylon and other sources emphasise the substantial amount of financial and human resources spent on the Sri Lankan free education system. It is crucial to find out whether this expenditure is worthwhile and effective. This study aimed to identify the impact of school educational resources on students' G.C.E. (O/L) mathematics performance. The data was collected from 27 principals and 52 mathematics teachers from 27 selected schools in the Vadamaradchy Education Zone. Schools were selected using the cluster sampling method. Information regarding school resources and their efficient use was collected from principals and teachers through structured questionnaires. The G.C.E. (O/L) mathematics results in the last five years were used to evaluate students' performance. The statistical analysis was conducted using the Statistical Package for Social Science (SPSS) 17.0, employing Spearman's correlation coefficient to determine the correlation between variables. This study revealed that 1 AB schools had the highest average pass percentage in mathematics (85.55%) than 1 C schools (70.32%) and Type II schools (47.36%). The classroom size and teacher-student ratios did not have a significant impact on the pass percentage. More than 75% of scholarship-holding students got admission to 1AB schools, and this had an impact on the pass percentage. Considering the relationship between educational resources and mathematics performance as a whole, there was a significant and large correlation ($r=0.514$, $p=0.000$) between the availability of school buildings and classrooms and students' mathematics performance. A positive, moderate, but significant correlation ($r=0.489$, $p=0.000$) between the availability of instructional space and mathematics performance was observed. Availability of instruction materials also showed a positive moderate correlation ($r=0.481$, $p=0.000$) with G.C.E. (O/L) mathematics performance. The factors of developing their own lessons by the teachers, frequency of using computer software or applications for teaching, and frequency of using library resources demonstrated negative correlations with students' mathematics performance. Based on the results, it can be concluded that several school resource factors significantly impact G.C.E. (O/L) mathematics performance, although the magnitude of these impacts is not substantial. Thus, it remains uncertain that educational resources have a significant impact on students' G.C.E. (O/L) mathematics achievement. This conclusion suggests that while school resources play a role in shaping student performance in mathematics, they are only part of the equation, and other factors may also contribute to overall outcomes. This study encourages further research to delve deeper into the specific aspects of school resources that have a significant impact and explore strategies to optimise their effectiveness.

**Keywords**: G.C.E. (O/L) Mathematics, Impact, Performance, School resources

***Abstract No: 28*** ***Science Education***

# IMPROVING SCHOOL ATTENDANCE OF A GRADE EIGHT STUDENT EMPOWERING COMPETENCE, AUTONOMY SUPPORT AND RELATEDNESS THROUGH SCIENCE ACTIVITIES: AN ACTION RESEARCH

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Teachers' support of students' basic psychological needs for autonomy, competence and relatedness facilitates students' autonomous self-regulation for learning, empowering academic performance and well-being. Teachers can nurture these needs by autonomy-supportive behaviours. Thus, it creates more opportunities for students to work on their own. Autonomy-supportive teachers promote the relevance of schoolwork, provide more opportunities for choice, ask more questions about what students want to do, and praise signs of improvement. As there was a Grade eight student with meagre attendance, this action research was conducted to improve the attendance of a student who was absent from school regularly (only once in two weeks) by enhancing three innate needs of intrinsic motivation: Competence, Autonomy support, and Relatedness (CAR). This was accomplished through various science activities in a 1AB school in the Dehiowita education zone. Discussions were held with the student, the teacher of Grade Eight, the sectional head, and the child's mother to explore the reasons for poor attendance, interests of the child, learning style, and level of achievement as the first phase of the intervention process. Existing CAR was estimated using a multidimensional questionnaire as pre-intervention. Different activities in science with the supportiveness of CAR were conducted with the students with the support of the school community as lab-based activities, innovations with the support of technology teachers, scientific drawings with other science teachers, and equipment handling with lab assistants as the steps of interventions. The same multidimensional questionnaire was administered to measure student CAR after the intervention. The mean statistics of CAR were 1.5, 1.85, and 1.43, respectively, prior to the intervention, and related mean statistics of CAR were 3.35, 3.54, and 3.26 after the intervention. Thus, student's interest in engagement in science has been improved while increasing student's school attendance with the enhancement of science performance. As such, this study concludes that the empowerment of CAR is highly effective in the enhancement of student school attendance and performance while developing student's intrinsic motivation.

**Keywords:** Attendance, Autonomy support, Competence, Relatedness, Science activities

***Abstract No: 29*** ***Science Education***

# ENHANCEMENT OF STUDENT ACHIEVEMENT IN SCIENCE OF A 1AB SCHOOL IN DEHIOWITA EDUCATION ZONE: AN ACTION RESEARCH

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Intrinsic motivation is a fundamental element of student learning, and teachers could assist in increasing and developing intrinsic motivation for optimal achievement in the classroom. As there were students with deficient levels of achievement in science, this action research was conducted to enhance their achievement in science in Grades 7, 8 and 9 through interventions. A purposive sampling technique was used. Participants comprised 16 students in each Grade, totalling 48 students. A multidimensional questionnaire was used to measure intrinsic motivation, along with pre-test papers, post-test papers, and continuous assessment test papers to measure achievement before and after the intervention. Students were identified with low achievement in science as the first phase of the intervention. Positive reinforcement, positive feedback, verbal rewards and other strategies were used to enhance intrinsic motivation in the second phase. Furthermore, activity-based learning methods were applied in the third phase. Focus group interviews were conducted for qualitative data. Post-test papers and other measurement tools were used to measure their progress in the fourth phase of the intervention. The mean statistics of the pre-test and intrinsic motivation of students were 26.63 and 1.33 prior to the intervention, respectively. The mean statistics of the post-test and intrinsic motivation were 35.73 and 4.26 after the intervention, respectively. Results showed a significant difference in intrinsic motivation and achievement of students prior to the intervention and after the intervention ($p$=25.67 (47), t=.000 and $p$=8.93 (47), t=.000). Three themes were derived from the thematic analysis, including enhancement of intrinsic motivation through attractive teaching-learning methods; teacher's verbal rewards for intrinsic motivation; and enhancement of students' achievement through a student-centred approach. Thus, the intervention process improved the intrinsic motivation and achievement of the students who demonstrated low achievement in science in Grades 7, 8, and 9. Thus, Student-centered teaching-learning methods and teaching strategies to enhance students' intrinsic motivation are highly effective in teaching science to meet 21st-century educational goals.

**Keywords**: Achievement, Action research, Intrinsic motivation, Student-centered teaching-learning methods.

***Abstract No: 30*** ***Science Education***

# THE EFFECT OF INTRINSIC MOTIVATION ON SCIENCE ASPIRATIONS IN GRADE ELEVEN STUDENTS IN DEHIOWITA EDUCATION ZONE

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Students' aspirations are strongly associated with their intrinsic motivation. Thus, this quantitative study was conducted to identify the effect of intrinsic motivation on science aspirations in Grade Eleven students in two 1AB schools and two 1C schools in the Dehiowita education zone to compute the relationships of the above two psychological factors of students. The convenience sampling technique was used to select 435 students from Grade Eleven who sat for G.C.E. (O/L) in 2023. A Likert-type multidimensional questionnaire was administered to measure students' aspirations and intrinsic motivation. Descriptive and regression analyses were conducted according to the G.C.E. (Advanced level) subject stream and across gender. Results showed a high positive relationship between intrinsic motivation and aspirations of the science stream ($R^2$ =.953 (186), t=61.165, p=.000). Moreover, there was a low positive relationship of the above aspect in subjects other than science ($R^2$ =.519 (247), t=16.301, p=.000). The results demonstrated a high positive relationship of female students when compared to the male students (Female; $R^2$ =.910 (183), t=42.943, p=.000 and Male; $R^2$ =.920 (250), t=53.496, p=.000). Thus, the effect of intrinsic motivation on aspirations in science is more substantial than other subjects. As such, student intrinsic motivation is to be enhanced to empower students' aspirations.

**Keywords**: Aspirations, Intrinsic motivation, Other subjects, Science

***Abstract No: 61*** ***Science Education***

# KNOWLEDGE, ATTITUDES, PRACTICES AND PARTICIPATION IN ENVIRONMENTAL CONSERVATION ACTIVITIES OF GRADE 11 STUDENTS IN FOUR SELECTED SCHOOLS IN MATALE DISTRICT, SRI LANKA

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Environment-related topics are included in the school curricula of Grades 1 to 11 in Sri Lanka since it is essential to educate the future generation to ensure sustainable use of natural resources. This study investigated the basic environmental knowledge, practices, attitudes and participation in environmental conservation activities of Grade 11 students in four schools in the Matale district. The sample consisted of 200 students from four secondary schools in two educational zones. A questionnaire was used to collect data to test the basic knowledge of students regarding the environment, investigate practices and attitudes, and determine participation in environmental conservation activities. Data were analysed using both quantitative and qualitative methods. The findings revealed that the students' basic knowledge of environmental topics, including concepts like defining the environment, biodiversity, invasive plants, and renewable energy sources, was lacking, with 56% scoring below 5 out of 20 marks. Nevertheless, there was a positive attitude toward environmental awareness, as 81.5% of students believed it was crucial for sustainable living. Many students endorsed eco-friendly practices, such as using reusable bags (60%) and minimising polythene bag usage (60%). Despite these positive attitudes, some negative attitudes prevailed, including the misconception that natural resources are infinite (75%) and the belief that schools should hire labourers for cleaning (71.5%). According to Spearman's correlation analysis, there was a significant correlation ($P<0.05$) between students' environmental knowledge and their attitudes, as well as between knowledge and environmental practices. The majority of students follow energy and water conservation practices. However, only 29.5% of students were members of environmental conservation-related clubs, and the study noted that only a few activities were organised through these clubs. The research suggests the need for diversifying environmental conservation activities in school curricula and clubs to boost Grade 11 students' participation in environmental conservation efforts. Motivational awards and incentives are recommended as strategies to enhance students' environmental knowledge, practices, attitudes, and participation in environmental conservation activities.

**Keywords:** Attitudes. Environmental knowledge, Conservation

***Abstract No: 75*** ***Science Education***

# AWARENESS OF FOOD LABELS AMONG SCHOOLCHILDREN IN AMPARA DISTRICT: PROMOTING BETTER HEALTH CHOICES THROUGH KNOWLEDGE EVALUATION

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Consumers can make better food selections with the support of information on food labels. This study endeavours to determine the awareness among schoolchildren aged 11 to 15 years, specifically in grades 7 and 8 in Ampara district, regarding the information provided on labels of packaged food products. A total of 260 students participated, providing verbal consent after being informed about the study. Data collection utilised a self-administered questionnaire (15 questions, ticking and writing). Statistical analysis was done by Minitab 17 software. The majority of students (91.9%) prioritised the manufacturing and expiration dates when purchasing packed foods. Price (40.38%), ingredients (37.7%), and nutrition data (23.5%) were also considered essential. About 63.31% of students were aware of colour coding on food labels, but only 70.8%, 28.1%, and 61.9% of them were concerned about sugar, fat, and salt levels, respectively. Health concerns (51.5%) and parental advice (38.8%) played significant roles in students' awareness of colour coding. Gender had a significant association ($P \leq 0.05$) with awareness of food labels, preference for packed foods, and frequency of consumption. Typically, females check the label information than ($P \leq 0.05$) males. However, there was no correlation ($P \leq 0.05$) between gender and awareness of colour coding. Body mass index (BMI) showed a strong correlation ($P \leq 0.05$) with awareness of colour coding and knowledge of food ingredients. Only 25.8% of students knew food additives, and 2.7% recognised chemical names on food labels. Feedback from 58.5% of students indicated a request for improved quality and nutritional value of packed foods. Education on nutrition data other than the expiration date is vital. Knowledge of colour coding is beneficial to maintain the BMI value of the body. Therefore, by making informed choices and selecting healthier food options, individuals can improve their overall well-being.

**Keywords**: Awareness, Food labels, Schoolchildren, Students

***Abstract No: 104*** ***Science Education***

# IMPACT OF SOCIAL ISOLATION ON MENTAL HEALTH, SOCIAL INTERACTIONS, AND ACADEMIC PERFORMANCE AMONG ADOLESCENTS DURING COVID-19 PANDEMIC

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The effect of COVID-19 took a toll on the efficiency of delivering education due to the change from traditional classrooms to online learning. While the shift to online education was relatively successful, the efficiency of its deliverance was questionable, especially in developing countries like Sri Lanka. This study aims to assess the effect of social isolation during the pandemic on student mental health, social interactions and academic performance. For the study, students following secondary education from 2020-2021, during the peak of the COVID pandemic, were considered. The survey conducted received 1,500 responses representing students of 21 districts with multiple economic backgrounds. To visualise the influence of virtual education, academic performance was measured via examination results from the years 2018 to 2021 (considering 2018 and 2019 as pre-virtual education and 2020 and 2021 as post-virtual education). Survey results indicate that mental health played a crucial role in distinguishing the productivity of respondents, with a majority (72%) showing severe stress and panic with the start of online learning. Forty seven percent of students were not satisfied with the communication during social isolation due to a lack of social interactions caused by the increased use of virtual platforms to conduct academics. Factors such as change in environment, motivation, guidance, and communication had similar contributions ($F= 28.31$; $p= 0.001$) to an overall decrease in performance (46%). The combined effect of mental and social factors affected all students irrespective of socio-economic status. Time management was a key issue with online learning. Thirty seven percent of the study population stated that technology became a barrier to their productivity, while 25% disagreed. Results indicate the absence of a significant impact on the overall results of O/L and A/L. Higher pass rates among males and females in almost all considered districts for both O/L and A/L exams (paired t-test for A/L- $p = 0.007$; O/L- $p = 0.006$) were seen after the virtualisation of classrooms. This study provides crucial insight into exactly which factors have the most significant effect on student performance in terms of virtual education and whether that effect is significant.

**Keywords**: Blended learning, Factors, Productivity, Virtual Education, Technology

***Abstract No: 112*** ***Science Education***

# THE EFFECTIVENESS OF ONLINE TEACHING AND LEARNING COMPARED TO IN-PERSON INSTRUCTIONS ON SCIENCE FOR JUNIOR SECONDARY STUDENTS: A CASE STUDY AT A CHOSEN SCHOOL IN THE KURUNEGALA EDUCATION ZONE

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Schools and Universities in Sri Lanka have been closed intermittently during the past three years due to COVID-19 and fuel shortages. During this period, in-person teaching became impossible, and online teaching was developed. Schools have been reopened for in-person teaching and learning at present. In contrast, other countries adopted both methods, online and in-person. Declining test scores among junior secondary students in some education zones during online learning were noticed. This study aimed to assess and compare the effectiveness of online and in-person teaching and learning science among junior secondary students in a selected school within the Kurunegala education zone. The objectives of the study were to conduct both online and in-person science lessons for two groups separately and to compare grade eight students' performance in both settings; Compare teacher-student interaction, learning resources, peer group interaction, and motivation in both sittings; and make suggestions for effective teaching and learning process. Two equally weighted courses were used to teach the two groups. A convenience sample of 72 Grade 8 students was used in the data collection with mixed methods approach. Pre-tests, post-tests, and questionnaires were used in the quantitative data collection. Qualitative data were collected via interviews with ten randomly selected students. The findings indicated that the in-person group achieved slightly higher performance scores in Unit 4 (Properties of Matter) than the online group. Both groups demonstrated similar performance levels in Unit 8 (Changes in Matter). However, in-person teaching exhibited significantly higher scores ($p < 0.05$) than the online group for factors such as teacher-student interaction, peer group interaction, learning resources, and motivation. Students achieved high results in both settings but needed more resources, reliable internet, and adequate technology skills for online teaching and learning. The study suggests adapting effective instructional methods, technology usage, resource availability, training, participation, peer interactions, and monitoring well-being for effective online science teaching.

**Keywords**: Online teaching, Science teaching, In-person teaching

***Abstract No: 186*** ***Science Education***

# EVALUATION OF TRADITIONAL AND SKILL-ORIENTED TEACHING AND ASSESSMENT IN ENHANCING GENERIC SKILLS OF STUDENTS IN CHEMISTRY COMPONENTS IN GRADE SEVEN SCIENCE: A CASE STUDY IN CENTRAL PROVINCE, SRI LANKA

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Formative and summative assessments are used to evaluate students' learning process to fulfil intended learning outcomes. This research examines the effectiveness of traditional teaching and assessment versus skills-oriented instruction and assessment in enhancing generic skills in learning Chemistry in Grade Seven class in the Central Province of Sri Lanka. This is an experimental study employing a mixed methods approach. Two subunits from the Grade Seven science curriculum were selected for instruction. Nine Schools were selected from the central province with a sample size of 636 students by convenience sampling. Two parallel classes of Grade Seven in each school were selected. A Pre-test was administered to both classes to ensure comparability of the groups. One class was considered a control group, and the other class was an experimental group. In the 2nd sub-unit, these groups were interchanged. The first lesson was conducted using the traditional method for the control group and using skill-oriented instructional and assessment methods for the experimental group. The parallel classes were switched over in the second lesson, employing the same teachers. After the teaching-learning process, post-tests were administered to both groups for both lessons. While conducting both traditional and skill-oriented learning, generic skills were observed by the researcher with the help of three other teachers with scoring rubrics. The difference between the mean scores of pre-tests, post-tests and generic skill tests were compared. According to the results, skill-oriented groups showed significantly higher performance than the traditional group. Furthermore, the observational data analysis demonstrated that the students of the skill-oriented instructional group demonstrated better orientation to real-life situations. Findings from focus group discussions with students and teachers reveal that skill-oriented instruction and assessments cultivate much higher generic skills than traditional instructions and assessments. According to the above, the current teaching-learning process has to be re-evaluated to enhance students' meaningful learning in the chemistry component of Grade Seven science.

**Keywords**: Assessment, Meaningful learning, Skill-oriented approach, Student performance

# Postgraduate Institute of Science, University of Peradeniya

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