The Open University of Sri Lanka

Open University Research Sessions 2023

09th and 10th November 2023

THE OPEN UNIVERSITY

OF SRI LANKA

Book of Abstracts

Open University Research Sessions 2023

OURS 2023

09th & 10th November 2023

All abstracts in the proceedings are reviewed and accepted for publication.
Responsibility for the contents of the abstracts rests with the authors.

ISSN 2012-9912

Cover Page Design:

Mr. Samith Daladawatta

MESSAGE FROM THE VICE-CHANCELLOR

I am indeed happy to contribute this message to the Open University Research Sessions (OURS) 2023 which is one of the flagship events in the university calendar. Research has a clear potential to make significant contributions to the quality of higher education. Therefore, universities have an obligation to make the research-teaching nexus as strong as possible. The annual OURS provides an opportunity for sharing of knowledge created through research across various disciplines.

The OURS publishes the results of multidisciplinary research in the areas of Open and Distance Learning, Education, English Language Teaching, Natural Science, Engineering Technology, Law, Humanities and Social Sciences, and Management Studies. It is open for the publication of research articles, reviews, and research communications in all disciplines. The OURS provides a opportunity for OUSL academics as well as researchers at other state and Non-State Sector Higher Educational Institutions (NSHEIs) to publish high-quality research covering above all diverse disciplines.

The world around us is rapidly evolving and as an institution of higher learning and research, it is our duty to keep pace with these changes. OURS is a testament to our commitment to stay at the forefront of cutting-edge research, academic exploration, and interdisciplinary collaboration. As global citizens we are living in era with plenty of pressing challenges. Climate change, healthcare disparities, technological advancements, and socioeconomic inequalities are just a few of the complex issues that demand our attention and needs rigorous investigation.

I am confident that the research presented here will not only contribute to our understanding of these challenges but also provide tangible solutions to address them. I want to express my deep gratitude to all the researchers, scholars, and students who have dedicated countless hours to developing their research papers. Your efforts exemplify the spirit of inquiry and discovery that lies at the heart of our institution's mission. You are the driving force behind our academic community, and your work continues to inspire us all.

To our distinguished guests and partners from other institutions, your presence is a testament to the collaborative spirit of academia. It is through partnerships and the exchange of ideas that we can achieve true progress. I encourage you to engage in meaningful dialogues with our researchers and explore opportunities for future collaborations. As we embark on this journey of knowledge dissemination and exploration, I encourage you all to embrace the diverse perspectives and ideas that will be shared over the course of this conference. Let us challenge our assumptions, ask difficult questions, and be open to new possibilities. In doing so, we can pave the way for a brighter, more sustainable future.

I look forward to the rich exchange of ideas, the insightful discussions, and the innovative solutions that will emerge from this research sessions. Together, we can make a significant impact on the world and work toward a better, more sustainable future. Thank you for your dedication to research, your commitment to excellence, and your passion for making a difference. Let us seize this opportunity to inspire, collaborate, and shape the future through our collective efforts.

I wish you all a productive and enlightening Open University Research Sessions.

Snr. Prof. P.M.C. Thilkarathne
Vice-Chancellor

PREFACE

The Open University Research Sessions 2023 (OURS 2023) is held on 09th and 10th November 2023 as a hybrid conference with the objective of bringing local and foreign researchers to one forum. It commences with the inauguration on Thursday 09th November and continues until 10th November holding six parallel technical sessions, which includes a Panel Discussion session.

The annual Open University Research Sessions (OURS) organized by the Research Unit of OUSL established itself as a high calibre research forum that attracts not only researchers from the OUSL community, but also from other state universities and higher education institutions, creating a forum for presenting and discussing valuable research findings leading to enriching experiences to the researchers. OURS which started its journey in 2003, significantly contributed to enhance the research culture among OUSL staff members in ODL and disciplinary-based research, which directly inspired our staff members to participate at other national and international conferences.

This year we received 232 abstracts and extended abstracts for reviewing and 140 abstracts were selected for presentation following a rigorous and blind peer review process. The abstracts received covered a wide range of sub themes which include, Open and Distance Learning (ODL), Education, English Language Teaching (ELT), Engineering and Technology, Health Sciences, Biological Sciences, Agriculture, Forestry, Physical Sciences, Humanities and Social Sciences, Management, and Law. This volume contains the abstracts that were accepted for presentation.

The Chief Guest at the inauguration of OURS 2023 is Prof. R.M. Gamini Rajapakse who is a Senior Professor in Chemistry, University of Peradeniya, Sri Lanka. The invited keynote speakers include Prof. M. Sornarajah, Emeritus Professor of Law, National University of Singapore, Singapore, Mrs. Maria Obraztsova, Director of Institute of Additional Education, Innopolis University, Russia and Prof. Gunther Paul, Adjunct Associate Professor, Faculty of Science and Engineering, Australian Institute for Tropical Health and Medicine, James Cook University, Australia. We are very grateful to all of them for taking time off from their busy schedules to be with us at the sessions.

A special feature of the OURS 2023 this year is the six panel discussions organized by the faculties of Education, Engineering and Technology, Health Sciences, Management Studies, Natural Sciences and the Centre for Environmental Studies and Sustainable Development (CESSD) of OUSL. Another highlight of this series of events are the Pre-Conference lectures and workshops to be conducted on 07th and 08th November 2023 by the Research Unit of OUSL in collaboration with the six faculties and the Post-Graduate Institute of English (PGIE) of OUSL.

Organizing an event of this nature and magnitude required the collaborative and dedicated effort of all the members of the organizing committee of OURS 2023. From formulating the Call for Abstracts to compiling a volume of proceedings and planning the research sessions, everyone worked hard in a true spirit of leadership

and teamwork. Therefore, on behalf of the Senate Sub-committee for OURS 2023, I thank all the authors who submitted abstracts and extended abstracts to the conference, all reviewers for their intellectual input that helped shape and uplift the quality and rigour of the research to be presented at the sessions, and the language editors, theme conveners, and the Session Chairs of OURS 2023.

We appreciate the services rendered by members of the Senate Sub-committees for the OUSL Research Awards, OUSL Best Educational Video Production, and Best Online Course Awards for selecting the awardees. Special appreciation goes to the Three-Minute Thesis (3MT) Competition Awards Committee for their hard work and the judging panel for selecting the winners.

We wish to record our thanks to the Vice-Chancellor, Professor P.M.C. Thilkarathne, for his ready support in carrying out our work to make this event a success. We also thank him for suggesting new events such as the 3MT Competition, as well as panel discussions for the dissemination of knowledge and thought-provoking research ideas.

We thank Prof. C. S. De Silva, Act. Director CETMe for facilitating us with designing the graphics and video coverage of OURS 2023 inauguration session. My special appreciation is extended to Mr. Samith Daladawatta at CETMe for graphic designing and Mr. J. P. P. Tharanga at the Department of Computer Science, OUSL, for maintaining and updating the OURS 2023 web page. I especially thank Dr Dushantha Alwis for her hard work as the chairperson of 3MT Organizing Committee.

I extend a very special appreciation for the excellent team effort of "OURS 2023 Online Working Group" for their efficiency and willingness to make the OURS 2023 conference a reality. The untiring efforts of Dr Saminda Fernando, Dr Uthpala Jayawardena, Dr Dushantha Alwis, Dr K. A. Sriyani, Mr Lal Medawattegedara, Ms Mayanthi Jayakody, Dr Sanjeeva Rodrigo, Ms Nilakshi Wickramasuriya/AR-Fac. Education, Ms Vindya Angammana/AD-CRC, Mr. J.P.P. Tharanga, Mr. Kanishka Tennakoon, and Mr Chameera Chandrarathna is greatly acknowledged. The secretarial assistance provided by Ms. Rajika S. Weerasinghe and Ms I. P. S. Sandamali is very much appreciated.

Finally, let me thank all the presenters whose research and ideas will be showcased here and the participants.

I am confident that OURS 2023 will bring you renewed motivation and enthusiasm to engage in more productive research.

I wish all of you two days of intellectually stimulating and successful engagement in the research sessions.

Prof. S.R Weerakoon
Senior Professor and Chair of Botany
Director/Research
Conference Chair – OURS 2023

EDITORIAL BOARD

Prof. S.R. Weerakoon (Director/Research)

Dr. K. A. Sriyani (Editor-in-Chief)

Mr. Lal Medawattegedara

LANGUAGE EDITORS

Dr J.C.N. Pullenayegem
Dr D.E. Devendra
Dr K.R.M. De Silva
Dr H.M.N.N. Menike
Dr Nirosha Abeysekara
Dr Agra Rajapakse
Dr Romola Rassool
Ms Mihiri Jansz
Ms T.M.K. Jayakody
M. Srianthie Salgado
Ms K.G.S.A Wijesinghe
Ms Manikya Kodituwakku
Ms Samathi Disanayake
Ms Pramiltha Fernando

MAIN ORGANIZING COMMITTEE

Prof. S.R. Weerakoon	Director/Research
Dr. K. A. Sriyani	Editor-in-Chief
Dr T. S. P. Fernando	Chairperson/OURS 2023 Online Working Group
Dr Uthpala Jayawardena	Chairperson/Sub-Committee– OURS 2023 Online-Organization
Mr Kanishka I. Tennakoon	Chairperson/Sub-Committee– OURS 2023 Online-Technical Support
Ms Rajika S. Weerasinghe	Secretary/OURS 2023
Ms Supuni Sandamali	Secretary/OURS 2023

THEME COORDINATORS

Open and Distance Learning	Ms Geetha Kulasekara
Agriculture & Forestry	Dr Buddhika Aruggoda
Biological Sciences	Dr Uthpala Jayawardena
Education	Prof. F.M. Nawastheen
Engineering and Technology	Dr Nadeera Gunathilaka
English Language Teaching	Ms Mihiri Jansz.
Environmental Sciences	Dr M.G. Yohan L. Mahagamage
Health Sciences	Ms K.G.P.K. Munidasa
Humanities and Social Science	Prof. Galagedara T. Madhubhashini Hewage
Law	Dr Sunethra Gunathilaka
Management	Prof. L.P.S. Gamini
Physical Sciences	Dr Renuka Hettiarachchi
	Dr Dushantha Alwis

Dr W.M.K.G.A. Wickramasinghe	Bursar/OUSL
Mr P.K. Seneviratne	Deputy Registrar
Ms N. Prabodini Wickramasuriya	Convener/Inaugural Ceremony Sub-Committee
Ms Vindya Angammana	Convener/Food Sub-Committee
Ms Shalini Rajasingham	Convener/Registration Sub-Committee
Mr Upeksha Subasinghe	Convener/Media and Publicity Sub-Committee

Mr J. P. P. Tharanga	IT Consultant
Mr Kanishka I. Tennakoon	IT Sub-Committee
Dr Prasad Senadheera	International Outreach Committee
Mr Priyantha Seneviratne	Logistics Committee

LIST OF REVIEWERS

Snr. Prof. Thevaki Mahendran
Prof. S. Kugamoorthy
Prof. G.D.L. Lekamge
Prof. F.M. Nawastheen
Prof. T. Mukunthan
Prof. W.M.S. Wanasinghe
Prof. T. D. Dassanayake
Prof. Anton Piyarathne
Prof. A. S. Chandrabose
Prof. Wimal Hewamanage
Prof. Suwarna Kahandagamage
Prof. Ruwan Abeysekera
Prof. Rupika Rajakaruna
Prof. Chandima Dangalle
Prof. Inoka Perera
Prof. Indra Wickramasinghe
Prof. Inoka Karunarathna
Prof. Gayani Galhena
Prof. Camena Guneratne
Prof. A. Sarveswaran
Prof. Dinesha Samararatne
Prof. N. S. Punchihewa
Prof. R. S. Scharenguivel
Prof. Jennifer Perera
Prof. Lilantha Samaranayake
Prof. Niranga Amarasinghe
Prof. Shameen Jinadasa
Prof. Anura Wijepala
Prof. Nalin Abeysekera
Prof. V. Sivalogathasan
Prof. Champika Liyanagamage
Prof. N. S. Senanayake
Prof. Lilani K. Senaratna
Prof. G. D. Lekamge
Prof. H.T. R. Jayasooriya
Prof. G. R. Ranawaka
Prof. G. T. Madhubhashini Hewage
Prof. T. K. Weerasinghe
Prof. Rangika Bandara
Prof. R. Senthilnithy
Prof. G. M. Lasantha P. Aponsu
Prof. P.A.S. R. Wickramarachchi
Prof. R.N. Attanayake
Prof. M.L.M.C. Dissanayake
Prof. M. Pagthinathan
Prof. P.A. Weerasinghe
Prof. N. Dahanayake
Prof. Thayamini H. Seran
Prof. V.P.A. Weerasinghe
Associate Prof. Dr. Kartheges Ponniah
DrLakmini Gamage
Dr Kumudini Maddumage
Dr H. U. S. Pradeep
Dr Sugath Mahinda Senarath
Dr E.A.D. Anusha Edirisinghe
Dr Manoj Samarathunga
Dr Chandima Gayathri
Dr K.D.L.R.J. Perera
Dr Ayomi Irugal Banadara
Dr J.D. Careemdeen
Dr D.D.I. Deepthinee
Dr B.M.C.R. Wimalasiri Yapa
Dr H.M.D.R. Herath
Dr K. A. A. Dilhari
Dr G.P.S.G. Senadheera
Dr W.J.A.B.N. Jayasuriya
Dr Sujeewa Hettihewa
Dr A.V. Pramuditha Madhavi
Dr W. N. Priyanthi
Dr H. E. Yapa
Dr B. I. Wickramarachchi
Dr. A. M. S. D. Pathiranage
Dr O. T. M. R. K. S. B. Kalawana
Dr L. D. R. De Silva
Dr.Y. A. U. D. Karunaratne
Dr Leena Illeperuma Arachchige

Dr W. A. S. Saroja Weerakoon
DrA.M. Sachinthi Amarasiri
Dr. D.T. Wijeratne
Dr P. K. S. Tissera
Dr W. B. N. T. Fernando
Dr R. G. L. Ratnayake
Dr K. G. Jayasekara
Dr J.A.N. Sandamali
Dr B.A. Gayashan Chathuranga
Dr B. Sunil.S. De Silva
Dr B. M. P. Mendis
Dr S. N. Morais
Dr Kanchana Bulumulle
Dr Sepalika Welikala
Dr S. Pathmanesan
Dr.S. M. A. K. Samarakoon
Dr Sanjeewa Rodrigo
Dr Rukshani Haputhanthri
Dr Uthpala Jayawardena
Dr Chaminda Wijesundra
Dr Ravindra Jayaratne
Dr Varuni Gunathilaka
Dr Isuru Wijesekara
Dr Varuni Gunathilaka
Dr Gihan Dahanayake
Dr Imalka Munaweera
Dr Ureshani Karunarathna
Dr Kanishka Ukuwela
Dr Dulan Jayasekara
Dr Pavithra Sandani
Dr Y. Kathirgamathamby
Dr Sanath Sameera Wijesinghe
Dr U. A. T. Udayanganie
Dr Thusitha Abeysekara
Dr Ramani Jayasundere
Dr Tissa Hemaratne
Dr Kalana Senaratne
Dr R.M.S.N. Embogama
Dr K. Sivaji
Dr Nirosha Abeysekera

Dr Dinali Devendra
Dr Agra Rajapakse
Dr Chaminda Udayakumar
Dr Chandana Jayawardana
Dr Uthpala Premaratne
Dr Gehan Anthony
Dr Dumith Jayathialaka
Dr Saminda Premaratne
Dr Samiru Gayan
Dr P.A.K. Karunananda
Dr I. S.K. Wijewardana
Dr Hasitha Damruwan
Dr N.C.K. Seram
Dr Buddhika Annasiwaththa
Dr N.K. Hettiarachchi
Dr L.K.T. Srimal
Dr G.I.P Perera
Dr Ruminda Wimalasiri
Dr E. M. H. S. K. Ekanayake
Dr Kalimuththu Shanmuganathan
Dr Sujeevi Sapukotanagage
Dr Indika Kaluarachchi
Dr Chamil Senarathne
Dr Ganga Karunathilake
Dr Prajna Senevirathne
Dr V. K. Aruna Shantha
Dr Nayana Nilakarawasam
Dr K. D. N. Kumari
Dr J. C. N. Pullenayegem
Dr S.M.M.P.K. Seneviratne
Dr E. M. M. S. Ekanayake
Dr G.Yasodara Liyanage
Dr Kalpani Marasinghe
Dr W.H.M.A.T. Herath
Dr Kumudu Bandara
Dr A. Witharana
Dr F. S. Idroos
Dr Pradeep Gajanayake
Dr Choolaka Hewawasam
Dr Pabasari Arundathi Koliyabandara

Dr Ureshani Karunarathna
Dr Yohan Mahagamage
Dr Ruwan Illeperuma
Dr W.W.P. Rodrigo
Dr D.D.G.L. Dahanayaka
Dr A.A.D. Amarathunga
Dr K.O.L.C Karunanayake
Dr.C.D Jayasinghe
Dr U.K.B.L. Peiris
Dr Kithsiri H. Jayawardana
Dr H.O.W. Perera
Dr K.K.W. Hasitha Erandi
Dr W.A.C. Niwanthi
Dr N.C. Ganegoda
Dr K.D.N. Kumari
Dr I.T.S. Piyatilake
Dr M. Sandirigama
Dr Isurika Fernando
Dr Menaka Fernado
Dr H.K.L.K. Gunasekera
Dr U.G.A.I. Sirisena
Dr A.G.B. Aruggoda
Dr R.M.S.I. Rathnayake
Dr J. A. Surani Chathurika
Dr W.M. Wishwajith W. Kandegama
Dr Kaushalya Wijayasekara
Dr T.C. Jeyaseelan
Dr Niranjana Rodney Fernando
Dr Buddhika Perumpuli
Dr G.S.N. Fernando
Dr M.S.F. Sirasa
Dr Kamani Ratnayake
Dr K.N. Nadeeshani Silva
Dr G.A.A.R. Perera
Dr Kanagarajah Premakumar
Dr Kumari M. Rathnayake
Dr K.N. Nadeeshani Silva
Dr L P. Rupasena
Dr K. Prasannath
Dr D.M.S. Duminda

Dr H.K.L.K. Gunasekera
Dr G. Abhiram
Dr T. Suvanthini
Dr.D.V.S. Kaluthanthri
Dr Rasika Wanigatunge
Dr Thilanka Ranathunga
Dr S. Rajika Amarasinghe
Eng. Wasantha Perera
Eng. Suranga Perera
Eng. T.K. Navarathna
Eng. Buddhika Edirisooriya
Eng. Lakmal Perera
Eng. Rangana Manoj
Eng. Malinga Jayamal
Eng. Chathurika Weliwita
Mr Prasantha Lal De Alwis
Mr Rajā Goonaratne
Mr W.D. Manoj
Mr M. A.M. Hakeem
Mr M.N.C. Fernando
Mr P. Ramathaas
Mr W.M.S. Weerakoon
Mr T. Thanaraj
Mr R.G.W.D.B. Rajapaksha
Mr M. A. Siriwardhana
Mr N. Balamurali
Mr Binara Angammana
Mr Nelson De Silva
Mr Charudaththe B. Illangasinghe
Mr Prabhash Siriwardhana
Mr M.D.S. Shantha Kumara
Mr Suranga Bandara
Mr Sampath Wickremasinghe
Mr H.D.N.S Priyankara
Mr Deepal Bataduwarachchi
Mr Asanka Senevirathne
Mr K.P. Nishantha
Mr G.R.M. Gamlath
Mr Janaka Heenkenda
Mr Chanaka Weerasekara

Mr. Lekha Karunadasa
Mr. Achinthya Koswatta
Mrs Irosha Marasinghe
Mrs Dinithi Uthpala Ranasinghe
Mrs H.N.D. Gamalath
Mrs Sandya Hewameealla
Mrs W.N.G. Panditharatne
Ms W.A.Y.Chandrani
Ms S.A.S.K. Perera
Ms P.W.G.D.P. Samarasekara
Ms R.B.J. Buddhika
Ms K.G.P.K. Munidasa
Ms L.C. Damayanthi
Ms N. D. D. Wickramasinghe
Ms A.Y.R. Athukorala
Ms Dhakshila Niyangoda
Ms Kalpanee Bandranayake
Ms J. Selvaras
Ms K. H. D. Nagahawatte
Ms Nadeera Wijegoonewardene
Ms D.H.P.S. Gunasekera
Ms Harini Udara Perera
Ms Ishara Lakmali
Ms Manoshika Sathyavel
Ms D. K. Sewwandi
Ms M. I. Jansz
Ms Jayani Hapugoda
Ms Dinithi Samarathunga
Ms Shamali Rathnasri

Address of the Chief Guest

Sustainable development through responsible utilization of natural resources

This guest lecture summarizes the research and development activities carried out, in the author's research group, in utilizing natural minerals and plant products for the design, development and manufacturing of nanomaterials, advanced electronic materials, and devices. Numerous significant environmental and economic advantages support using natural materials over synthetic alternatives. Since natural resources are abundantly available and renewable, they offer sustainability, scalability, and industrial viability for large-scale production of advanced materials and devices. Additionally, the use of local minerals and plant products decreases reliance on fossil fuels, thereby reducing the carbon footprint of chemical synthesis processes. Moreover, natural products have tailor-made compounds with inherent properties which can be extracted using environmentally friendly solvents, such as water, eliminating multi-step synthesis strategies that require hazardous chemicals and toxic reagents. Also, the biocompatible nature of many natural materials warrants an enormous potential for biomedical applications. As such, employing natural materials for producing nanomaterials can hinder the dependence on expensive imports for industrial production and foster regional development that significantly promote long-term economic growth. The guest lecture explores the conversion of graphite, apatite, dolomite, zircon, ilmenite, and quartz to value-added nanomaterials. Figure 1 shows (a) gemstones and (b) some industrial minerals present in Sri Lanka.

The lecture further unveils value addition to gemstones while revealing the use of natural products for developing next-generation electronic materials and antimicrobial nanoparticle dispersion cream products. Respective cost analyses shall enrich the extension of the current state-of-the-art towards next-generation biomaterials, implants, targeted drug delivery systems, electronics, optronics, and solar cells.

Figure 1: Photographs of some minerals naturally present in Sri Lanka: (a) gem varieties and (b) other industrial minerals.

Prof. R. M. G. Rajapakse
Senior Professor in Chemistry
Department of Chemistry
University of Peradeniya, Sri Lanka

Keynote Address 1

Sri Lanka as a Battlefield of International Law

From the time of Western interest in Asia and before, Sri Lanka, despite its size as a small state, has played a role in the shaping of international law.

It cursorily deals with the Chola conquest as an early example of Indian interest in the island and the visit of the Chinese Admiral, Cheng Ho as an example of Chinese interest with Sri Lanka but its concern is with the application of Eurocentric international law by successive European colonisers with the island, most importantly, the use and justification of the right to conquer Asian peoples and the struggle for independence from colonialism. Thereafter, it deals with the concerns of independent Sri Lanka with the application of international law. It deals with the manner in which international law has been received into Sri Lankan law. It then details modern problems which have arisen in the several areas like the environment, human rights and the law of the sea.

This speech serves as a survey of the research themes that are covered in the project.

Prof. M. Sornarajah
Emeritus Professor of Law
National University of Singapore
Singapore

Keynote Address 2

Methodology of Distance Learning. Increase in Quantity without Loss of Quality. The Experience of Innopolis University

The pandemic experience has taken online learning to a new level, expanded the boundaries for mass learning.

Innopolis University tries to combine the best practices and advanced technologies for the most comfortable and productive training of students. Despite the fact that the University is only 10 years old, there are already more than 67 thousand trained citizens in our database within the framework of additional professional education programs. The main direction is the expansion /acquisition of competencies in the field of digitalization, pumping software and hard skills of IT and non-IT specialties.

How is it possible to maintain quality in the absence of full-time presence of both training participants and teachers?

It is important to note several components that we have:

- our own high-quality flexible platform, which provides a comfortable passage through all stages of training, allowing you to build an individual trajectory;
- digital footprint: to receive high-quality feedback, as well as analysis of students' progress, the quality of teachers' work, which allows you to adapt all processes to obtain the most effective result;
- tutors: they are specialists who support the student throughout all stages of training: from the moment of admission to the course to graduation. The tutor checks the completion of tasks, monitors the progress and deadlines of the stages, navigates the participants of the training on the platform, at a time convenient for the listeners;
- gamification: to maintain the dynamics and interest in the educational process, as well as to switch attention (especially for teenagers). This is important with the current motivation and abundance of information in the modern world;
- speakers: Innopolis University selects the most qualified specialists for individual customer requests, has more than 300 resumes in its database, more than 130 active speakers.

Thus, providing an integrated approach and at the same time individual for each student, Innopolis University receives high quality both for offline and online training of students.

Mrs. Maria Obraztsova
Director of Institute of Additional Education
Innopolis University, Russia

Keynote Address 3

Digital Transformation in Ergonomics through Digital Human Modelling to the Digital Twin

"Digital Transformation" is one of those buzzwords which we find difficult to avoid these days. While omnipresent in most modern business environments, attempts at precisely defining what this transformation exactly stands for remain scarce. More commonly provided examples of digital transformations include the transportation industries where a mobile APP may integrate services to facilitate making and managing a booking, communicating with a customer service, and checking in etc. to eliminate the need for time-consuming queuing at offices or information desks; the automotive industry, where cutting edge in-vehicle communications and entertainment systems integrate seamlessly into a driving environment; or home consumer electronics which integrate and interface various modes of communication and devices. The common denominator of these examples appears to be the **integration of services** in technical systems, sometimes supported by artificial intelligence (AI) based software and Internet of Things (IoT) hardware.

Ergonomics is by its very definition an **integrating science,** the "scientific discipline concerned with the understanding of interactions among humans and other elements of a system". Although historically largely based on technical measurements, analogue drawings, social and health sciences, and human based interrogation, this unique art has also undergone a digital transformation over the past 20 years. While criticised by many for an often reactive and therefore costly approach to work and workplace design, computer-based modelling is the de-facto standard in modern, prospective Ergonomics. The digital transformation in this case is taking shape in a computer modelled (computer-aided) world, integrating digital 3-dimensional environments, digitized, often automated measurements, 3-dimensional human models, and digitized feedback of a human operator within this virtual world.

Driven by dramatic advances in data processing and data storage capacities, virtual environments have achieved a great level of precision and complexity in recent years, whereas integrated Digital Human Models appeared to lag in virtuosity, largely due to the complexity of recreating realistic appearance, animation, and

behaviour. Much of this gap however could be bridged with 4-dimensional human digitization (scanning, capture) technology and artificial intelligence algorithms.

The Digital Twin (DT) goes beyond traditional computer-aided applications and represents a two-way communication bridge between the physical and the digital worlds. The concept model of Digital Twin consists of three parts being the physical object or human in the real world, the virtual object or human in the digital world, and the connections between these two objects or humans that provide data flow. This digital transformation however requires reorientation from a population-based approach toward an individual based modelling attempt when aiming to progress from a Digital Human Modelling based framework in the direction of the Digital Twin. The Digital Twin then becomes an integrated physiological representation of the human body, from molecular, biochemical, genetic, cellular, to system levels.

Prof. Gunther Paul
Adjunct Associate Professor
Faculty of Science and Engineering
Australian Institute for Tropical Health and Medicine, James Cook University
North Queensland, Australia

PROCEEDINGS

OPEN AND DISTANCE LEARNING (ODL)

AGRICULTURE AND FORESTRY

ENGINEERING AND TECHNOLOGY

ENVIRONMENTAL SCIENCES

HEALTH SCIENCES

MANAGEMENT

PHYSICAL SCIENCES

OPEN AND DISTANCE LEARNING (ODL)

INTENTION OF CONTINUOUS USE OF ZOOM FOR E-LEARNING WITH SPECIAL REFERENCE TO MANAGEMENT UNDERGRADUATES' OF SOUTH EASTERN UNIVERSITY OF SRI LANKA

M. I. F. Abrose*, A. L.F. Nadhiya, M.F. Nusaika and D.G. M.L.W. Kumari,
South Eastern University of Sri Lanka, Sri Lanka

The COVID-19 pandemic has had a significant impact on people's lives, altering how they work, live, play, and study. Due to infection concerns, classroom instruction was discontinued throughout this pandemic. As a result, e-learning has grown in importance as a means for educational institutions to carry on with their teaching and learning operations. Only a few empirical research have examined the variables influencing students' intentions to use Zoom for online learning consistently. The purpose of this study is to determine the factors that affect management undergraduates' desire to continuously use Zoom applications for e-learning at South Eastern University of Sri Lanka's Faculty of Management and Commerce. This study is quantitative, and data from a sample of 300 undergraduates from the Faculty of Management and Commerce at South Eastern University of Sri Lanka were gathered via a self-administered questionnaire survey. Around 2400 students from various faculty departments make up the population. A total of 300 responses to the 331 questionnaires were delivered to the students via Whatsapp and used for this study. The necessary statistical analysis was completed using SPSS and the data was imported from the Google form that was used to collect the data.

Performance expectancy, hedonic motivation, work-life quality, and access to the internet all significantly contributed to the explanation of the intention to continue using the Zoom application for e-learning. Effort expectancy significantly decreased the likelihood that people would continue using the Zoom program for e-learning. The findings showed that the most significant element influencing management undergraduates' intention to continuously use Zoom applications for e-learning was hedonic motivation. Additionally, the explanation of the intention to continue using the Zoom program for e-learning was positively and significantly influenced by performance anticipation, hedonic motivation, work-life quality, and access to the internet. However, effort expectations made a significant, but negative, contribution to the justification of the decision to keep utilizing the Zoom e-learning program. The study's conclusions offer crucial recommendations for decision-makers, designers, developers, and researchers, enabling them to better understand the primary elements influencing the decision to continue using Zoom for e-learning during the pandemic. Since there is a lack of knowledge on the crucial issues and components that influence the student's continuous intention to use e-learning systems during and after the COVID-19 pandemic, universities and higher educational institutions that implement e-learning for conducting academic activities continuously face a significant problem in identifying the factors influencing the intention for continuous use of the system. To fill current

theoretical and empirical research gaps, this study examines undergraduates' ongoing intent to use Zoom for online learning activities while also adding to the body of knowledge.

Keywords: Intention of Continuous Use, E-Learning, COVID-19, Undergraduates

***Corresponding Author:* abroseiqbalweb@gmail.com**

A PRELIMINARY STUDY ON STUDENT PERFORMANCE IN FACE-TO-FACE AND ONLINE DELIVERY MODALITIES OF OPERATING SYSTEMS MODULE

A.U.P. Athukorala*
Division of Information Technology, Institute of Technology University of Moratuwa, Sri Lanka

Operating Systems (OS) is one of the core modules in any Software Engineering/Computer Engineering or Information Technology curriculum. Therefore, gaining insights into student performance in this module can contribute to enhancing instructional strategies, curriculum design, and overall learning outcomes. The National Diploma in Technology (NDT) in Information Technology course was introduced in 2019. Hence, analyzing individual subject performance also is an indicator of course success. For this study, NDT 2018/2019 (first batch) and NDT 2020/2021 (third batch) batches were used. The main difference between these two batches is their learning mode. NDT 2018/2019 batch learnt in face-to-face mode and NDT 2020/2021 batch learnt in online mode. Mid semester examination marks, continuous assessment marks and final examination marks of both batches were analyzed. The batch learnt in a face-to-face setting resulted in better performance compared to online learning. Future studies should investigate reasons for performance degradation in online learning.

Keywords: Operating Systems, Online Learning, Face-to face Learning

[*]*Corresponding Author: uthpalap@itum.mrt.ac.lk*

PERCEPTIONS OF TEACHERS AND LEARNERS ABOUT ONLINE LEARNING IN AN ELECTRICAL AND ELECTRONIC ENGINEERING DEGREE IN SRI LANKA

E.A.P. Sandarenu[1] and T.G. Jathunga[2]

[1] Department of Electrical and Computer Engineering, Faculty of Engineering Technology, The Open University of Sri Lanka, Nawala, Sri Lanka

[2] Department of Electrical and Electronic Engineering, Faculty of Engineering, Sri Lanka Institute of Information Technology, Malabe, Sri Lanka

Due to the temporary closure of educational institutions during the COVID-19 pandemic situation, online education was enforced across the world. However, this transition from a traditional classroom environment to an e-learning environment has led to several arguments. Despite the COVID-19 epidemic being four years ago, some universities continued online learning while others reverted to the traditional onsite education system. This study aimed to determine how well online learning was perceived by both students and teachers. To carry out the study, two questionnaires were prepared and distributed among students and teaching staff in three engineering faculties in some Sri Lankan universities. The questionnaires were prepared to collect their view on online lecture sessions, online examinations, and online lab classes. The analysis of the data revealed that both students' and teachers' satisfaction with online education will be impacted by the quality of the equipment. One of the main issues raised by the lecturers was how poorly the students interacted with the lecture owing to the concept of remote learning. Another finding from the students' questioner data analysis shows that the maximum online session length that students could tolerate was 1-1.5 hours. In addition, around two third of the students who participated for the survey choose a mix of both asynchronous and synchronous education system. As a conclusion, the traditional educational system will be effective for exams and practical lessons, and a combination of synchronous and asynchronous teaching methods will be fecundity for learning and teaching concepts.

Keywords: E-learning, E-teaching, COVID-19, Synchronous, Asynchronous, Hybrid

**Corresponding Author: sandarenueap@gmail.com*

A STUDY ON STUDENT DROPOUTS IN THE BSC DEGREE PROGRAMME AT THE ANURADHAPURA CENTRE OF THE OPEN UNIVERSITY OF SRI LANKA

K.G. Jayalath*, L.M.S.S. Bandara and P.L.S.I. Sudaraka
Anuradhapura Regional Centre, The Open University of Sri Lanka, Sri Lanka

The Open University of Sri Lanka (OUSL) is the only National University in Sri Lanka to offer the programmes entirely through Open and Distance Learning (ODL) education model. Anuradhapura Regional Centre (ARC) is one of the regional centres of the OUSL out of nine regional centres. The number of students registered for the Bachelor of Science (BSc) Degree programme offered by the Faculty of Natural Sciences is low compared to the other regional centres that were established after the ARC. The intake of new students is affected by the number of graduates who passed out from the ARC. Hence, the status of newly registered students at ARC within five consecutive academic years from 2012/2013 to 2016/2017 was extracted using the Open University Management Information System (OMIS) in 2023 and identified the students who did not continue the re-registration as dropouts. The reasons for dropping the degree were collected through telephone call interviews and a thematic analysis was used to categorize them. The number of students who graduated/continued was 44 out of 187. Newly registered students within the selected period were an average of 24%. Thus, the average of total dropout was 76% and the maximum dropout was observed during the first year with the range of 50 – 72%. This gradually reached the range of 70 – 93% after five years of initial registration. The reasons for dropouts were categorized into four broad themes, namely, personal circumstances, employment-related issues, institutional context, and learner context. Some students who dropped the course after two or more years indicated financial difficulties. However, when carefully looking at the academic records in the OMIS, poor academic performance and re-registering for repeat courses several times seem to be some of the reasons. The institutional context and certain learner context issues are under the university's control and proper personal counselling during re-registration, implementing peer-assisted learning environment and expanding the academic activities such as day schools and practical sessions at ARC are suggested to reduce the dropout rate. However, future studies are recommended to identify and expand the themes further with the current reasons for dropouts and develop strategies to overcome them.

Keywords: Open Distance Learning, BSc degree, Student Dropouts, OUSL

* *Corresponding Author: jijay@ou.ac.lk*

EMBRACING OF THE FULL POTENTIAL OF ODL RESOURCES: A STUDY ON COURSE WORK RELATED AUDIO AND VIDEO PRODUCTION AT THE OPEN UNIVERSITY OF SRI LANKA

Mayanthi Kulatunga Jayakody*
Centre for Educational Technology and Media, The Open University of Sri Lanka, Sri Lanka

The Open University of Sri Lanka (OUSL) prioritizes course material as the main mode of knowledge transferring since the ODL system does not consider student attendance at day schools to be compulsory. In order to facilitate this situation, the ODL system primarily relies on three main components: course/instructional, online as well as audio and video (A/V) material. Apart from writing course material, an ODL academic is also expected to produce A/V material that further enhance the teaching learning process. The Centre for Educational Technology and Media (CETMe) provides guidelines for designing self-instructional materials, designing and developing educational resources through media. Yet, when you consider the output of such material produced at the OUSL, the numbers seem significantly low. Furthermore, a considerable amount of A/V material are temporarily stalled at the editing stage. Therefore, this study focused on discovering the issues behind the less number of course work-related A/V material produced by the OUSL academics. So far, no studies have been conducted on the said issues. Accordingly, a questionnaire was shared among all OUSL academics focusing on their experience/non-experience in producing course work related A/V material, issues faced, their future intentions of producing such material and the training they have received from the University. A content analysis was made on the data collected relying on the quantitative research method. The results evidenced reasons such as time constrains caused by the heavy workload, academics going on study leave, technical crew being assigned for other work, transport issues for outdoor shooting, not having received guidance as well as lack of motivation from course teams. They could be minimized by realizing the integral part played by A/V material in the ODL system, assigning another related academic to attend to unfinished productions and following the correct procedure when booking a technical officer, CETMe Studio and transportation. Richer data could have been gathered had more academics responded to the questionnaire. Nevertheless, the study evidenced that OUSL academics should make more effort in embracing the full potential of the ODL resources available within the University in producing course work related A/V material by minimizing the prevailing issues.

Keywords: Course Work Related Audio and Video material, ODL Resources, CETMe, OUSL Academics

**Corresponding Author: mkjay@ou.ac.lk*

LIFE SCIENCES

I. AGRICULTURE AND FORESTRY

EFFECT OF SEED PRIMING WITH JELLYFISH *Chiropsoides buitendijki* POWDER ON SEED GERMINATION AND SEEDLING ESTABLISHMENT OF MAIZE AND WATERMELON

V.D. Samaraweera[1*], D.C.T. Dissanayake[1] and S.H.N.P De Silva[2]
[1]Department of Zoology, Faculty of Applied Sciences, University of Sri Jayewardenepura, Sri Lanka
[2]Department of Crop Science, Faculty of Agriculture, University of Peradeniya, Sri Lanka

Jellyfish make seasonal blooms and are increasing rapidly worldwide. Despite the negative effects of jellyfish blooms, there are potential benefits in many industries including agriculture. The potency of jellyfish *Chiropsoides buitendijki* in seed priming to enhance seed germination and seedling establishment of maize (*Zea mays*) and watermelon (*Citrullus lanatus)* was studied. Three concentrations of jellyfish (T1, T2, and T3) were prepared by dissolving oven-dried *C. buitendijki* powder (0.4g, 0.5g, and 0.6g per 40mL of DW) in distilled water and water (C) was used as the control. After a 12-hour soaking period of experimental seeds (n=20 for each treatment), a Petri plate method was used to determine seed germination. Seedling emergence and establishment were tested by sowing seeds on trays filled with sterilized sands with adequate moisture. Appearance of sprout was counted in each day and seedlings were tested for vigor after 14 days. Soaking maize seeds in jellyfish liquid did not inhibit the normal seed germination confirming that *C. buitendijki* has no lethal effect on seeds when used as a seed primer. Seedling emergence of jellyfish-treated maize seeds was greater than the control, and a significant increment in their root lengths was recorded. All jellyfish-treated watermelon seeds had significantly higher maximum germination percentage, maximum emergence, and Seedling Vigor Index than the control ($p<0.05$). However, there were no significant differences among treatments for measured parameters except seedling emergence percentage where T1 showed higher value than T2 and T3. The watermelon seeds treated with jellyfish germinated and emerged three times faster than the control. *C. buitendijki* powder can be successfully used for seed priming to overcome seed germination delays by enhancing seed germination, seedling emergence and establishment of watermelon.

Keywords: Jellyfish, Maize, Watermelon, Seed Priming, Germination, Emergence

[*] *Corresponding Author: vishwadulanji.tmp@sjp.ac.lk*

BIO EFFICACY OF SELECTED PLANT ESSENTIAL OILS AGAINST FALL ARMYWORM, *Spodoptera frugiperda* (J.E. SMITH)

G.K.M.M.K Ranaweera[1]* and A.D.N.T. Kumara[1]

[1]Department of Biosystems Technology, Faculty of Technology, South Eastern University of Sri Lanka, University Park, Oluvil, Sri Lanka

The fall armyworm, *Spodoptera frugiperda* (J.E. Smith), is a significant Lepidopteran pest of maize that causes economic damage to maize crops worldwide. Synthetic pesticides are widely used to control pests, but overuse leads to environmental contamination and several drawbacks. Therefore, natural alternatives such as plant essential oils (EOs) are needed to replace synthetic chemicals. This study aimed to evaluate the insecticidal potential of Lemon grass (*Cymbopogon citratus*), Peppermint (*Mentha piperita* L.) and Neem (*Azadirachta indica*) EOs and their effective doses on *S. frugiperda*. EOs were diluted into 1%, 3%, 5%, 8% and 10% dose levels, and antifeedant effects on 3rd instar larvae were assessed under *in vitro* conditions compared to the untreated control. The results revealed a significant effect of EOs on larval biology. The larval weight gain of the untreated control was 99.00 ± 0.62 mg and significantly ($p<0.05$) higher than all the tested essential oil doses. The 10% neem showed the least weight gain (3.00 ± 2.08 mg), and doses higher than 3% for mint and citronellol oil not showed a single unit of weight increment of 3rd instar larvae three days after treatment. The larval duration of 3% mint was restricted to 3.00 ± 0.57 days, and for 5% to 10% doses, it was only 2.00 ± 0.00 days. Additionally, the 10% neem and doses higher than 3% of mint and citronellol completely ceased pupal development. These results provide valuable insights for the use of plant-based EOs to manage the voracious pest, fall armyworm in a sustainable manner. Further research can be done by formulating neem, mint and citronellol with different combinations and ratios to assess their combine effects in managing fall armyworms in an environmentally friendly manner.

Keywords: Antifeedant, Fall Armyworm, Essential Oil

* *Corresponding Author: ranaweera@seu.ac.lk*

GREEN SYNTHESIS OF COPPER OXIDE NANOPARTICLES USING *Panicum maximum* LEAF EXTRACT

W. P. S. Lakmini[1], A. G. B. Aruggoda[1]*, and S. R. Weerakoon[2]
[1]Department of Agriculture and Plantation Engineering, Faculty of Engineering Technology,
[2]Department of Botany, Faculty of Natural Sciences,
The Open University of Sri Lanka, Nawala, Nugegoda, Sri Lanka

Copper oxide nanoparticles (CuONPs) are considered one of the most important metal nanoparticles, because they are low in cost, easily available, and have good antimicrobial properties, catalytic efficiency, excellent electrical conductivity, etc. "Green Synthesis" is the process of synthesizing nanoparticles by using natural reducing and capping agents, thereby reducing the impact of hazardous chemicals on the environment. The present study reports an eco-friendly way to synthesize CuONPs by using *Panicum maximum* leaf extract and copper sulphate pentahydrate ($CuSO_4.5H_2O$). The effect of three different ratios of plant extract: precursor salt (1:1, 1:2, 2:1) and five different pH values (5.5, 6.5, 7.5, 8.5, and 9.5) on synthesis of CuONPs were studied. To confirm synthesized nanoparticles, UV-Vis, XRD, FTIR and SEM techniques were used. The Surface Plasmon Resonance (SPR) of synthesized NPs showed peak at 270-315 nm. The 2:1 ratio showed the highest particle intensity. It was concluded that the best plant extract for synthesizing CuONPs was precursor salt ratio. The highest particle intensity was observed at pH 8.5. It indicated the formation of CuONPs in the reaction mixture. SEM results revealed the formation of irregularly shaped and aggregated particles in the nano range. The average size of the nanoparticles was calculated by using XRD Data and Scherrer equation, resulting in the 17 nm for *Panicum*-CuONPs. The presence of natural reducing and capping agents on CuONPs were identified by FTIR analysis. According to these results, it is possible to conclude that *Panicum maximum* leaf extract can be used to synthesize CuONPs in an eco-friendly way.

Keywords: Copper nanoparticles, Green Synthesis, *Panicum maximum,* Surface Plasmon Resonance

**Corresponding Author: agbar@ou.ac.lk*

CHARACTERIZATION OF NANOPARTICLES AND OPTIMIZATION OF AGRICULTURAL RAW MATERIALS TO PRODUCE A FERTILIZER FOR PADDY CULTIVATION IN SRI LANKA

A.M.C.H. Abeysekara[1]*, B.S.S. Fernando[1], K.M. Mewan[1], M.J.M.S. Kurera[1] and R. D. A. A. Rajapaksha[2]

[1] Department of Biotechnology, Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP), Sri Lanka

[2] Department of Nano Science Technology, Faculty of Technology, Wayamba University of Sri Lanka, Kuliyapitiya (NWP), Sri Lanka

Paddy is a major cultivation crop in Sri Lanka, and rice has become the staple food in the country. Fertilizers are utilized to meet the nutrient requirements of paddy cultivation, and fertilizer produced from Agricultural raw materials are a promising alternative tool in agricultural ecosystems as an eco-friendly source of plant nutrients. Agricultural raw materials are easily biodegradable, and composting is the most inexpensive method to convert these materials into fertilizer. The aim of this study is to, formulate macronutrients (Nitrogen (N), Phosphorous (P), and Potassium (K)) by using *Gliricidia* (G), *Azolla* (Az), *Salvinia* (Sv), and Banana inflorescence (BI), and allocate the required amounts of micronutrients through Nanoparticles (NPs) (ZnO, MgO, and S) synthesis from *Azadirecta indica* as an approach to produce a sustainable fertilizer that is not harmful to the environment. Six treatments were prepared using G, Az, Sv, and BI in different ratios for the composting process until 28 days. Physical and chemical parameters were measured at 3, 7, 14 and 28 days to maintain the final formulation in line with the Sri Lanka Standards (SLS). Treatment 6 [5 (G): 1 (Az): 1 (Sv): 2 (BI)] was found to be the most significant treatment for composting due to its high N%-P%-K% (3.66±0.027, 0.58±0.007, 1.96±0.006) values on a dry weight basis and optimal physicochemical properties considering the results obtained on the 14th day. The size and the crystal orientation of synthesized MgO, ZnO, and S NPs were 22.62 nm, 47.44 nm, and 80.63 nm, and hexagonal wurtzite, cubic, and orthorhombic, respectively. This study proved that G, Az, Sv, and BI, which are readily available in nature, can be utilized to produce organic fertilizers, while *Azadirecta indica* has high potential for synthesizing NPs at a high purity level, and Treatment 6 during composting gives the most significant macronutrient supply. Further feasibility studies can focus on producing a novel product as a replacement for the toxic fertilizers available on the market to fulfill the nutrient demand in paddy cultivation in Sri Lanka.

Keywords: Agricultural Raw Materials, *Azadirecta indica*, Composting, Organic fertilizer, Nanoparticles

**Corresponding Author:* chamaleeabeysekara@gmail.com

ACTINOMYCETES AS CANDIDATES FOR BIOFERTILIZER FORMULATION

A.G.N.N.A.S. Gamlath* and S.M.K. Widana Gamage
Department of Botany, Faculty of Science, University of Ruhuna, Matara, Sri Lanka

Application of actinomycetes to improve plant growth, nutrient availability and soil properties is an eco-friendly alternative strategy in sustainable agriculture. This study aimed to evaluate the potential of previously characterized plant growth promoting (PGP) actinomycetes in the soil as biofertilizers. For the development of consortia, 27 strains of PGP actinomycetes were screened for their ability to produce iron-chelating siderophores using the liquid Chrome Azurol S assay. Two strains, ACM25 and ACM31 showed positive results and ACM25 strain was the most efficient. Therefore, ACM25 was selected as an essential member of each consortium. Considering the overall PGP properties, four consortia were prepared with ACM25, ACM28, ACM35, ACM37, ACM42 and ACM45 in different combinations. Their compatibility to stay together in a consortium was tested in co-culture plate assay. Each consortium contained a combination of two or three strains and they were separately inoculated into the soil and determined the availability of N, P, K, organic C and total bacterial count and total microbial activity compared to the non-inoculated soil after 30 days. There was a significant enhancement of NH_4^+ -N and NO_3^- -N in soil treated with all four consortia. Among all, C1 (ACM25+ACM45+ACM3) treatment showed the highest level of available N in the soil. Orthophosphate and exchangeable potassium contents in all treatments found significantly increased and C3 (ACM25+ACM42+ACM37) gave the highest. Organic matter content in the soil appeared to have no significant effect when treated with any of the consortia. This may be due to the accelerated decomposition rate by the significantly enhanced bacterial count and total microbial activity in actinomycetes-treated soil and their involvement in the cycling of nutrients in the soil. Therefore, the enhanced nutrient availability in actinomycetes-treated soil may be due to the cumulative effect of introduced actinomycetes and enhanced growth of microbial community and their activities in the soil. Further research is needed to overcome challenges related to production efficiency, stability in soil, and extensive field trials. Despite these challenges, actinomycetes hold great promise as biofertilizers for promoting sustainable agriculture, improving soil health, increasing crop yield and reducing reliance on chemical fertilizers.

Keywords: actinomycetes, biofertilizer, consortia, nutrient availability, plant growth promotion

* *Corresponding Author: shirani@bot.ruh.ac.lk*

EVALUATION OF HAZARD ANALYSIS AND CRITICAL CONTROL POINT (HACCP) SYSTEM FOR THE ULTRA HIGH TEMPERATURE MILK PRODUCTION LINE AT MILCO (PVT) LTD, POLONNARUWA

C.G.I.D. Fernando[1], W.A.S.B. Aththanayaka[2], and N.S. Weerakkody[1*]
[1]The Open University of Sri Lanka, Nawala, Nugegoda, Sri Lanka
[2]Miloco Private Limited, Galllella, Polonnaruwa, Sri Lanka

The hazard analysis critical control point system is a science-based and systematically identified specific hazards and apply measures to control and ensure the safety of food. The objective of this study was to develop a Hazard Analysis and Critical Control Point (HACCP) system manual for the ultra-high temperature milk production line at Milco (Pvt) Ltd, Polonnaruwa. Good manufacturing practices, good hygienic practices, standard operational procedures, and standard sanitation operational procedures were developed and documented as the prerequisite programs. As the preliminary steps of HACCP, the HACCP team was assembled, then product description, intended uses and a flow diagram was drafted. Finally onsite verification was carried out and documented. Identification of critical control point was done using decision tree and critical limits too were established for critical control points with effective monitoring action, corrective action, and verification procedures. In addition, each step of the process was analyzed for biological, chemical, and physical parameters by collecting the samples through the process line and hands of workers before and after implementation of HACCP system. In this study, the biological hazard analysis of all milk samples before pasteurization were positive for the E-coli/coliform while after the pasteurization and sterilization all samples were negative. Average Total Colony Count for the bowser samples, stored raw milk and pasteurized milk were 7.48±0.72 log CFU/ml, 7.57±0.82 log CFU/ml, 1.82±0.11 log CFU/ml respectively and after sterilization no counts were identified. Hands of workers did not show a significant different ($p>0.05$) microorganism load (1.27±0.41 CFU/ml) compared to samples taken after educating the workers (1.20±0.38 CFU/ml). Peroxide adulteration and physical hazards were not detected in the milk. Based on the findings, the hazard analysis nine critical control points were identified using the decision tree and they were raw milk reception (below 10^0C), raw milk storage (below 6^0C), mix making (below 45-60^0C), pasteurization (85^0C, 3 minutes), mix storage (below 10^0C), sterilization (140^0C, 2 seconds), filling (Aseptic condition), storage (5 days, 30^0C-32^0C) and cleaning in place (Acid 1.5%, Soda 2%, 85^0C). The HACCP system has been indicated as one of the most effective ways to guarantee high quality and safe food.

Keywords: HACCP, Milk, CCP, Hazard

[*]*Corresponding Author: nweer@ou.ac.lk*

AN EVALUATION OF INSECTICIDAL POTENTIAL OF *Olax zeylanica* LEAF EXTRACT MEDIATED SULFUR NANOPARTICLES TOWARDS *Sitophilus oryzae* (L.) (COLEOPTERA: CURCULIONIDAE) AND *TRIBOLIUM CASTANEUM* (L.) (COLEOPTERA: TENEBRIONIDAE)

G. D. V. A. Sandeepani [1], A.G.W.U. Perera [2*], and S.D.M. Chinthaka [1]
[1] Department of Chemistry, University of Sri Jayewardenepura, Sri Lanka
[2] Department of Zoology, University of Sri Jayewardenepura, Sri Lanka

Rice is a staple food for half of the world's population but is often damaged by insects during storage, namely, *Sitophilus oryzae* and *Tribolium castaneum*. Conventional insecticides, which are commonly used to control them, have adverse effects. Therefore, green synthesized nano-pesticides can be used as a safer, and ecologically sound alternative to conventional insecticides. The objective of this study was to assess the insecticidal efficacy of green synthesized sulfur nanoparticles (SNPs). Synthesis of SNPs was done by mixing sodium thiosulfate ($Na_2S_2O_3.5H_2O$) and *Olax zeylanica* leaf extract at room temperature. The resulting SNPs were then characterized by UV-Vis spectroscopy, X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), thermogravimetric analyzer (TGA), scanning electron microscopy (SEM), transmission electron microscopy (TEM) and energy dispersive X-ray Spectroscopy (EDX). The effect of SNPs on *S. oryzae* and *T. castaneum* was evaluated by bioassays for repellency and mortality. The UV- Vis spectroscopy showed a peak in the range of 260–280 nm, indicating the successful formation of SNPs. According to the Debye–Scherrer formula of XRD data, the average crystalline size of the SNPs counted to be 75.2 nm. All the diffraction peaks are consistent with orthorhombic sulfur (JCPDS 01-089-2600). FTIR spectrum revealed peak positions corresponding to octasulfur (S_8). TGA results show that the SNPs are thermally stable under storage facilities. The SEM and TEM images verify the particle size obtained from the XRD results, while the EDX results of SNPs confirm the existence of sulfur. According to the bioassay results, *S. oryzae* exhibited a repellency of 100% when exposed to doses of 0.0625, 0.125, 0.25, and 0.5 g kg^{-1} and *T. castaneum* demonstrated a repellency rate of 100% at the doses of 0.125, 0.25, and 0.5 g kg^{-1} within 24 hours. Also, 100% mortalities of *S. oryzae* at 1.5 g kg^{-1} dosages within 7 days and *T. castaneum* at 1.5 g kg^{-1} dosages within 6 days were shown. The results of the study indicated that using green synthesized sulfur nanoparticles will be a viable way to control insect pests in grain storage systems.

Keywords: Green-Synthesized sulfur nanoparticles, *Olax zeylanica*, *Sitophilus oryzae, Tribolium castaneum*.

* *Corresponding Author:* *wathsala@sjp.ac.lk.

DEVELOPMENT OF VALUE-ADDED TEA FROM THEBU (*Costus speciosus* L.) LEAVES

S.H.S.D. Senarath and W.K.S.M. Abeysekera*
[1]Department of Agricultural Technology, Faculty of Technology, University of Colombo, Mahenwatta, Pitipana, Homagama, Sri Lanka

Non-communicable diseases (NCDs) are a leading cause of deaths worldwide. Tea is the most widely consumed beverage next to water and therefore phytochemical rich herbal teas could be good alternatives in the prevention and management of NCDs. *Thebu (Costus speciosus L.)* is a well-known anti-diabetic plant having various health benefits. This study aimed to develop a *Thebu* tea product and to study its physicochemical and anti-oxidant properties. Three different maturity stages namely immature, partially mature and mature leaves were dried at 50, 60 and 70 °C until the moisture content reaches 8-10 % (w/w). Further, effectiveness of blanching on drying was tested by blanching leaves at 60℃, 70℃ and 80℃ for 3-5 min. The best samples were selected based on the colour and were ground (850µm) and *Thebu* tea was prepared (2.00 g/tea bag). Then, physicochemical (moisture, total ash content, water activity, colour and pH; n=3 each), and antioxidant properties [total polyphenol content (TPC; n=3 each), total flavonoid content (TFC; n=3 each), ferric reducing antioxidant power (FRAP; n=3 each) and DPPH & ABTS radical scavenging activities; n=3 each] were studied. Results showed that blanching was not an effective pre-treatment in any stages of *Thebu* leaves drying. Immature, partially mature and mature leaves dried at 50°C for 7-8 hrs was the best time temperature combination. Interestingly, *Thebu* tea formulated from immature leaves exhibited significantly ($P<0.05$) high antioxidant properties for all the tested antioxidant activities (TPC: 0.77±0.11 mg GAEs/200ml tea cup; TFC: 2.02±0.05 mg QEs/200ml tea cup; FRAP: 5.74±0.25 mg TEs/200ml tea cup; DPPH: 53.32±19.7 mg TEs/200ml tea cup; & ABTS: 50.62±1.26 mg TEs/200ml tea cup) compared to the other maturity stages studied. Further, it also showed desirable physicochemical properties (water activity: 0.453±0.01; ash content: 14.42±0.11%; Colour: L*=39.38±0.25, a*-10.82±0.01, b*21.93±0.01; & pH=5.81±0.01). Considering all, it is concluded that, *Thebu* tea formulated from immature leaves has the greatest potential as a value-added functional tea which can be commercialized in the long run.

Keywords: *Thebu* leaves, blanching, maturity stages, physicochemical antioxidant properties, value-added tea

* *Corresponding Author:* kanchana@at.cmb.ac.lk

ASSESSMENT OF SELECTED QUALITY PARAMETERS OF COCONUT OIL IN KURUNEGALA DISTRICT

E.M.R.D. Edirisingh, and H.M.D. Nayomi*
Faculty of Science, Horizon Campus, Malabe, Sri Lanka

Coconut oil is extracted from coconut (*Cocos nucifera*) kernel, commonly known as copra. Due to its extensive use in daily life, coconut oil is highly demanded in Sri Lanka. Lauric acid accounts for the majority of the fatty acids in coconut oil. This research seeks to identify whether the quality of coconut oil produced by coconut oil manufacturers in Kurunegala district are up to Sri Lanka Standards (SLS) under SLS 32:2017. This research is designed to compare selected quality parameters such as peroxide value, free fatty acid value and iodine value of coconut oil produced locally within the Kurunegala district, Sri Lanka. In total, 15 coconut oil samples were collected under three categories as small-scale manufactured coconut oil, coconut oil obtained from grocery shops and branded coconut oil from supermarkets. Five samples were collected under each category and tests were performed in triplicate. The results indicated that peroxide value ranged from 0.22 meq/kg to 3.89 meq/kg, free fatty acid value (FFA) ranged from 0.09% to 1.16% and iodine value ranged from 7.495% to 31.320%. Peroxide values of all samples obtained from the grocery shops were less than the maximum allowable limit (3.0 meq/kg). Higher peroxide values were observed in three small scale manufactured coconut oil samples. Several samples had a high FFA value than the standard value (0.8%) but most of them were marginal to standard value. A very low FFA value (0.09%) was observed in two samples, one from small scale manufacturers and the other from branded samples. Samples obtained from grocery shops had a higher iodine value than SLS (7.5%-11.0%). The results indicate that the majority of the coconut oil samples were not up to the SLS quality criteria. Therefore, it is required to improve quality of coconut oil manufactured in the district to be on par with SLS standards.

Keywords: Coconut oil, Free fatty acids, Iodine content, Kurunegala district, Peroxide content, Quality

* *Corresponding Author: *danushika@horizoncampus.edu.lk*

PHYSICOCHEMICAL AND SENSORY PROPERTIES OF FLAVOURED CEYLON BLACK TEA CONSUMER PACKS

S.S.V Sumanadasa[1], W.K.S.M Abeysekera[1*] and K. Ranjith W. Abeywickrama[2]
[1]Department of Agricultural Technology, Faculty of Technology, University of Colombo, Mahenwatta, Pitipana, Homagama, Sri Lanka
[2]Analytical Laboratory, Sri Lanka Tea Board, Ministry of Plantation Industries, Colombo, Sri Lanka

Tea is the second most consumed beverage next to water and Ceylon tea is the finest tea in the international trade. Flavoured teas are one of the most important value-added products exported from Sri Lanka. However, extremely limited studies have focused on physicochemical and sensory properties of flavoured teas exported from Sri Lanka. This study investigated selected physicochemical and sensory properties of ten flavoured black (Broken Orange Pekoe Fanning's: BOPF) teas namely cardamom tea, Earl Grey tea, apple tea, lemon tea, ginger tea, exotic chai tea, peach tea, raspberry tea, cherry tea, and mixed fruit tea. Non-flavoured black tea (BOPF) served as the control. As physicochemical properties moisture, total ash, water-soluble ash, alkalinity of water-soluble ash, and pH were analysed using internationally accepted standard protocols. An in-house trained panel at the Tea Board, Sri Lanka performed sensory attributes (leaf colour, leaf evenness, liquor strength & overall quality) for leaf, infused leaf and liquor properties of the selected flavoured teas. Results showed significant differences ($P<0.05$) among the samples and compared to control for the studied physicochemical and sensory properties. Moisture, total ash, water-soluble ash, alkalinity of water-soluble ash, and pH of the flavoured teas ranged from 6.46 ± 0.01 - 9.29 ± 0.01%, 5.76 ± 0.07 - 6.25 ± 0.00%, 36.57 ± 1.06 - 43.82 ± 0.52%, 1.83 ± 0.07 - 2.19 ± 0.03% and 4.88 ± 0.01 - 5.02 ± 0.02 respectively and complied with the ISO standard requirements given for black tea. The sensory evaluation revealed that raspberry, cherry, cardamom, Earl Grey, and mixed fruit teas were the most preferred teas in terms of tested sensory attributes. In conclusion, flavouring has an effect on physicochemical and sensory properties of black tea.

Keywords: Flavoured Ceylon Tea, Physicochemical Properties, Sensory Properties, Black Tea, Sri Lankan Tea

[*] *Corresponding Author:* kanchana@at.cmb.ac.lk

EFFECT OF POTASSIUM SOLUBILIZING BACTERIA ON GROWTH AND YIELD OF BRINJAL (*Solanum melongena* L.)

R.Thuvaraka[1*], K.K.K.Nawaratna[2], A.G.B. Aruggoda[1] and S.Kohombange[2]
[1]Department of Agriculture and Plantation Engineering, The Open University of Sri Lanka, Sri Lanka
[2]Soil Microbiology Unit, Horticulture Crop Research and Development Institute Gannoruwa, Peradheniya, Sri Lanka

Potassium-solubilizing bacteria (KSB) based bio fertilizer is a sustainable approach to increase K availability in soil for crops. The present study was conducted to assess the ability of potassium solubilizing bacteria inoculum (KSB) to enhance the growth and yield of brinjal under plant-house condition. The KSB was isolated from soil samples which were collected from six (06) different locations in Sri Lanka: Matale Alfisol, Artisol, Jaffna Oxisol, Ultisol and Gannoruwa Ultisols. Matale Alfisol and Jaffna Ultisol soils were identified having more KSB naturally. Six (06) treatments were applied: nitrogen (N), phosphorous (P), potassium (K), NP+K inoculum, NP+ 50%K+K inoculum, NP+75%K + K inoculum, NP only and no fertilizer. Growth and yield parameters were assessed. Plant height, number of flowers per plant and number of leaves per plant were increased significantly ($p<0.05$) with both KSB inoculum and K inorganic fertilizer application. Shoot and root biomass was increased significantly ($p<0.05$) with KSB application. However, the highest growth was observed in NP+75%K + K inoculum treatment. Number of fruits per plant and fruit dry weight was increased significantly ($p<0.05$) with both KSB inoculum and K inorganic fertilizer application. The highest yield was observed in trial treated with both KSB and 75% K chemical fertilizer. The results indicated that KSB application increased soil available K. The best growth and yield promotion of brinjal was achieved by applying 75% Potassium, Nitrogen and Phosphorus chemical fertilizer along with Potassium solubizing bacteria

Keywords: Bio fertilizer, potassium solubilizing bacteria, inoculum, Alfisol, Ultisols, Artisols, Oxisols

[*] *Corresponding Author: thuvaraveendranath@gmail.com*

DEVELOPMENT OF A VALUE-ADDED BITTER GOURD (*Momordica charantia* L.) TEA

D.M.A.D. Bandara and W.K.S.M. Abeysekera*
Department of Agricultural Technology, Faculty of Technology, University of Colombo, Sri Lanka

It is a well-known fact that functional foods can play a major role in prevention and management of non-communicable diseases (NCDs). Tea is the second most widely consumed beverage next to water and phytochemical rich herbal teas could potentially serve as a functional beverage in prevention and management of NCDs. Bitter gourd (Momordica charantia L.) is a well-known anti-diabetic plant. This study focused on developing a value-added functional tea from bitter gourd. Three different slice thickness (1mm, 2.5mm and 5mm) of bitter gourd Preethi variety was dried at 50°C, 60°C and 70°C until the moisture content reaches 8-10%. Selected best sample/s were ground (sieve size - 850µm) and bitter gourd tea was prepared. Then, physicochemical (moisture, total ash content, water activity, color and pH; n=2 each), anti-glycation (n=3 each) and sensory properties (using a trained panel; n=12) were studied for bitter gourd tea. Results showed that bitter gourd samples of 1mm and 2.5mm slice thicknesses dried at 70°C and 50°C for 2 h and 6h respectively were the best in terms of physicochemical properties. Anti-glycation activity of the best samples was moderate (2.5mm slice thickness dried at 50℃: IC_{50} 266.95 ± 87.25 µg/ml; 1mm slice thickness dried at 70℃: IC_{50} 380.32 ± 46.85 µg/ml) compared to the reference standard Rutin (IC_{50}: 23.25 ±6.08 µg/ml). In sensory studies, bitter gourd tea formulated from 2.5mm slice thickness dried at 50°C exhibited the best sensory attributes. It is concluded that selected two best samples have a great potential as a value-added functional tea which can be commercialized in the long run.

Keywords: Bitter Gourd Tea, Value Added Tea, Physicochemical Properties, Anti-Glycation Properties, Sensory Properties

**Corresponding Author: kanchana@at.cmb.ac.lk*

Acknowledgments
AHEAD grant is greatly acknowledged for providing funds to obtain multimode micro-plate reader to the Department of Agricultural Technology, Faculty of Technology, University of Colombo

STAKEHOLDER PERCEPTIONS ON ADOPTION OF ECO-FRIENDLY TECHNOLOGIES TO MINIMIZE CHEMICAL FERTILISER USE IN PADDY FARMING

Y.S. Delile[1*], U.K. Jayasinghe-Mudalige[1], R.S. Dharmakeerthi[2] and W.S. Dandeniya[2]

[1]Department of Agribusiness Management, Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, Sri Lanka

[2]Department of Soil Science, Faculty of Agriculture, University of Peradeniya, Sri Lanka

Recent literature points out that eco-friendly technologies (EFTs) identified scientifically possess the potential to reduce the now excessively using levels of chemical fertilizers (CFs) in agriculture that in turn, generates multiple benefits to the society in the areas of, but are not limited to, socio-economic and environmental. To deeply explore this phenomenon following a period of turmoil caused by sudden ban of importing and using agro-chemicals, this study was conducted to inquire about the perceptions of key stakeholders: farmers, experts, related government and private sector administrators with high interest and impact on paddy production in Sri Lanka. To represent those diverse segments pertaining to paddy production, the selection of respondents was based on the principle of purposive sampling techniques, where the individuals possess a previous track record of experience with EFTs and exposure to similar studies. An in-depth in-person and/or online interviews, supported by a structured questionnaire, were conducted to gather first-hand information from 167 individuals, and each was guided to evaluate a set of statements (s=30) build up on a 10-point linear numeric scale ranging from "extremely disagree" (0) to "extremely agree" (10). Statements were categorized under three criteria: (1) Social and Regulatory (SR); (2) Economic and Financial (EF) and (3) Environmental (EN). In analysis of data, the comparison of median indicates that those stakeholder perceptions varied significantly in the face of diverse scenarios. It was revealed that in the context of EN, the stakeholders, overall, favoured adoption of EFTs above the use of CFs. The outcome of non-parametric Kruskal-Wallis test shows that there is no significant difference among the medians of responses amongst the stakeholder groups and that their perceptions lie in favour of EFTs over CFs (p=0.253, 95% confidence level). This signals the importance of institutionalization of those parties responsible for regulation (e.g., setting the standards, licencing/certification) and facilitation (e.g., capacity building, rewarding) in the agri-food value and plant nutrients supply chains with a solid national and overarching agricultural and fertilizer policy frameworks at its earliest.

Keywords: Adoption, chemical fertilizer, eco-friendly technologies, paddy farming, stakeholder perceptions

[*]*Corresponding Author: yoshelldelile@outlook.com*

EFFECT OF CO - INOCULATION OF *Azotobacter* spp. AND *Trichoderma asperellum* WITH INORGANIC FERTILIZER ON GROWTH AND YIELD OF CARROT

T.T. Gunasekara[1]*, K.K.K. Nawarathna[2], A.G.B. Aruggoda[1] and S. Kohombange[2]

[1]Department of Agricultural and Plantation Engineering, The Open University of Sri Lanka, Sri Lanka

[2]Horticultural Crop Research and Development Institute, Gannoruwa, Sri Lanka

Phosphate solubilizing and Nitrogen fixing microorganisms based biofertilizers can be used to reduce the inorganic Nitrogen (N) and Phosphorous (P) based chemical fertilizer usage and increase the available nitrogen and phosphorus in soil. To accomplish this, Sri Lankan isolates of Azotobacter spp. and Trichoderma asperellum were combined with lower rates of chemical fertilizers to evaluate the growth and yield characters of carrot. This study was conducted at the Division of Soil Plant and Nutrition, Horticultural Crop Research and Development Institute (HORDI) Gannoruwa. Prior to the combination of both organisms, the compatibility test was done. The pot experiment was carried out in Completely Randomized Design (CRD), consisting six treatments and four replications. The Treatments were namely T1 (No Fertilizer), T2 (100% NPK - DOA Recommendation), T3 (50% NP + K), T4 (50% NP + Azotobacter spp. + T. asperellum + K), T5 (75% NP + K) and T6 (75% NP + Azotobacter spp. + T. asperellum + K). The results of the compatibility test revealed that the isolates of T. asperellum and Azotobacter spp. were completely compatible. According to the results of the pot experiment, the significantly ($P < 0.05$) longest shoot length, maximum number of leaves, highest root diameter, highest root length, maximum shoot fresh weight, root fresh and dry weights were observed from treatments T6 and T2 while maximum shoot dry weight was observed from treatments T4 and T6. Available phosphorus content in treated soil was higher in T2 and T6. These results demonstrated that combined use of Sri Lankan isolate T. asperellum and Azotobacter spp. with reduced levels of (25% and 50%) nitrogen and phosphorous based inorganic fertilizers could enhance growth and yield parameters of carrot equivalent or higher than those obtained by using full rates of Department of Agriculture Sri Lanka recommended inorganic fertilizers.

Keywords: *Azotobacter* spp, Carrot, Inorganic Fertilizer, *Trichoderma asperellum*

**Corresponding Author: taniyagunasekaratg11@gmail.com*

DEVELOPMENT OF ANTHER CULTURE TECHNOLOGY FOR SELECTED CHILLI (*Capsicum annum* L.) VARIETIES

V.G.T.D. Kumari [1*], H.M.P.S Kumari[2] and A.G.B. Aruggoda [1]

[1]Department of Agricultural and Plantation Engineering, The Open University of Sri Lanka, Sri Lanka

[2]Horticultural Crop Research and Development Institute, Gannoruwa, Sri Lanka

The study is to determine suitable callus induction medium for anther culture of capsicum varieties to enhance plant breeding. Conventional breeding of capsicum is a time-consuming and a labor-intensive process and this could be overcome by using *in-vitro* methods of haploid plant production. The four different capsicum varieties: ISPN-8 (breeding line), HORDI breeding line 300 (inbred line), Prarthana (released by HORDI Gannoruwa) and HYW (released by Department of Agriculture). The experiment followed a Completely Randomized Design. Three different callus induction MS media were tested, with varying concentrations of 0.1 mg/L, 0.5 mg/L, and 1.0 mg/L of BAP (6-benzyl amino purine) with three replicates. The result revealed that the percentage of callus formation did not show a significant effect ($p > 0.05$). The highest percentage of callus formation (82.20%) was obtained in the medium supplemented with 0.5 mg/L BAP from the variety Prarthana, while the lowest percentage (49.00%) was obtained in the medium containing 1.0 mg/L BAP from HORDI breeding line 300. Significant variations were observed in the responses of selected varieties based on the genotypes used. The medium supplemented with 0.5 mg/L BAP was found to be the most suitable for callus induction in the selected varieties of capsicum than media containing 0.1 mg/L and 1.0 mg/L of BAP. In conclusion, the study provides valuable information on the response of capsicum varieties to anther culture and identifies a promising callus induction medium for further plant breeding efforts. Callus greening percentage did not show a significant effect ($p > 0.05$). The highest percentage of callus greening (38.87%) was obtained in 0.1 mgL^{-1} BAP from Prarthana. In conclusion, the study provides valuable information on the response of capsicum varieties to anther culture and identifies a promising callus induction medium for further plant breeding efforts

Keywords: Anther culture, callus induction, capsicum, BAP

[*]*Corresponding Author: thushari.1dilrukshi@gmail.com*

ASSESSMENT OF GROUNDWATER RECHARGE ZONES USING GEOSPATIAL TECHNIQUE IN NORTH CENTRAL PROVINCE, SRI LANKA

D.S.N. Hettiarachchi*, K.G.S. Nirmanee and M.H.J.P. Gunarathna
Department of Agricultural Engineering and Soil Science, Faculty of Agriculture, Rajarata University of Sri Lanka, Anuradhapura, Sri Lanka

Groundwater is a vital natural resource which provides water for all over the country and it varies in distribution across different regions. However, lack of sustainable management practices such as overexploitation and unplanned projects have depleted groundwater resources, while population growth and industrialization have increased the demand for groundwater. In North Central Province (NCP), most people rely on groundwater to meet their water needs since surface water varies spatially as well as temporally. Hence, sustainable management of groundwater resources is important to meet the demand while assuring the sustainability of this valuable natural resource. To identify suitable locations for groundwater exploitation and artificial recharge, this study employed a GIS-based approach. Seven thematic layers based on factors influencing groundwater recharge; geomorphology, geology, soil type, slope, lineament density, drainage density, and land use were taken to analyse the potential. Multi-influencing factor approach was used to determine the weights of each layer for the overlaying analysis. The created groundwater recharge map was divided into high, moderate, and low potential zones and the NCP region has 20.8%, 53.1%, and 26.1% in high, moderate, and low recharge potential zones, respectively. Further, the study demonstrates that there is ample opportunity to implement aquifer recharge programs to reduce groundwater stress in NCP. Since the accuracy of the study depends on the classification criteria and weights assigned to the thematic layers, suggested to have an accuracy assessment, using groundwater level data in NCP.

Keywords: GIS, Groundwater Recharge, Multi Influencing Factor

**Corresponding Author: shyanihettiarachchi24@gmail.com*

MORPHOLOGICAL CHARACTERIZATION OF BRINJAL (*Solanum melongena* L.) CULTIVARS IN SRI LANKA AND PRELIMINARY MOLECULAR EVALUATION FOR BACTERIAL WILT RESISTANCE

C.L.T. Sandanayake[1], S.R. Weerakoon[1*] and S.A.C.N. Perera[2]

[1]Department of Botany, Faculty of Natural Sciences, The Open University of Sri Lanka, Sri Lanka*

[2]Department of Agricultural Biology, Faculty of Agriculture, University of Peradeniya, Sri Lanka

Brinjal (*Solanum melongena* L.) is the second most economically important solanaceous crop in the world. Brinjals are low in calories but rich nutritional factors, antioxidants, vitamins and minerals. Wild as well as genetically modified brinjal cultivars are available in Sri Lanka. Information on available local and imported brinjal cultivars can aid in brinjal breeding programmes and help farmers select suitable cultivars for planting. The study assessed morphological diversity in selected brinjal cultivars in Sri Lanka using plant growth and leaf characteristics of 1- month and 6-month-old seedlings. Seeds of nine brinjal cultivars (*Padagoda, Raveena 135, Lucky green, Plastic batu, Lena iri batu, Deshiya Ela batu, Thalana batu, Thith batu and Hybrid bride*) were obtained from the Horticultural Crops Research Development Institute (HORDI), Department of Agriculture, Sri Lanka and characterization was carried out in a plant house at the Open University of Sri Lanka, Nawala.

A total of 25 plants from each cultivar (arranged in Randomized Complete Block Design [RCBD]) was subjected to characterization following the minimum descriptors (plant and fruit) for eggplant published by the International Board for Plant Genetic Resources. The data was analysed using descriptive and inferential statistical methods including ANOVA, Cluster Analysis and a PCA using SPSS ver.20.0. The study reveals a wide range of variation in morphological characteristics among brinjal cultivars in Sri Lanka. ANOVA results showed statistically significant differences ($p \leq 0.05$) in plant height, petiole length, leaf number, growth habit, leaf blade length and width, leaf blade lobing, and leaf prickles. According to the dendrogram obtained from tree cluster analysis, nine brinjal cultivars were grouped into eight clusters, indicating significant variation in plant height and leaf morphologies. Leaf blade width, leaf blade color, leaf blade length, and tip angle can be used to classify these cultivars as the tree cluster diagram indicates. Further, correlation matrix of Principle component analysis indicated negative correlation between growth habit and leaf blade characters.

A preliminary molecular evaluation for bacterial wilt resistance using five specific primers) was carried out for five different brinjal cultivars which showed varying banding patterns among the cultivars. Further analyses with more primers are required to confirm the extent of bacterial wilt resistant among brinjal cultivars.

Keywords: Brinjal, *Solanum melongena* L., morphological characterization, bacterial wilt

**Corresponding Author:* srwee@ou.ac.lk

CHARACTERIZATION OF SEED OILS OF THREE FABACEAE SPECIES

K.A.H. Thathsara and S.D.M. Chinthaka*

Department of Chemistry, Faculty of Applied Sciences, University of Sri Jayewardenepura, Nugegoda, Sri Lanka

As a tropical country, Sri Lanka has wide varieties of oil-bearing seeds which often end up as waste without proper utilization. Plant seed oils have emerged as a promising avenue for the use in cosmetics and dietary supplements due to their triglycerides with a useful fatty acid composition and other non-polar constituents. However, most of these oils are not characterized by chemical composition. This study aims to characterize the seed oils of *Pongamia pinnata L.*, *Clitoria ternatea L.* and *Adenanthera pavonina L.* by determining Fatty Acids (FA) composition as their methyl esters, nonpolar constituents in unsaponifiable matter, and other physical properties. The oil was extracted using the soxhlet extraction method. 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 unsaponifiable matter were analyzed using GC-MS. Thermogravimetric Analysis (TGA) was performed to assess the thermal stability. The results indicated that *P. pinnata*, *A. pavonina* and *C. ternatea* show oil yields (w/w) of 28.32%, 28.25%, and 12.90%, respectively. Smoke point values ranged from 151.6 ± 12.1 °C to 213.5 ± 14.3 °C. *P. pinnata* showed a higher AV of 67.73 ± 1.36 mgKOH/g, while the other oils showed 10.17 ± 0.93 mgKOH/g and 8.46 ± 1.13 mgKOH/g. IVs ranged from 10.54 ± 2.65 to 13.97 ± 1.46 gI2/100g and ash content values varied from 2.61 ± 0.16% to 4.58 ± 0.32%. A higher yield of unsaponifiable matter of all three of these oils is found which ranged from 2.05 ± 0.01 % to 5.02 ± 0.01 %. Long-chain fatty acids, such as Oleic, Linoleic, Stearic, and Palmitic acids, were the most abundant FA constituents in all the oils. *C. ternatea* contained γ-sitosterol, stigmasterol, campesterol and taraxasterol as phytosterols that show antioxidant, and anti-inflammatory effects on human. *P. pinnata* contained a higher amount of squalene which is a good emollient in the unsaponifiable fraction. In conclusion, the results suggest that all three oils show a high potential to be used in both dietary supplements and cosmetics.

Keywords: Family Fabaceae, unsaponifiable matter, fatty acids, cosmetics, dietary supplements

**Corresponding Author: sdmchin@sjp.ac.lk*

II. BIOLOGICAL SCIENCES

WATER ABSORPTION AND FLAMMABILITY PROPERTIES OF WATER HYACINTH *(EICHHORNIA CRASSIPES)* FIBRE REINFORCED THERMOPLASTIC COMPOSITE

N.A. Kaushi Aloka[1,2], R.A. Jayasinghe[1*], G. Priyadarshana[3], A.H.L.R. Nilmini[3]
[1]Department of Civil and Environmental Technology, Faculty of Technology, University of Sri Jayawardena, Pitipana, Homagama, Sri Lanka
[2]Faculty of Graduate Studies, University of Sri Jayewardenepura, Sri Lanka
[3]Department of Materials and Mechanical Technology, Faculty of Technology, University of Sri Jayawardena, Pitipana, Homagama, Sri Lanka

Natural fibers are considered the foremost alternative to synthetic fibres due to their comparatively lower environmental impact. The water hyacinth *(Eichhornia crassipes)*, an invasive aquatic weed is a potential source of natural fibres for various applications. The study focused on the use of water hyacinth fibres (WHF) as a reinforcing phase in a Polyethylene (PE) matrix, where the PE material was obtained as waste packaging material from an industry. The WHF were extracted using a decorticating process and added to the PE matrix at varying rates of 0, 5, 7.5, 10 and 12.5 w/w%. The composites were manufactured using a compression moulding technique and developed without the use of any chemical additives. Moisture absorption and flammability tests were conducted on the prepared composites according to ASTM D 570 and UL-94 Horizontal Flame Propagation test, respectively. The results showed that the 5% WHF composite had the lowest water absorption compared to the other WHF reinforced composites while the control sample (0% WHF) had the lowest water absorption overall. However, the water absorption value of the polyethylene (PE) composite reinforced with 12.5% WHF was found to be significantly lower, at only 2.5%, compared to that of commercially available wood particle board, which absorbed water at a rate as high as 80% in 72 hours. Moreover, the burning rate increased with an increase in WHF content. However, it is necessary to conduct mechanical experiments to assess the viability of utilizing water hyacinth fibre composites in non-structural applications, particularly, in the development of panel boards.

Keywords: Water hyacinth fibres, composites, polyethylene, moisture absorption, flammability.

[*]*Corresponding Author: randika@sjp.ac.lk*

PRELIMINARY STUDY OF *Strongyloides* SPP. DISTRIBUTION OF DUNUMADALAWA FOREST KANDY, SRI LANKA

W.M.G.R. Wickramaratne* and K.C. Weerakoon
Department of Zoology, Faculty of Science, The Open University of Sri Lanka, Polgolla, Kandy, Sri Lanka

Strongyloides is a genus of parasitic nematodes that, belonging to the family Strongylidae. Unusually, has a free-living adult generation and transmitted through the environment causing strongyloidiasis disease. Two species of *Strongyloides* infect humans. ie, *S. stercoralis* and *S. fuelleborni*. These parasites affect around an estimated 100-200 million individuals worldwide. Strongyloidiasis, in which worms, particularly larvae are potent to penetrate the gut wall and invade the other organs. This is fatal unless anti-*Strongyloides* therapy is given. Most of the previous studies have used microscopic identification techniques to the detection of *Strongyliodes spp.* Understanding the distribution of these parasites in a densely populated area is important for public health authorities to assess the potential risk of human infections and implement appropriate control measures. The objective of the present study therefore was to examine the *Strongyloides spp.* Distribution in Dunumadalawa forest Kandy, Sri Lanka. Dunumadalawa (70 17'00"N; 800 38'49"E; 548-972 m above sea level) is a semi-isolated, hill country wet zone forest reserve located in Kandy District, Sri Lanka. It is approximately 480 ha in extent and comprises mainly of secondary growth forest boasting a rich diversity of flora and fauna, with a notable presence of primates and mammals. Soil samples were collected from seven sampling sites, i.e., Pine tree forest patch, Natural Forest area near pine trees, Invasive plant area-Yakadamaran – Left side from the Rosnith Lake, Invasive plant area-Yakadamaran – Right side from the Rosnith Lake, Yakadamaran removed area, Natural Forest area, Natural Forest area near entrance. Baermann funnel method was used to separate the Nematodes from the soil samples and identified the specimens using microscopic techniques. All study sites were revealed that in every 25g of soil sample, 8% -12 % filariform larvae of *Strongyloides spp.* were consistently present. Filariform larvae can be penetrated intact skin to initiate infection. Identifying where *Strongyloides spp.* is commonly found in Dunumadalawa forest will inform environmental control strategies to reduce this neglected disease.

Keywords: Dunumadalawa, S. fuelleborni, S. stercoralis, Strongyloides spp., Strongyloidiasis

**Corresponding Author: randikawiki@gmail.com*

SPATIAL DYNAMICS AND COMPOSITION OF WATERBIRDS IN JAFFNA AND KILINOCHCHI DISTRICTS, SRI LANKA

G. Kandasamy[1*], D.K. Weerakoon[2], A. Sivaruban[1] and H.B. Jayasiri[3]

[1] Department of Zoology, University of Jaffna, Sri Lanka

[2] Department of Zoology, University of Colombo, Sri Lanka

[3.] Ocean University of Sri Lanka, Sri Lanka

Species composition, diversity and abundance of waterbirds will vary spatially based on their habitat requirements for foraging, resting, roosting or breeding. Although the northern region of Sri Lanka consists of unique bird species and migrant entry points, the region was inaccessible for three decades due to the armed conflict. Based on the habitat variability, the present study was carried out in eight study sites namely, Mandaitivu, Mankumban, Kayts-Araly Road, Kavutharimunai, Pallai, Thadduvankoddy, Sarasalai and Nagarkovil from December 2016 to November 2018 to document the spatial distribution patterns of waterbird communities. The block count method was carried out for counting of waterbirds. In this method, each site was divided into 500 m blocks along a line transect. Each block was separated at least by 500 m to avoid double counting. Altogether 82 waterbird species belonging to 20 families were recorded. Among them, 44 were migrants while 38 were breeding residents. The most dominant species is Northern Pintail (*Mareca penelope*), followed by Greater Flamingo (*Phoenicopterus roseus*) and Black-tailed Godwit (*Limosa limosa*). Abundance of birds were transformed into densities (number of birds km^{-2}). Kruskal-Wallis test revealed that density of waterbirds varied significantly among eight study sites (Kruskal-Wallis test, H = 40.120, $p < 0.01$). That might be due to habitat heterogeneity and available microhabitats with water level fluctuation and migration of birds. According to the hierarchical agglomerative cluster analysis (SPSS, 14.0), dendrogram on density of waterbirds separated Sarasalai from all other sites. Sarasalai is with the highest species richness (71) and mean species density (2834.33) due to the rich habitat heterogeneity comprising a mosaic of habitats for a wide array of waterbirds. Pallai was separated from all other sites. That might be due to the lowest density of waterbirds (335.17) which may be due to the disturbances caused by the nearby wind farm. The present study revealed that Sarasalai was the richest site in terms of density of waterbirds, followed by Thadduvankoddy, Mankumban and Nagarkovil. Sarasalai showed rich habitat heterogeneity including mangroves, saltmarsh, mudflats and scrublands and had shallow waters throughout the year. Thus, conservation of these wetlands is important for the conservation of waterbirds in the northern region of Sri Lanka.

Keywords: Composition, Jaffna, Kilinochchi, Spatial, Waterbirds

[*]*Corresponding Author: vadhana.gk@univ.jfn.ac.lk*

DIVERSITY OF ANT ATTENDED SCALE INSECTS IN SELECTED AREAS OF THE ANURADHAPURA DISTRICT

L.R.T. Lakshani and D.K. Hettiarachchi*
Department of Biological Sciences, Rajarata University of Sri Lanka, Mihintale, Sri Lanka

Scale insects are phytophagous arthropods of order Hemiptera, found worldwide and including about 6000 species belonging to 21 families. Scale insects produce honeydew that serves as the food for ants. Even though the scale insects have been identified, the diversity of plants and ants that they are associated with is poorly studied in this country. This study intends to identify the scale insects in home gardens in selected areas of the Anuradhapura District and the ant and plant species associated with them. Fifty (50) home gardens were selected as ten home gardens per five divisional secretariats, Mihinthale, Rambewa, Thirappanaya, Kahatagasdigiliya and Puliyankulama. In each home garden, a circular area (radius 50m) was examined to collect ant associated scale insects. The diversity and the abundance of scale insects were assessed. Scale insects, ants and plants were identified at least up to the family level using appropriate keys. The species diversity was analysed using Simpson's and Shannon indices. From the 50 home gardens 17 species of scale insects were identified from 32 plant species interacting with 5 ant species. Families Coccidae and Pseudococcidae were found to feed on many plant families whereas members of families Diapsidae and Monophlebidae were only found in Apiaceae and Moraceae respectively. The dominant ant species attended scale insects was *Oecophylla smaragdina*. Abundance of the scale insects was recorded highest in Kahatagasdigiliya and the lowest in Thirappanaya whereas the highest species diversity was reported in Kahatasdigiliya and the lowest in Thirappanaya. From this study it can be stated that scales belonging to families Coccidae and Pseudococcidae are more generalized feeders whereas the members of families Diapsidae and Monophlebidae are specialized feeders. The species level identification of the scale insects are continuing. It is recommended to expand this study to cover a wider geographical area to identify this Tritrophic interaction to see the temporal and special variations of the populations along with varying climatic conditions.

Keywords: *Sri Lanka, Hemiptera, Scale Insects,* Tritrophic Interactions, Phytophagouse

* *Corresponding Author: dilanikh@as.rjt.ac.lk*

DEVELOPMENT AND PHYSICOCHEMICAL CHARACTERIZATION OF A PHYCOCOLLOID FILM FROM *G. hikkaduwensis:* A SEAWEED FROM SRI LANKA

P.H.I. Udeshani and K.V.K. Gunathilake*
Department of Zoology, Faculty of Applied Sciences, University of Sri Jayewardenepura, Sri Lanka

Globally, phycocolloids from seaweeds are widely used in industries due to their film forming ability. Family *Gracilaria* is one of the well renowned seaweed family which is used in phycocolloid extraction and development of film, yet poorly investigated for the said purpose in Sri Lanka. The present study, for the first time, aims at extraction of phycocolloids from *G. hikkaduwensis*, which is an endemic seaweed species in Sri Lanka. Seaweed samples were collected from shallow sea waters near to Koggala, Sri Lanka by hand picking (Department of Wildlife Conservation Permission No; WL/3/2/29/21) and identified based on morphology. Phycocolloids were extracted and a film was prepared using glycerol (80% v/w) as plasticizer by the film casting method. Physico-chemical properties of the biofilm; solubility, thickness, water vapour transmittance rate (WVTR), water vapour permeability (WVP), water content, transparency and light absorbance analysis were recorded. The phycocolloid film formation from *G. hikkaduwensis* resulted in a wet film with a thickness of 0.46 ± 0.04 mm, high in water content (62.31 ± 0.98 %), low in solubility (33.41 ± 0.56%) while having high WVTR (0.02 ± 0.02 g s^{-1} m^{-2}) and low WVP through the film ($3.879x10^{-9}$ g s^{-1} m^{-1} Pa^{-1}). The wet film, after 6 hours of oven-drying at 50 ˚C, contained a thickness of 0.32 ± 0.08 mm, low water content (23.04 ± 0.78%) and high solubility (68.72 ± 1.23%). Light absorbance analysis of phycocolloids film exhibited potential UV barrier properties. The film forming ability of the extracted phycocolloids with adequate barrier properties suggested the possibility of the film to be utilized in various industrial applications. Thus, the present study, for the first time, unveiled a potential and previously unexplored source of phycocolloids; i.e. *G. hikkaduwensis* to develop safe biomaterials for future use.

Keywords: Biofilm, Gracilariaceae, Phycocolloids, Physico-chemical Properties

* *Corresponding Author: varunig@sjp.ac.lk*

ATTENUATED TOTAL REFLECTANCE FOURIER TRANSFORM INFRARED (ATR-FTIR) SPECTROSCOPY FOR DETECTION OF BREAST CANCER

Panchala Dhanushi Walpita [1], Supipi Amanda Manage[1], A. A. P. Keerthi[1*], P. R. Haputhanthri[2], and Mahendra Perera[3]

[1]College of Chemical Sciences, Institute of Chemistry, Ceylon, Rajagiriya, Sri Lanka
[2] The Open University of Sri Lanka, Nawala, Nugegoda, Sri Lanka
[3]Asiri Surgical Hospital, Colombo 05, Sri Lanka

Breast cancer is a significant health condition affecting millions of women worldwide. Early detection of breast cancer is crucial for its successful treatment and cure. In this study, we developed a non-invasive, rapid, inexpensive, and accurate method for detecting potential breast cancer patients using Attenuated Total Reflection Fourier Transform Infrared (ATR-FTIR) spectroscopy coupled with multivariate analysis. The Infrared (IR) spectrum of blood serum has a diagnostically significant range of 2800-3000 cm^{-1} for breast cancer, which corresponds to the C-H asymmetric stretching vibration of CH_3 and CH_2 of lipid acyl chains. Application of Principal Component Analysis (PCA) and Partial Least Squares Regression (PLS-R) from the multivariate analysis shows the change in intensity of the bands between the control group and the patient group. Using PLS-R, we constructed a predictive linear regression model within the above wavenumber range of the obtained IR spectra to quantify lipids to correlate to breast cancer. The model found linear regression graphs of spectral data that were most predictive of breast cancer status, which could be used to predict the probability of breast cancer. The best-fitting PLS-R models are evaluated according to their determination coefficient (R^2) and the Root Mean Square Error of Calibration (RMSEC). After performing PLS-R analysis, it generated a mathematical model with an RMSEC value of 0.5778 and an R^2 value of 0.7546, proving that this approach may offer a less discomfiting and time-consuming method for screening breast cancer, which may encourage more women to undergo this lifesaving screening test.

Keywords: Breast Cancer, Blood serum, ATR-FTIR spectroscopy, Principal Component Analysis, Partial Least Squares Regression

** Corresponding Author: aapkeerthi1976@yahoo.com*

THE INFLUENCE OF COOKING ON THE ANTI-NUTRIENT CONTENTS OF TWO *Dioscorea* VARIETIES IN SRI LANKA

W.A.E.M.P. Menike[1*], J.W.A. Sajiwanie[2] and R.M.U.S.K. Rathnayaka[2]
[1]Faculty of Graduate Studies, [2]Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka, Sri Lanka

The presence of anti-nutrients, which limit the food value of crops by causing toxicities and reducing the bioavailability of nutrients, is one of the major concerns for many valuable food crops. Local yams, one of the nutrient-rich but underutilized crops in Sri Lanka, with a significant content of anti-nutrient factors such as phenol, alkaloid, oxalate, phytate, tannin, saponin, which cause toxicity and bitterness, leads to the underutilization of these yams. In Sri Lanka, yams are commonly consumed after cooking in boiling water. Moreover, cooking is a scientifically proven traditional technique to reduce the amount of anti-nutrients in plant foods. However, the scientific studies on anti-nutrients in local yams were limited. Therefore, this study aimed to assess the alkaloids, saponins, and oxalate contents in two local yam varieties and investigate the effect of cooking on the anti-nutrient contents of these yams. Bulk samples of the two selected varieties, Pani ala (*Dioscorea alata*) and Kirikodol (*Dioscorea alata*) were collected from the Field Crop Research and Development Institute, Mahailluppallama, Sri Lanka. Yams were cooked in boiling water at a ratio of 1: 10 (W/V) for 30 minutes to determine the cooking effect. Alkaloids and saponin content were analyzed using gravimetric methods, and Oxalate content was analyzed using the Permanganate titration method. Recorded values were as the fresh weight basis. Data were analyzed using Analysis of Variance (ANOVA) with Minitab 19 statistical software. The highest alkaloid content was observed in uncooked Kirikodol (0.36±0.01%) and cooked Pani ala had the lowest (0.16±0.01%). Oxalate contents of tested samples ranged between 11.25±0.00 mg/100 g (cooked Pani ala) and 78.75±0.00 mg/100 g (uncooked Kirikodol). Saponin content ranged between 1.5±0.18% to 3.8±0.28%, the lowest for cooked Pani ala and the highest for uncooked Kirikodol. Uncooked Kirikodol showed the highest anti-nutrient content, while the lowest in cooked Pani ala among the tested samples. All the cooked samples showed reduced contents of three anti-nutrients than the uncooked samples. Thus, cooking is an effective way of minimizing the levels of alkaloids, saponin, and oxalate content in Pani ala and Kirikodol.

Keywords: Alkaloids, Anti-nutrients, *Dioscorea*, Oxalate, Saponin

[*]*Corresponding Author:* erandipremachandra@gmail.com

TEMPERATURE AND RAINFALL EFFECTS ON OVIPOSITION DENSITY OF *Armigeres subalbatus* IN GELIOYA, SRI LANKA

A. Imtiaz* and S.K. Wijesekara

Department of Zoology, The Open University of Sri Lanka, Sri Lanka

Climate change is expected to have a considerable impact on mosquito population dynamics. This underscores the necessity of gaining better understanding of the biology and behaviour of ***Armigeres subalbatus*** mosquitoes, which are vectors for several ***diseases including*** **Brugia pahangi**. The purpose of this study was to link meteorological factors and *Ar. subalbatus* oviposition density to examine the potential effects of temperature and rainfall.

In this study, we conducted hourly ovitrap surveillance in Kandy, Sri Lanka for seven diel cycles to investigate the oviposition activity of *Ar. subalbatus*, which is the most prevalent vector species in this area. Ovitrap collections were made hourly for seven 24-hour cycles, with eggs counted on absorbent paper. Pearson Correlation test at a 0.05 significance level was used to explore the relationships between temperature and rainfall and oviposition density.

Our results confirmed the biphasic crepuscular behaviour of *Ar. subalbatus* with a small peak of oviposition activity at dawn and a larger peak at dusk. Hourly maximum temperatures showed a negligible correlation to egg population ($r=0.054$, $P= 0.802$) while a marginally positive trend was observed between rainfall and egg population ($r=0.221$, $P= 0.3$), suggesting that rainfall may play a role in the population dynamics of *Ar. subalbatus*. Rainfall provides breeding sites, hatching of eggs following oviposition while temperature affects mosquito activity and development.

The results highlight the importance of rainfall as a factor that can have a potential impact on mosquito population dynamics and subsequent spread of mosquito-borne diseases.

Keywords: Temperature, Rainfall, Oviposition, *Armigeres subalbatus*

* *Corresponding Author:* *asnaimtiaz836@gmail.com*

QUANTUM MECHANICS / MOLECULAR MECHANICS STUDY ON SELECTED NUTRACEUTICALS TARGETING MITOCHONDRIAL DYSFUNCTION-RELATED PROTEINS IN ALZHEIMER'S DISEASE

D. R. H. Sirimanna[1], R. Dushanan[2], D. P. W. Jayatunga[1]* and R. Senthilnithy[2]

[1]Genetics and Molecular Biology Unit, University of Sri Jayewardenepura, Sri Lanka

[2]Department of Chemistry, The Open University of Sri Lanka, Sri Lanka

Several pathways are related to Alzheimer's Disease (AD) progression, and previous studies have confirmed mitochondrial dysfunction as a potential therapeutic target for AD. The objective of this study was to solidify the results obtained from a previous *in-vitro* study targeting AD. This study is focused on four major proteins, namely Sirtuin-1, Sirtuin-3 (SIRT1/3), Adenosine monophosphate-activated kinase (AMPK), and PTEN-induced kinase 1 (PINK1) related to mitochondrial dysfunction pathways and the activity of the nutraceuticals, Urolithin-A, Luteolin, Docosahexaenoic acid (DHA) and Resveratrol. Quantum Mechanics / Molecular Mechanics (QM/MM) ONIOM (our own N-layered Integrated molecular Orbital and Molecular mechanics) calculations are used to assess the binding affinity of ligands with the target proteins. ONIOM calculation enables the application of Density Functional Theory (DFT) and molecular mechanics to be applied to different parts of the ligand-protein complex. Initially, the ligands were docked to the target proteins using the Schrodinger software. The docked poses were used to perform the ONIOM calculation using the two-layer method of Gaussian software. The QM/MM ONIOM calculations on SIRT1, SIRT3, and AMPK proteins selectively had a high binding affinity to ligands, while the PINK1 protein had a low affinity to all ligands. The binding interaction energy of SIRT1 with DHA is -19.39 kcal/mol, SIRT3 with Resveratrol is -18.14 kcal/mol, and AMPK with Urolithin A is -1.87 kcal/mol, also related to the *in-vitro* cell viability results of the human neuroblastoma cell line pre-treated with the specific ligand. The proteins have shown a binding affinity trend of SIRT1 > SIRT3 > AMPK, specifically binding to selective ligands and the possible activation of Sirtuin family-related mitochondrial biogenesis and mitophagy pathways. Therefore, further *in-silico* analyses together with *in-vitro* and *in-vivo* are needed to ensure the efficacy of these nutraceuticals, which may be improved as potential AD-related therapeutic approaches to enhance the functional mitochondrial mass in diseased neurons.

Keywords: Alzheimer's Disease, Mitophagy, ONIOM calculation, QM/MM, Density Functional Theory (DFT)

**Corresponding Author: pamoda@sci.sjp.ac.lk*

FREE RADICAL SCAVENGING ACTIVITY AND TOTAL PHENOLIC CONTENT OF METHANOL EXTRACT OF *Dillenia retusa* FRUITS

H.M.C.K. Herath[1], S.K. Rodrigo[1*], and U. L. B. Jayasinghe[2]
[1]Department of Chemistry, The Open University of Sri Lanka, Sri Lanka
[2]National Institute of Fundamental Studies, Sri Lanka

The *Dillenia retusa* (Dilleniaceae), “Godapara", is an endemic plant in Sri Lanka and extensively used in traditional medicines against a plethora of human ailments. The antioxidant compounds can either completely prevent or slow down cell damages caused by free radicals avoiding inflammation and other relevant diseases. In this study, methanolic extract of *D. retusa* fruits was evaluated for antioxidant activity and total phenolic content using ascorbic acid as the positive control. The total phenolic content of the methanol extract was determined by the Folin–Ciocalteu assay, and the result was expressed as a ratio of gallic acid equivalents to dry weight of the crude extract (GAE/DW). The antioxidant activity of the methanol extract was determined by the 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging assay. The methanol extract exhibited a significant antioxidant activity, with an IC50 value of 3.46 ± 0.65 ppm compared to the positive control, Ascorbic acid (IC50 value of 37.26±4.34 ppm). These results suggest that the methanol extract of *D. retusa* fruits has a high potential to function as a natural antioxidant. The total phenolic content of the extract was 340.44 mg GAE/g DW which is relatively high compared to other fruit extracts found in the literature. The high phenolic content indicates that the extract contains a significant number of phenolic compounds that may contribute to its antioxidant activity. Overall, these investigations showed that the methanol extract of *D. retusa* fruits has a potent antioxidant activity and a high total phenolic content. The results suggest that the extract may be used as a natural alternative for synthetic drugs of antioxidant. The active compounds responsible for these properties have yet to be isolated and identified.

Keywords: DPPH, Gallic Acid Equivalent, Folin–Ciocalteu, Natural Alternative for Synthetic Drug

[*]*Corresponding Author: srodr@ou.ac.lk*

TAXONOMIC DIVERSITY AND COMPOSITION OF SCIAENIDS IN THE SHRIMP TRAWL BY-CATCH OFF HENDALA, SRI LANKA

N.M.S. Jayasekara* and D.C.T. Dissanayake
Department of Zoology, University of Sri Jayewardenepura, Gangodawila, Nugegoda, Sri Lanka

By-catch is a common problem in all fisheries particularly in trawling. Species belonging to the family Sciaenidae are reported to be abundant in shrimp trawl by-catch worldwide. This study analyzed the taxonomic diversity and composition of the sciaenids in the shrimp trawl by-catch, off Hendala, Sri Lanka. Data were collected bi-weekly at the Hendala fish landing site from January to December 2021. About 50-60% of the landed shrimp trawlers was sampled randomly to collect catch and effort data (average daily landed boats=65). Sciaenid samples (n=3) of each ~2 kg was collected randomly from the sampled trawlers. External morphology, swim bladder characteristics and sagitta of the inner ear were used in taxonomic identification. The shrimp to by-catch ratio for the study period was 1: 1 and was as high as 1: 4.5 during the northeast monsoon period. Sciaenid species made the highest contribution (31%) to the shrimp trawl by-catch. 14 Sciaenid species belonging to 8 genera were reported in the by-catch. *Otolithes ruber* (27%) reported the highest contribution followed by *Kathala axillaris* (21%), *Johnius belangerii* (15%), *Johnius macropterus* (15%), *Johnius (Johnieops) borneensis* (10%), *Johnius (Johnieops) dussumieri* (6%) and *Nibea maculata* (1%). Other identified species include *Johnius carouna*, *Johnius amblycephalus*, *Johnius carutta*, *Nibea soldado*, *Pennahia anea*, *Protonibea diacanthus* and *Daysciaena albida*. *Johnius (Johnieops) dussumieri* reported in this study is a new record to Sri Lanka as per the available literature. Sciaenids in the trawl by-catch are mainly used for human consumption. The average price of 1 kg of by-catch is ~Rs.150.00. *P. diacanthus* and *D. albida* grow larger in size (5-25 kg) than the other species (50-400 g) and they have a high economic value (~Rs.2000.00 per kg) as their swim bladder is used for fish maw production. Assessment of impact on Sciaenids from shrimp trawl fishery is a timely need.

Keywords: By-catch, Trawl Fishery, Sciaenidae, Fish Maw, Hendala

**Corresponding Author:* *madhavisulochana97@gmail.com*

ELCTROSPUN NANOFIBRES FOR CO–ENCAPSULATION OF CURCUMIN AND PIPERINE

U.B.H.G.R.L. Bokalawela[1], Sanjeewa K. Rodrigo[1]* and G.K. Rohan Senadeera[2]

[1]Department of Chemistry, [2]Department of Physics, Faculty of Natural Sciences, The Open University of Sri Lanka, Sri Lanka

Curcumin is the major chemical compound found in turmeric (Curcuma longa). It shows anti-cancer, antioxidant, anti-inflammatory and antibacterial effects. However, it suffers drawbacks such as low solubility, poor bioavailability and rapid metabolism to tetrahydro curcumin and phase II glucuronidation in the liver. Studies show that piperine improves the bioavailability of curcumin. Hence, the right combination of curcumin and piperine will resolve the said issues associated with curcumin. This study aims to develop curcumin and piperine-loaded PVA (polyvinyl alcohol) nanofibers using the electrospinning technique in which curcumin is loaded to the core and piperine to the sheath of the nanofibre. Curcumin was extracted into ethanol using the Soxhlet extraction method from dry turmeric rhizomes and dried ground black pepper seed powder was refluxed with dichloromethane to isolate piperine and purified by recrystallization. The presence of piperine and curcumin was confirmed with UV-vis and FT-IR spectroscopies. Fabrications of nanofibres were carried out under different electrospinning and experimental conditions to counter the transition phase from coaxial electrospray to coaxial electrospinning. The fibre was developed by electrospinning technique with various formulation parameters like concentration of PVA, curcumin, piperine, dichloromethane and isopropyl alcohol. Also, preparation parameters like applied voltage, needle tip to collector distance and flow rate of the solutions. The developed fibres were morphologically characterized using SEM. Polyvinyl alcohol-based curcumin in the core and polyvinyl alcohol-based piperine in the outer layer fibres showed better distribution in fibre-diameter in the range of 0.0 to 0.5 μm.

Keywords: curcumin, piperine, polyvinyl alcohol, co-encapsulation, electrospinning, coaxial electrospinning

**Corresponding Author: srodr@ou.ac.lk*

EVOLUTIONARY RELATIONSHIPS AMONG THE REGIONAL POPULATIONS OF *Turdoides affinis taprobanus* IN SRI LANKA, REVEALED THROUGH MORPHOLOGY AND GENETIC CHARACTERISTICS

T. Illesinghe*, P. Atapattu, and T.S.P. Fernando
Department of Zoology, The Open University of Sri Lanka, Sri Lanka

Turdoides affinis (Yellow-billed babbler) is a member of the family Leiothrichidae, which is endemic to Southern India and Sri Lanka. The objective of this project was to study the morphological and genetic characteristics of *Turdoides affinis taprobanus*, the Sri Lankan subspecies and hence to evaluate the intraspecific relationships between the regional populations in Sri Lanka. Field sampling was carried out in Jaffna, Pooneryn, Mannar, Hiyare Sanctuary and Colombo city areas. Each captured bird using mist netting method was sampled for 10 morphometric parameters and plumage colourations focusing on 21 identified areas of the body *in situ*. DNA was isolated from a total of 15 blood samples (3 from each site) drawn from a wing vein of the captured birds (40µl) using QIAGEN DNeasy blood and tissue kit, a 653 bp region of CO1 subunit was PCR amplified using primer combinations BirdF1 (TTCTCCAACCACAAAGACATTGGCAC) and BirdR1 (ACGTGGGAGATAATTCCAAATCCTG) and visualized through agarose gel electrophoresis. The PCR products were sequenced and were aligned using the BioEdit software. Sequences for the Indian species were downloaded from NCBI GenBank and all the sequences were aligned with clustalW in Mega 5.5. Phylogenetic trees were generated using RaxML using rapid bootstrap, for 1000 replicates with the GTR+G model using different outgroup species. Morphologically and plumage-wise, a significant difference exists between the Northern population and the Southern population. Body size, beak and tail lengths were significantly higher in Jaffna population than that of Galle ($P < 0.001$). Even though there's a considerable genetic difference between the Indian subspecies and Sri Lankan species, the molecular phylogenetic analysis implies that the Northern and Southern populations have no significant genetic divergence in mitochondrial CO1 gene, because all the Sri Lankan populations are placed in two clades, each with > 98% bootstrap support, though they showed a significant morphological and plumage difference. In conclusion, this study demonstrates a clear illustration of local adaptation of regional populations of *Turdoides affinis taprobanus* in Sri Lanka leading to isolation by distance and resulting in phenotypic variation.

Key words: Genetic Characteristics, Morphology, Yellow-billed Babbler

**Corresponding Author: tharushirukshani97@gmail.com*

EDUCATION

ACTIVITY BASED TEACHING PEDAGOGY FOR ENGLISH LANGUAGE TEACHING - FOR LEARNERS IN HIGHER EDUCATION; A CASE STUDY OF THE STUDENTS IN BATCH 11 OF THE FACULTY OF MANAGEMENT IN HORIZON CAMPUS

Chrishankar Janathanan*
Management Faculty, Horizon Campus, Sri Lanka

Knowledge of the English language has been a primary challenge in the Sri Lankan context. This is due to the existence of Sri Lanka's native language-based teaching (L1) strategy during primary and secondary school education. School education is largely based on mother tongue (L1) for the vast majority. English language was introduced to learners as a link language in Grade 5 with the 1997 Educational reforms. This presents a greater challenge to learners who have come from the context of schools that do not have access to proficient teachers, systems that encourage English language teaching, a societal background that could promote and implement English language-based education. Activity based learning has been widely discussed in the field of educational learning. The application of Activity based learning has been focused on the aspect of technology adoption (mLearning), problem-based learning, collaborative learning, communicative approach, use of podcasts, project-based learning methods, online vocabulary tools and games. However, in all of this coverage, though activity-based learning is appreciated, there is no set template or model for an educator to follow. While each teaching practitioner is required to understand the classroom, it is quite important for the teaching pedagogy to improve. The research aims to understand an effective model for building the capability of learners and to create a theoretical model for teaching English to learners from native L1 socio-economic backgrounds. The primary research objectives are to understand the effectiveness of the activity-based learning model on the student's English Language proficiency, determine how activity-based learning can promote the student's motivation to learn English, gauge the efficacy of activity-based learning in imparting knowledge, skills to the learners and recognise challenges and limitations. The research involved an action research study. Observations are recorded by the research author. The skill building capability is accessed by the submission of logbooks. Learner's capability adaptation was evaluated with a series of activities conducted via in-class speech presentation and logbook which records a series of activities. On findings, the research uncovered that a weekly submission of work will improve the student's engagement with the learning activity. Weekly submissions and in-class activities when promoted with positive encouragement will lead to a positive outcome. Stage fright, fear of making mistakes, peer pressure are all considerable challenges that are to be considered by a future trainer. The logbook which records the weekly progress of students was an immensely positive tool. Peer pressure worked positively as the learners who did not submit felt left out. Therefore, it increased the rates of submission. Further, pinning the assessments to internal grades further

disarmed the peer pressure experienced by learners as all learners understood that grades were the outcome of their academic practice.

Keywords: Activity-based Learning, English Language teaching (L2), Teaching English for Foreign learners

*Corresponding Author: chris.30dec@gmail.com

A COMPARISON OF THE Z-SCORE METHOD AND THE AGGREGATE RAW MARKS METHOD: A CASE STUDY

W.A.J.R Silva[1] and B.M.S.G. Banneheka[2*]

[1]Faculty of Graduate Studies, University of Sri Jayewardenepura, Nugegoda, Sri Lanka

[2]Department of Statistics, Faculty of Applied Sciences, University of Sri Jayewardenepura, Nugegoda, Sri Lanka

The currently used z-score method to select candidates to state universities in Sri Lanka was introduced in 2001 as a solution to the problem of undue competitive advantage that may accrue to some candidates by offering easy subjects, when the aggregate method was used. The expected effect of the z-score method was to provide a higher chance of selection for a student who has got x marks for a difficult subject than for a student who has got the same marks for an easy subject. The objective of this study was to explore whether this expectation has been realized in selecting candidates to biological science degree program. The chances of candidates being selected to the biological science degree program from the two competing combinations "Chemistry, Biology, Physics (CBP)" and "Chemistry, Biology, Agriculture (CBA)" based on the z-score method and the aggregate raw marks method were compared using the raw marks from 2014 to 2018, obtained from the Department of Examinations. The aggregate marks and z-scores were calculated for all the candidates in the above two combinations. Assuming 35 as the pass mark for all the subjects, those who failed at least one subject were omitted. Since the students in CBP could apply for medical, dental and veterinary sciences, the top n students were omitted from that combination. The remaining students in both combinations were combined into one group and the top m students were selected for the biological sciences, separately based on the aggregate marks and z-scores. The numbers n and m were obtained from the documents published by the university grants commission of Sri Lanka. Physics is generally considered as more difficult than Agriculture. However, the z-score method has reduced the chance of those in CBP by 0.032% and increased the chance of those in CBA by 0.234%, on average. This shows that the z-score method has failed to deliver the expected outcome. Instead, it has delivered the opposite of what was expected. This is the first time this adverse effect of the z-score method is pointed out using the real data.

Keywords: University Selection, Competitive Advantage, Chance of Selection

[*]*Corresponding Author:* *sarath.banneheka@sjp.ac.lk*

IMPACT OF GRADE LEVEL ON ENVIRONMENTAL ATTITUDES AMONG STUDENTS: AN ANALYSIS OF MULTIPLE AGE GROUPS

U. Mathura* and K. Piratheeban

Department of Education, University of Jaffna, Sri Lanka

A healthy and productive environment is considered the key to a sustainable human life. In order to provide adequate education on environment, environmental education is being introduced and followed in the curriculum of many countries. The Sri Lankan curriculum also has environmental education not as a separate subject but as a coordinated subject with Science and other subjects. This study was designed as a survey study under the quantitative approach to explore the impact of grade level on the environmental attitudes of students. Out of a total population of 1078 students, 285 students were selected as a sample through a stratified random sampling technique for this study. The questionnaire consisted of fifteen Likert-type questions on attitudes towards eco-friendly behaviours that were adapted from the questionnaire prepared by and modified as per the Sri Lankan context. Reliability was determined by the Cronbach Alpha test (0.749). Descriptive statistical techniques and inferential techniques such as the One-way ANOVA test and Post-Hoc LSD test were used for the analysis of collected data. Based on the significant value, no significant differences were observed for the following variables between the grades of secondary level students ($P>0.05$): Reading environmental-related news and articles while reading newspaper, switching off the television when no one is watching, preferring to walk to nearby places rather than going in a motorbike or other vehicles, not liking to drink anything in one-day cup at any ceremony, buying soft drinks in glass bottles or cans rather than plastic bottles, using one-side used papers for studies or Math practice, carrying re-usable shopping bags while going shopping and throwing wrapping papers and cover papers of food items in dustbins based on biodegradable and non-biodegradable varieties. However, significant differences were observed of the other seven environmental attitudes of the secondary level students and some of the grades ($P<0.05$). Though environmental concepts are in the curriculum from Grade Six to Eleven with the hope of involving students as partners of the environment, some grades did not show significant differences. Therefore, an emphasis on environmental concepts in the existing curriculum should be given to build positive environmental attitudes among school students in their respective grades.

Keywords: environment, environmental attitude, secondary level students, environmental behavior, Science-curriculum

**Corresponding Author: uruthirathasan.mathura@gmail.com*

EFFICACY OF APPLYING REFLECTIVE DIALOGUE ON UNDERGRADUATES' LEARNING ATTRIBUTES IN *AYURVEDA RASA SHASTHRA*

U.R.S.R.K. Senarathne*

Department of Ayurveda Pharmacology, Pharmaceutics and Community Medicine, Faculty of Indigenous Medicine, University of Colombo, Sri Lanka

The experience of more informative lectures given to the students under the topic of Appliance (*Yantra* used is *Ayurveda Rasa Shastra*) has shown less effectiveness in the assessment from a previous batch of undergraduates. Though the students could retrieve the information, creativity and applicability like high level of learning objectives have not been well performed. It was realized that silent listeners and passive learners can achieve only the low level of learning outcomes mentioned in Bloom's Taxonomy. To improve the undergraduates' attributes of retention, identification, application and innovation regarding ancient appliances used in *Ayurveda Rasa Shasthra* (Alchemy), the reflective dialogue method of active learning was applied. The expected undergraduate batch (n=168) was considered as research group A and the previous parallel batch which was learned without using this method was taken as group B (n=159). Group A encouraged self-reflection and peer dialogue about the subject matter by providing subject guidelines three days before the scheduled lecture. Dialogue with the lecture was continued at the beginning of the lecture, during each important point, and at the end of the lecture. Randomly selected two students got the opportunity of discussion per each point. Cognitive levels of students' learning in both groups were assessed by the structured essay questions created by following the stages of Bloom's Taxonomy. Results were compared by using paired and unpaired t–test. The overall marks earned by Group A were higher than Group B. There was a significant difference between the two clusters. Similarly, there was a significant difference among the levels when the questions went up to the upper hierarchical planes. The mean difference between each level of the corresponding groups again exhibited a significant difference when doing the evaluation. ($p < 0.001$). The reflective dialogue method of active learning was more effective than teacher-oriented learning, and the students' applicable knowledge of *Yantra* and the novel invention of appliances were enhanced by the discussion method.

Keywords: Reflective dialogue, active learning, Bloom's Taxonomy, Ayurveda Rasa Shasthra, innovation

**Corresponding Author: kumarisenarathne@fim.cmb.ac.lk*

A NEW OPTIMAL SUMMARY MEASURE FOR LIKERT SCALE STUDENT EVALUATIONS OF TEACHING

Thisaakhya Jayakody* and B.M.S.G. Banneheka
Department of Statistics, Faculty of Applied Sciences, University of Sri Jayewardenepura, Nugegoda, Sri Lanka

Student evaluations of teaching (SET) is one of the oldest techniques used to assess lecturer performance in universities around the globe and it plays a crucial role in the Sri Lankan state university system as a critical quality assurance measure. However, universities continue to use incorrect summary measures to analyze student responses which in turn leads to incorrect decision making and other critical errors. The objective of this study was to identify a population parameter to represent the most deserving response to a question with 5-point Likert scale choices in a student feedback form and an optimal estimator for the same. The population mean and population median as parameters with corresponding estimators sample mean and sample median and the population mode as a parameter with sample mode and a newly introduced adjusted sample mode as estimators, were considered. The responses to a question with 5-point Likert scale choices were considered as the rounded integer values of a random variable that follows some continuous distribution on the support. The bias and the root mean squared error (RMSE) of each estimator were estimated based on 10000 samples of size 50 from the truncated normal distribution truncated at 1 and 5. Simulations were done by fixing the value of each parameter at every possible student response. The population mean and median never take values 1 or 5. Hence they are not suitable when the deserving response is 1 or 5. Therefore, they were rejected even though their estimators perform well when the corresponding parameters are in the interval. The population mode can be any value in the interval. Hence it is suitable to represent the deserving response. Out of its two estimators, the adjusted sample mode was found to be an optimal estimator with a smaller bias and RMSE. These findings are discussed with the intention of developing a performance index to quantify students' perception regarding a lecturer in the future.

Keywords: SET, Student Feedback, Simulations, Optimal Estimator, Truncated Normal

**Corresponding Author: thisaakhya@gmail.com*

ASSESSING LEARNERS' SATISFACTION WITH ZOOM-BASED COURSE DELIVERY

F. M. Nawastheen[1*] and K. Ketheeswaran[2]

[1] Department of Secondary & Tertiary Education,

[2] Department of Special Needs Education, Faculty of Education, The Open University of Sri Lanka, Sri Lanka

This study examines the satisfaction of postgraduate students in Sri Lanka with Zoom-based online teaching and assessment practices during the COVID-19 pandemic. The Faculty of Education at The Open University of Sri Lanka transitioned to online teaching using Zoom technology due to the pandemic. This study aimed to investigate students' satisfaction levels regarding the quality of online teaching using Zoom-based instruction. A survey research design with a quantitative approach was employed, and an online questionnaire was used to collect the data from the participants. Data was collected from 189 postgraduate students enrolled in the Master of Education, and Master of Education in Special Needs Education programs across Sinhala, Tamil, and English mediums. Closed-ended questions, Likert-type scale items, and open-ended questions were used to collect data, which was analyzed using descriptive statistics. The results indicate that students generally perceived Zoom-based instruction as effective and positive; however, some areas for improvement were identified, such as technical difficulties, course material, coverage, and communication. Additionally, students were satisfied with the assessment practices but had differing views on other aspects. Findings of the study provide valuable insights into improving online teaching quality and enhancing students' engagement in the learning process. Therefore, it is recommended to evaluate learners' satisfaction levels in the context of Zoom-based teaching and assessment for undergraduate programs, as well as other faculties' programs of the OUSL.

Keywords: Level of Satisfaction, Online Teaching, Zoom-Based Teaching

[*] *Corresponding Author: fmnaw@ou.ac.lk*

BRONFENBRENNER'S ECOLOGICAL SYSTEMS THEORY AND STUDENT MOTIVATION

K.D.R.L.J. Perera*

Department of Secondary and Tertiary Education, Faculty of Education, The Open University of Sri Lanka, Sri Lanka

Bronfenbrenner (1979) in his Ecological Systems Theory offers an important contribution to the interplay between an individual and its immediate environment. This model includes both the idea of bidirectional influence, which takes into account both the influence of the environment on the person and the mutual influence of the person on the environment, and the idea of indirect influence. Ecological Model of human development deals with the quality of a child's environment and how development is subject to multiple levels of influence, that is, the micro system, meso system, exo system, and macro system. The main research question is; How the different levels of Bronfenbrenner's ecological systems theory impact for students' (at any stage) motivation in learning? In this study systematic review method was applied. This literature review mainly attentive on books and research articles that investigated the Bronfenbrenner's ecological systems theory and students' motivation. They were reviewed, and the findings following the reviewed literature are presented based on the identified research question. Variables such as school subject and the type of lesson or work certainly belong to the most critical elements of the learning context at the micro-level. At meso level teachers' attitudes and behaviours, students' perception of the classroom climate or environment, as well as the classroom goal structure, norms, and practices, belong to a second level of contextual variables. In exo level changes in the organisation and structure of school, when moving from elementary to middle or high school, involvement in a special programme or section, have been found to influence students' perceptions of school and attitudes towards school work. Macro level contexts refer to out-of-school environmental characteristics such as familial, cultural, economic, or political variables. It could be concluded that Bronfenbrenner's Ecological Systems Theory explains student's motivation in learning at all the stages. It is implied that even though there are criticisms existing for Bronfenbrenner's Ecological Systems Theory, each and every system mentioned in the theory plays an important role in students' motivation in learning, thus these systems should be enhanced.

Keywords: Ecological Systems Theory, Micro system, Meso system, Exo system, Macro system, Students Motivation

* *Corresponding Author: kdper@ou.ac.lk*

A LITERATURE REVIEW ON QUESTION MANAGEMENT SYSTEMS IN ONLINE PROCTORING FOR ACADEMIC ASSESSMENTS

R.A.D.V.G. Ranathunga* and K.P. Hewagamage
School of Computing, University of Colombo, Sri Lanka

In response to the COVID-19 pandemic in 2019, education shifted from onsite to online learning. Online education has advantages but also challenges, especially regarding academic integrity. Academic dishonesty, like collusion, impersonation, and file sharing, is a significant malpractice in online assessments. This study explores the role of quiz generation systems in combating academic dishonesty and improving prevention efforts. Existing systems lack student engagement and robust authentication. Current question generation systems fall short in ensuring a secure assessment environment, hampering student participation and proctoring during online exams. Through a comprehensive literature review, this research identifies shortcomings in existing question generation systems and emphasizes the need for improvement. By developing an innovative system to fill these gaps, the study aims to raise standards in online education, ensuring fairness and security in evaluation for students and institutions. This effort is a crucial step in preserving the authenticity and quality of education in the digital age.

Keywords: E-learning, Academic dishonesty, Examination management system

**Corresponding Author: vinuog8@gmail.com*

SELF-REGULATED LEARNING STRATEGIES PRACTICED BY STUDENTS STUDYING FOR G.C.E O/L

A.C. R Amina*, G.D.Lekamge and D.V.M. De Silva
Faculty of Education, The Open University of Sri Lanka, Sri Lanka

The percentage of students passing mathematics and science in G.C.E O/L has been low over the past years. Among many reasons for students to fail, lack of the practice of self-regulated learning strategies is one of the reasons. Hence, this study aimed to identify various forms of self-regulatory learning (SRL) strategies practiced by students studying for O/L examination and to investigate the factors that would facilitate self–regulated learning strategies relating to student academic achievement. The study adopted an explanatory sequential design. The participants of the study were 440 grade 11 students from the Colombo zone. Academic achievement was measured by the scores of mathematics and science in the 3rd term exam and calculating the Z- scores out of it. The students with a positive Z-score were labelled as high achievers and the students with a negative Z- score were labelled as low achievers.The Motivated Strategies for Learning questionnaire was used to find out the students' self-regulated learning strategies, and the self-developed questionnaire was used to investigate the factors that facilitate SRL. Further, focus group interviews for students and semi-structured interviews for teachers were used to triangulate data. Data were analyzed quantitatively using tables and charts from SPSS and qualitatively using content analysis. The findings revealed that the self – regulated learning strategies that were mostly practiced by students were rehearsal, elaboration, organization, critical thinking meta-cognition, time and environment management, effort regulation, peer learning and help-seeking strategies. According to this finding, it is clear that all nine strategies were practiced by high achievers but it is important to note that critical thinking was the strategy barely practiced by the students. Low achievers have practiced only five out of the nine self-regulated learning strategies. The study found that goal setting and employment perspective, motivation, and seeking help from teachers and parents are factors that facilitate self-regulated learning.

Keywords: Self-regulated learning (SRL), Strategies, Academic Achievement

* *Corresponding Author: aamina.cader@gmail.com*

AN EVALUATION OF THE QUALITY OF ACTION RESEARCH PROJECT REPORTS IN BACHELOR OF EDUCATION (HONS.) IN SPECIAL NEEDS EDUCATION DEGREE PROGRAMME

S.N. Jayasinghe [1], K. Ketheeswaran [2*], H.D.C. Priyadharshani [2], R.S. Jenorge [2] and D.M.G. Ranasinghe [2]

[1] Department of Secondary & Tertiary Education,

[2] Department of Special Needs Education, Faculty of Education, The Open University of Sri Lanka, Sri Lanka

The action research project is a major component in the Bachelor of Education (Hons.) in Special Needs Education (BEDSNE) Degree programme offered by the Department of Special Needs Education, the Open University of Sri Lanka. The study was conducted based on the requests and comments of supervisors of the BEDSNE pogramme. This study aimed to evaluate the quality of the action research projects which were completed by students (The academic year 2021/2022). The research followed a quantitative approach, and a survey design was used. All 78 action research project reports were purposively selected for the documentary survey. The primary data were collected by documentary survey using 50 standard criteria to evaluate the quality of the action research project reports. This study revealed that the categories of the factors of the reports are average and less than average in quality. The stranded deviations of almost one and above, it also strong evidence of the deviation in quality of the factors in the action research project reports. As a recommendation, the Department of Special Needs Education has to take action to improve the quality of action research projects in the future by developing proper guidelines for action research projects and conducting more sessions in relation to the action research project.

Keywords: Action Research Project Reports, Quality, Special Needs Education.

[*] *Corresponding Author: kketh@ou.ac.lk*

SYSTEMATIC REVIEW ON HIGH DROPOUT RATES IN MOOCS – REASONS AND SOLUTIONS

N.G.L.S.J. Liyanage*, K.A.D. Sandamali and W.M.A.P.S. Fernando
Department of Secondary and Tertiary Education, Faculty of Education, The Open University of Sri Lanka, Sri Lanka

Massive open online courses (MOOCs) are among the modern learning initiative that has gained wide popularity in higher education. They play a key role in encouraging self-regulated learning. There is considerable growth in using MOOCs in universities with the rapid development of technology-integrated education. In today's pandemic environment, it is impossible to conduct face-to-face learning sessions. As a solution, MOOCs can be used effectively in blended learning. The availability of many courses on various topics, support from the multilingual interface, flexibility in the mode of learning with study materials, the opportunity to join the courses created by teachers of leading educational institutions, availability of multimedia and interactive tools, and the opportunity to obtain a certificate at the end of the course are some advantages of this MOOC courses. However, one of the drawbacks of using MOOCs is the high student dropout rate. This research study aims at exploring the main reasons for the high MOOC dropout rates and solutions to minimize such dropouts. A semi-systematic review strategy was utilized in conducting the current study. Most of the examined literature was presented in online journals. The data gathered through the systematic review was analysed using qualitative analysis methods. The findings of the study reveal various factors related to the dropout rate of the students in MOOCs under various dimensions such as family-related factors, personal factors, factors related to the course structure and factors related to the teaching-learning process. Introducing a prediction model to identify learners who are at risk for attrition and implementing precautionary interventions, using adaptive approaches such as gamification, increasing cooperation activities, encouraging peer learning, and creating a learner-friendly interface are some solutions that emerged from the review of the literature.

Keywords: MOOCs, dropout rates, solutions, factors behind high MOOC dropout rate

**Corresponding Author: ngliy@ou.ac.lk*

TEACHING PRACTICUM: BUILDING A UNIVERSITY -SCHOOL PARTNERSHIP

W.M.S. Weerakoon*, N.M.R.K. Nawarathna and K.A.D. Sandamali
Department of Secondary and Tertiary Education, Faculty of Education, The Open University of Sri Lanka, Sri Lanka

Teaching practicum plays a significant role in teacher education programmes and helps to upgrade the professional capacities and competencies of student teachers. The primary goal of teaching practicum is to provide student teachers within a classroom setting. The Teaching practicum is considered a vital component of all the teacher education progrmmes offered by all the departments of the Faculty of Education, of the Open University of Sri Lanka. Although it has been given considerable volume of attention for the teaching practicum, it is being identified that, an intentional and strategical effort has not been taken to build and uphold sound university- school partnership to improve the efficiency and the effectiveness of teaching practicum. As mentioned by Lynch et.al (2012), As initial teacher education students transition to the profession, the experiences offered by the university and partner institutions require intentional, careful, and strategic planning, to ensure positive relational, organizational, and pedagogical experiences for all stakeholders. As emphasized by much empirical research, many countries have developed their own models to build and ensure university-school partnership. The university-school partnership has become a powerful model of professional development. Examples include the professional development school (PDS) movement in the USA, the partnership between higher education institutions and schools for initial teacher education as mandated in England and Wales, and the innovative Links Projects in Australia. the framing of strong, valuable, and effective partnerships that capitalize on the differing strengths of universities and schools in shaping quality teachers. According to, Partnerships that incorporate the community, school, and university are becoming increasingly significant in teacher education programs and are thought to be significant in addressing teacher quality. Hence, university-school partnerships have become important for professional development and educational reform. Adopting a qualitative research paradigm, current study aimed to investigate the possibilities of introducing one such university-school partnership model to the teaching practicum components of the faculty of Education to improve the efficacy of all teacher education programme. The data were collected through focused group discussion of school mentors, master teachers, and university academics were analysed through thematic content analysis. Findings revealed that, more important and ground-breaking strategies have been presented by the relevant stakeholders to stablish and maintain strong university- school partnership aiming an efficient and effective teaching practicum. Based on the strategies, it was able to conceptualize the outcome-based framework/model to build university-school partnership in relation to the teaching practicum of all teacher education programmes delivered by the faculty of education, OUSL.

Keywords: - Professional development, Teacher Education, Teaching Practicum, professional competencies. School-university partnership

**Corresponding Author: wmwee@ou.ac.lk*

IS EDUCATION A RIGHT OR A PRIVILEGE? A CRITICAL PERSPECTIVE OF THE SRI LANKAN UNIVERSITY EDUCATION SYSTEM DURING THE CURRENT ECONOMIC CRISIS

S.S. Hapuarachchi[1*] and F.F. Fairooz[2]

[1]The Open University of Sri Lanka, [2]NSBM Green University, Sri Lanka

The current economic crisis, which has affected citizens both globally and locally, has had a detrimental effect on all domains of human life, including the education sector. Sri Lanka, as a developing country, is severely affected by this economic crisis which has resulted in driving a greater part of the Sri Lankan student community, including those in tertiary education, into a dire state. Hence, students are now being forced to run the extra mile to make ends meet to ensure a holistic learning experience, despite being a part of the free education system, which Sri Lanka proudly claims to offer. As discussed in the social justice theory examined by John Rowl, education should be equal and fair to all despite individual differences, public or personal. In this light, this paper attempts to discuss how education, which is a fundamental right, is distanced from learners due to the heightened economic crisis, making it a privilege that only a handful can afford. This qualitative study was conducted using unstructured and semi-structured interview methods to collect data from sixty second year undergraduates following different degree programmes belonging to two state universities and one private university. Our findings reveal that education has become a burden for a majority of students, as even the everyday task of affording meals has become arduous. Owing to this situation students are now considering the option of dropping out of university as making a living has taken precedence over receiving an education. Therefore then, one could ask whether 'education is a right, not a privilege' still stands true.

Keywords: Education, Right, Privilege, Economic Crisis

[*]*Corresponding Author: swapnihapuarachchi@gmail.com*

ENGINEERING AND TECHNOLOGY

IMPACT OF CONSTRAINT HANDLING TECHNIQUES ON THE SOLUTION QUALITY OF MICROGRID SIZING & ENERGY MANAGEMENT SYSTEM OPTIMISATION

Kumudu Amarawardhana*, Hossein Enshaei, Shantha Jayasinghe and Alan Fleming

Australian Maritime College, University of Tasmania, Newnham, TAS 7248, Australia

Constraint handling techniques (CHTs) are crucial in solving microgrid sizing and energy management system (MSEMS) problems. However, CHTs' use and impact on solution quality are not explored enough. Our study compares the solution quality of three CHTs (Deb's rules, a novel repair scheme and a novel hybrid CHT) in solving a MSEMS optimisation problem. While Deb's rules sort the best solution based on the fitness and constraint violations, the proposed repair scheme repairs the infeasible solutions and returns them to the feasible region or close to it. The proposed hybrid CHT directs feasible solutions straight to Deb's rules, and it uses the repair scheme to repair infeasible solutions before directing them to Deb's rules to filter the best solution. Two performance indices were developed to evaluate the solution quality: the feasibility ratio (FR) and the constraint violation monitoring mechanism. In this study, the MSEMS problem minimises the levelized cost of electricity, loss of power supply probability, and CO_2 emissions while satisfying power balance, battery, and generator constraints. The Predator-parasite algorithm is employed to solve the MSEMS problem simulated in MATLAB, validated using actual weather data and the demand profile of Westray Island in Scotland. The simulation outcomes demonstrate that the FR through Deb's rules is 67%, limiting its capacity to converge towards feasible solutions. Nevertheless, the repair scheme enhances solution quality by increasing FR to 86%, and the hybrid CHT further improves solution quality with a FR of 99%. This improvement is further visualised through the constraint violation monitoring mechanism. The findings demonstrate that Deb's rules approach is ineffective in solving MSEMS optimisation problems of this nature and highlight the importance of CHTs in achieving quality solutions. This study's implications are significant for the energy industry, especially in microgrid control architectures, where the quality of solutions is critical in real-world applications. Therefore, this study highlights the importance of CHTs in solving MSEMS optimisation problems and demonstrates a practical hybrid CHT for achieving quality solutions. Furthermore, the proposed hybrid CHT has the potential to be used in solving problems that involve multiple constraints, making it useful in various other applications.

Keywords: Constraint handling techniques, energy management system, microgrid, optimisation, renewable energy, sizing

**Corresponding Author:* kumudua@utas.edu.au

EFFECTIVE CLASSIFICATION OF BREAST CANCER USING OUTLIER REMOVAL METHODS AND TRADITIONAL MACHINE LEARNING ALGORITHMS

M.M. Achini Nisansala*

Department of ICT, University of Vavuniya, Sri Lanka

Experimental results over the last few years report breast cancer to be the most common type of cancer diagnosed in women's bodies. Though it can arise at any age in a woman's life women over 50 years have a high risk of getting breast cancer. Around 2.3 million new cases are found every year, and among them, around 0.68 million die globally. There are two types of breast tumours: benign and malignant. Diagnosing breast cancer is kind of tough due to the compound nature of the breast cancer cells. However, the treatments for breast cancer are very effective when the disease is diagnosed at an early stage. In this study seven machine learning algorithms were used: Logistic Regression (LR), Linear Discriminant Analysis (LDA), K- Nearest Neighbor (KNN), Gaussian Naive Bayes (GN), Decision Tree Classifier (C4.5), Support Vector Classifier (SVC) and Random Forest (RF) on Wisconsin Breast Cancer Diagnostic Dataset (WBCD) collected from UCI repository for classifying the tumours into benign and malignant. This analysis was carried out in three approaches, without removing the outliers from the dataset, after removing the outliers from the dataset using the interquartile range, and after removing outliers from the dataset using the z-score treatment. Based on the analysis without removing the outliers Logistic Regression (LR) outperformed other classifiers with 95.61% accuracy. After removing the outliers in the interquartile range approach, Gaussian Naive Bayes (GN) achieved the highest accuracy of 97.09%. Z-score outlier treatment reached the highest accuracy of 97.27% among all approaches using the SVC algorithm marking it as the most appropriate method for classifying breast cancer.

Keywords: Breast Cancer, outliers, classification, accuracy

*Corresponding Author: nisansala491@gmail.com

FAILURE ANALYSIS AND PROPERTY IMPROVEMENT OF COCONUT HUSK CHIPPING BLADE

N.C. Wijesinghe[1], Galhenage A. Sewvandi[1]*and J. Adikari[2]

[1]Department of Materials Science and Engineering, Faculty of Engineering, University of Moratuwa, Sri Lanka

[2]Botanicoir Lanka (Pvt.) Ltd, Dankotuwa, Sri Lanka

The exportation of coconut-based products is one of the major foreign currency earnings in Sri Lanka. Among those products, grow bags made from coconut husk chips perform a main role. The quality of the grow bags is highly influenced by the chip quality.

Existing coconut husk chipping machines consist of two half circular blades which are encountered with unexpected production difficulties due to fractures in the blade material and low lifetime. This failure of the blade ultimately leads to enhanced production time and cost, enhanced machine downtime, reduced product quality by inefficient chipping and high wastage of input materials. However, despite this component failing frequently, industrialists have no idea about the reason for the failure or a method to avoid the failure. Therefore, the objective of this study is to identify the existing blade material, analyse the reason for the material failure and proposed a treatment to avoid the failure.

Accordingly, a detailed failure analysis was carried out using an arc spark spectrometer, optical microscope and micro hardness tester. The study found that Type 01 blade was manufactured by cold work D2 steel. The undesirable primary carbide network (coarse carbides) present in there reduces the toughness of the steel and leads to material cracking and distortions. Also, the retained austenite is present in the cold work steel at room temperature due to different cooling rates and thermal contractions between the surface and core. It produces comprehensive residual stresses that ultimately lead to a hardness gradient along the cross section of the blade. It favours the crack generation and mechanical failures of the blade due to high anisotropy. This anisotropic mechanical response along the cross-section is mainly due to material type and lack of control of thermal treatments. In order to avoid the failure, residual internal stresses and hardness gradient were eliminated by tempering at 350^{o}C.

Keywords: Coconut husk chipping blade, D2 steel, hardness gradient, Tempering

**Corresponding Author: galhenag@uom.lk*

EMPLOYABILITY SKILLS OF INFORMATION TECHNOLOGY GRADUATES – A COMPARISON OF EXPECTATIONS, PRIORITIES AND STRATEGIES

Anushka Puwakgahawela[1], Indra Mahakalanda[2*] and Vathsala Wickramasinghe[2]

[1]Department of Management of Technology,
[2]Department of Decision Sciences, University of Moratuwa, Sri Lanka

Evidence suggests that undergraduates often fail to secure employment due to the lack of the possession of employability skills. Since employability of entry-level graduates is a challenge, higher education institutes must produce graduates equipped with employability skills and reasonable expectations.

The objectives of this study are (1) to investigate employability skills required by employers, value addition imparted by the university lecturers and value brought by entry-level graduates in information technology (IT) sector in Sri Lanka, (2) to compare differences of expectations of employability skills among employers, university lecturers and final-year undergraduates, and (3) to identify strategies deployed by employers, university lecturers and final-year undergraduates to minimize the differences. The literature identifies mainly three types of employability skills, i.e., cognitive, intrapersonal, and relational, on which this study is built on.

Three representative samples were taken from employer, university lecturer and final-year undergraduate populations, and data were collected using three self-administered survey questionnaires. The findings show significant differences in the priorities given for each skill category by the three groups. The university lecturers have given a high emphasis to cognitive skills which significantly exceeds employer expectation. Undergraduates' intra- and interpersonal skills are below employer expected levels. There are some key strategies used by each party to enhance employability skills during the university tenure and after graduation. The findings led to highlight the importance of graduates marketing themselves effectively to meet employment requirements. Overall, undergraduates must have a clear view of how to secure an employment, maintain the employment and survive on the job.

Keywords: Employability Skills, IT Industry, Entry-level Graduates

[*] *Corresponding Author: indram@uom.lk*

MATERIAL DETECTING GLOVE FOR BLIND PEOPLE

W.G.J.B. Weraluange and W.D.S.S. Bandara*
Department of Electrical and Computer Engineering,
The Open University of Sri Lanka, Nawala, Nugegoda, Sri Lanka

Blind people identify materials by touching them and decide by the previous experience they have had. However, this is not an accurate method when some coatings were applied. The aim of this research was to design a material-detecting glove for blind people which will help them to understand and feel better about the surroundings.

While investigating the existing literature and technologies which support blind people, it was found that many were available to avoid obstacles but not to detect materials. Further, there were some to detect the distance and the location.

The principal theory behind the design is based on capacitive proximity sensing. First, it investigated the effects of dielectric constants of different single- and two-layer target materials for the variations of sensor head capacitance (ΔC). Then a mathematical function for ΔC was derived using the method of image theory in electrostatics for two layers of the material case. Then, the derived results were verified by simulations in MATLAB®. Finally, the plots were obtained and observations and data required for the design were collected.

A variable was derived which is used for the calibration of the sensor with respect to the different materials and was investigated through experiments carried out. By selecting the appropriate electronic components and utilizing the research data with several testing, the material-detecting glove with a wireless communication facility was designed and implemented successfully.

Keywords: material detection, capacitive proximity sensing, dielectric constant

* *Corresponding Author: wdban@ou.ac.lk*

ANAEROBIC DIGESTION AS AN EFFECTIVE METHOD FOR BIODEGRADABLE WASTE TREATMENT IN A RESIDENTIAL APARTMENT COMPLEX

K. U. C. Perera[1*] and K. A. D. C. Jayaweera[2]

[1]Department of Mathematics and Philosophy of Engineering, The Open University of Sri Lanka, Sri Lanka*

[2]Facility Management Integrated Pvt. Limited, 490, Oceanica Tower, Colombo 03, Sri Lanka

Municipal solid waste generation has created a challenging situation for modern cities to be managed in an environmentally friendly manner. Population growth and urban rural migration has created a pressure in the residential lands in cities in Sri Lanka. Residential housing complexes are constructed to cater for the rising demand for housing in cities. These housing complexes are sometimes constructed without a proper plan for waste management. This has aggravated the issues of solid waste generation in cities in Sri Lanka. The main fraction of solid waste in Sri Lanka is biodegradable waste which is more than 60% of the total waste generation. Biodegradable fraction of solid waste can be treated by thermal or biological methods. Anaerobic Digestion (AD) is a biological method to treat organic material which can be used to treat biodegradable fraction of waste. In the present study an Anaerobic Digestion system has been proposed to treat the biodegradable fraction of waste generation of Orchid II apartment complex, Malambe, Sri Lanka. The total volume of the AD reactor is 25.56 m^3 which can treat 197 kg of waste per day. The potential replacement of monthly cooking energy requirement by the generated biogas is 28 %.

Keywords: biodegradable waste, solid waste management, anaerobic digestion, biogas

**Corresponding Author : kuper@ou.ac.lk*

THE PARTIAL REPLACEMENT OF COARSE AGGREGATES BY CRUSHED ROOF CLAY TILES/CLAY BRICKS IN THE INTERLOCKING PAVING BLOCK PRODUCTION

M.R. Yasir**, and A.M.L.N. Gunathilake
Department of Civil Engineering, The Open University of Sri Lanka, Sri Lanka

Concrete interlocking paving blocks have become a popular paving material due to their attractive characteristics as a paving material. However, the scarcity of raw materials and price escalation of such materials are major challenges faced by the paving block manufacturing industry. Coarse aggregate is one such raw material.

Roof clay tile/clay brick waste generated during construction as well as during production, has good potential to be used as coarse aggregates in the production of interlocking paving blocks due to their nature of such wastes. Further, this would be an initiative towards sustainability. This potential had been highlighted by quite a few previous studies (especially in relevance to concrete) as well.

Accordingly, this study undertook the task of reviewing the possibility of the partial replacement of coarse aggregates by crushed roof clay tiles/clay bricks in the production of interlocking paving blocks. An experimental study was conducted by varying partial replacement percentages of crushed clay bricks and crushed roof clay tiles, separately. Based on the results of this study, these materials were identified to have a good potential to be used to partially replace coarse aggregates in interlocking blocks, in terms of the characteristics of the strength and skid resistance. However, there is a need for further study on this topic as it certain concerns were observed in relation to controlling water absorption, as per the results of the study.

Keywords: Interlocking blocks, coarse aggregates, sustainability

* *Corresponding Author: yaseerrazick@yahoo.com*

THE STRUCTURAL PERFORMANCE OF THE "PADMAKARA" STUPAS UNDER GRAVITY LOADING

I. Wickramanayaka* and A.M.L.N. Gunathilaka
[1]Department of Civil Engineering, The Open University of Sri Lanka, Sri Lanka

Sri Lanka is a country with one of the longest histories in giant brick structures, and most of these are Stupas. The "Padmakara" shape is one of the architectural shapes that is said to be used for the construction of stupas in Sri Lanka. However, presently there are no surviving ancient stupas that can be used to identify the exact architectural shape of this Stupa type. Some archaeologists/architects have proposed different imaginary shapes for this Stupa type. Nevertheless, any structural performance analysis of these proposed shapes has not been previously performed. Thus, this study focused on the analysis of the structural performances of different architectural models proposed for the "Padmakara" shape under gravity loading, which is the governing design load case of a stupa in general. According to the analytical results of this study, fairly large areas, where considerable tensile stresses existed were found in both the architectural designs considered for the analysis relevant to the "Padmakara" shape. Such large areas under tensile stresses have not been reported in previous studies carried out on other common architectural shapes that exist in ancient stupas. It may hint that the structural inefficiency of this shape, which could be one of the reasons for the non-existence of any surviving ancient "Padmakara" stupas in the country.

Keywords: Stupa, "Padmakara" shape, tensile stress, structural performance

* *Corresponding Author: isuruism@gmail.com*

INVESTIGATING THE PRODUCTION OF PINE PLANTATION WOOD AND ITS UTILIZATION IN SRI LANKA

Iresha S. Hewage[1*], M.S. Mendies[2] and R.U. Halwathura[1]

[1,] Department of Civil Engineering, Faculty of Engineering, University of Moratuwa, Sri Lanka

[2]Department of Design Studies, Faculty of Engineering, NSBM University, Sri Lanka

The production of plantation wood has become a significant contributor to Sri Lanka's economy. The State Timber Corporation is the main government organization responsible for harvesting and supplying timber from the forest plantations of Sri Lanka to meet the demands of the timber industries. This study aims to investigate plantation wood production and its utilization in Sri Lanka. Initially, the study evaluated the wood log production used for the borax treatment plant of the State Timber Corporation, and then conducted an industrial survey. This was conducted to investigate pine wood utilization in the wood industry. A company-based survey was conducted at randomly selected 20 mid-large scale wood companies located in Homagama, Moratuwa, Koralawella, Moratumulla and Soysapura. Results from the State Timber Corporation data shows, pine wood log production is higher than other timber types from 2019 to 2021. Further, wood production percentages in the borax treatment plant are: eu-microcorys 0.93%, eu-grandis 3.2% pine 90.7%, mahogany 2.8%, teak 0.42%, mango 1.67% and Gini Sapu 0.42%. Based on the data, treated pine log production was higher than other wood types. From the industrial survey data, 70% of the sawing mill, wood production plants and treatment plants did not use pine wood. 20% of wood industries use pine wood as construction material, furniture and make craft items and 10% of industries sometimes use pine wood for construction and furniture works. The study has proven that state timber corporations produce a high amount of treated pine wood logs but selected clusters use less pine timber. The study identified that the wood community should be aware of pine wood uses and their utilizations.

Keywords: Industrial survey, wood construction, pinewood, borax treatment, wood industry

[*] *Corresponding Author: reshi2020@gmail.com*

A PROPOSED CONCEPTUAL FRAMEWORK FOR CAPTURING ONLINE CUSTOMER REQUIREMENTS IN APPAREL CUSTOMIZATION

W. C. Uduwela[1*], J. de Silva[2] and L. Ranathunga[3]

[1]Department of Computer Science, The Open University of Sri Lanka, Sri Lanka
[2]Department of Textile & Apparel Engineering, [3]Department of Information Technology, University of Moratuwa, Sri Lanka

The surge in demand for web-based apparel configurators stems from customers seeking customized products with rapid delivery and competitive pricing. Yet, inaccuracies in eliciting customer requirements result in extended product development iterations, consuming time and resources. To empower customers' decision-making during the design phase, a precise product configurator (PC) is essential. This research addresses this challenge by proposing a chatbot-based conceptual model facilitating accurate customer requirement elicitation. The study explores existing PC challenges and applies solutions in the context of online apparel PCs thus enhancing customization efficiency.

Keywords: Apparel, Customization, Product Configurators, Requirement Elicitation

[*] *Corresponding Author: wasana@ou.ac.lk*

STRENGTH CHARACTERISTICS OF ALKALINE TREATED COCONUT FIBRE REINFORCED CONCRETE AT ELEVATED TEMPERATURES

I.M.S.M. Sandakelum and L. S. S Wijewardena*

Department of Civil Engineering, The Open University of Sri Lanka, Sri Lanka

Fibre-reinforced concrete (FRC) is produced by the addition of fibrous material to concrete which improves its structural integrity. Steel and synthetic fibres are widely used for this purpose. Both steel and synthetic fibres are very expensive, having to be imported, and not being easily available in large quantities compared to natural fibres available in Sri Lanka. Relatively freely available coconut fibre is the most suitable alternative for this purpose.

This study addresses the evaluation of the tensile and compressive properties of C25 concrete at elevated temperatures with the additional use of coconut fibre as a reinforcing material. Coconut fibres were treated with 5% NaOH solution before mixing with concrete in order to improve engineering properties.

The effect of mixing 20mm, 30mm, 40mm, 50mm and 60mm long fibres was investigated with variable mix proportions of 2.0%, 2.2%, 2.4%, 2.6%, 2.85 and 3.0% by weight of cement. The overall best result was obtained with 30mm long coconut fibres with a 2.8% by weight of cement. The compressive strength, split tensile strength and flexural strength of concrete improved by 17.36, 70.73, and 50.34% of conventional concrete respectively after 28 days. Cubes, cylinders and beams with this optimum fibre content and length were exposed to elevated temperatures at different values of 100˚C, 150˚C, 200˚C and 250˚C for a period of 1 hour. The weight loss of coconut fibre concrete cube was approximately 0.7%, 1.24%, 2.04%, and 2.73% at 100°C, 150°C, 200°C and 250°C at 1hr respectively. Also, the weight loss of coconut fibre concrete cylinder is approximately 0.64%, 1.02%, 2.16%, and 2.84% at 100°C, 150°C, 200°C, and 250°C at 1 hour respectively. After that, residual compressive strength, residual split tensile strength and residual flexural strength were investigated. Results indicated that the compressive strength, split tensile strength and flexural strength decreased from 38.73 to 29.8 N/mm^2 by 23%, from 4.2 to 3.36 N/mm^2 by 20%, and from 6.54 to 5.26 N/mm^2 by 19.57% respectively with the temperature increase up to 250˚C.

Keywords: Coconut fibre, alkaline treatment, compressive strength, split tensile strength, flexural strength, residual strength, elevated temperatures

* *Corresponding Author: Email – lswij@ou.ac.lk*

A STUDY ON THE PROPERTIES OF SCREW-PINE ROOT FIBER REINFORCED COMPOSITES

N. C. Malki* and C. N. Herath
Department of Textile & Apparel Technology, The Open University of Sri Lanka, Sri Lanka

Today, many natural fibers are used to develop fiber reinforced composites (FRC). This is due to these FRCs having important properties such as high specific strength and no abrasion during processing; being abundantly available as renewable resources, bio-degradable, low cost; and having minimum health hazards and low density for industrial applications.

In this study, Screw-Pine Root Fibers (SPRFs) were used as reinforcing material for the composites. SPF was used as reinforced fiber with 20%, 30%, 40%, and 50% fiber weight ratios with the composites being made using Epoxy and Unsaturated Polyester matrix polymers. Then the physical and mechanical properties of the 5% alkali-treated and untreated fibers, and composites were investigated. In the fiber state, the fiber bundle strength, single fiber strength, tensile strength, breaking elongation, and moisture absorption and in the composites, the tensile strength, breaking elongation, hardness, flexural strength, impact strength, compressive strength, and moisture absorption properties were tested according to the ASTM standards. The manual extraction of SPRFs with water retting was used without fiber damage and dried under sunlight. Part of them were alkali treated with 5% NaOH for one hour. After that, they were immersed in water and allowed to dry. Alkali-treated SPRFs have shown higher tensile strength, breaking elongation, bundle strength, and moisture absorption than untreated fibers. Further, the effective length of SPRFs was measured as being 16.7cm.

In SPRF reinforced composites, the tensile strength, breaking elongation, hardness, and impact strength were highest at 50% fiber ratio offering a positive correlation to the fiber ratio and a higher correlation with epoxy-based composites. However, the flexural strength of all the tested composites have shown a negative correlation with the fiber ratio and the highest value given with 20%. Thus, the flexural rigidity of the epoxy-based composites were also higher than the polyester-based composites. However, the compressive strength exhibited good behavior in all the tested samples. Thus, moisture absorption was lower with polyester-based composites compared with the epoxy=based composites. Therefore, the use of 5% alkali treated SPRFs with a 35%-40% fiber ratio (middle range) is recommended as is epoxy as a matrix material to make composites. This composite can be used for industrial applications such as cladding boards, automobiles, aircrafts, home appliances, aerospace equipment etc.

Keywords: Screw pine root fibers, fiber reinforced composites, mechanical and physical properties of composites, fiber reinforcement

** Corresponding Author: malkinavullage1996@gmail.com*

DESIGN AND DEVELOPMENT OF SUITABLE YARN COMBINATIONS AND FINE GAUGE HIGH CUT LEVEL INDUSTRIAL GLOVE TO PROTECT HUMAN BEINGS FROM INJURIES DURING INDUSTRIAL WORK

E.R.K.T. Perera and M.E.R Perera*

Department of Textile & Apparel Technology, The Open University of Sri Lanka, Sri Lanka

The majority of workers may be exposed to a range of occupational hazards at their industrial workplaces, which include cuts and lacerations. Accidents related to the handling of sharp objects account for a considerable percentage of workplace injuries. Generally, cut injuries account for more than 80% of all hand injuries. Therefore, ensuring the safety of workers at workplaces is one of the major requirements in order to avoid occupational injuries. The use of specially designed personal protective equipment is a general practice in such industries. The industrial gloves can be considered as one of the important equipment, which can be used to protect workers against cuts and lacerations.

Three different types of covered yarns were developed by using different yarn combinations in order to produce gloves with fine gauge high cut level for industrial usage. Testing was carried out to check whether developed yarn types were according to the research plan with respect to yarn count, twist per metre and stretchability. Eighteen pairs of gloves were produced by using the three developed yarn types. This included six pairs of gloves from each developed yarn type. The majority of the measurements of the designed and developed gloves were in accordance with the measurements of the selected size chart. The weight of the gloves was between 16.5 grams and 24.5 grams. It was observed that with the increase of the yarn count, the weight of the gloves has increased slightly. The developed gloves were tested for abrasion resistance, blade cut resistance, tear resistance and puncture resistance using the standards EN388. The best performance was shown by the gloves made of yarn type 3, but its weight was the highest (24.5 grams). On the other hand, all the performance results of the gloves made of three yarn types were above the recommended level for industrial gloves, that is Level 3. Therefore any glove made of developed three yarn types can be chosen for high cut applications.

Keywords: Fine gauge, High cut level, Industrial gloves, Occupational injuries, Performance of industrial gloves

**Corresponding Author: meper@ou.ac.lk*

PORTABLE PRIMARY CURRENT INJECTOR FOR CIRCUIT BREAKER TESTING

R. Senthuran * and K.M.G.Y. Sewwandi
Department of Electrical and Computer Engineering,
The Open University of Sri Lanka, Sri Lanka

Protective device failures and malfunctions are occurring frequently in industrial applications. When component failures occur, it is required to confirm whether it failed or malfunctioned. Therefore, a specially designed testing equipment is required to identify the status of protective devices in such situations, and this equipment is considerably expensive, even for hiring. Therefore, industries tend to develop low-cost protective devices testing equipment based on their requirements. A primary current injector, also known as a primary injection test set, is a specialized piece of equipment used for primary current injection tests in electrical power systems. It is designed to generate high currents and inject them into the system to simulate fault conditions and evaluate the performance of protective devices such as protective relays and circuit breakers. Generally, laboratory-based primary current injectors are used to conduct primary current injection tests, and they encounter certain limitations that need to be addressed. The size and weight are the major limitations in the laboratory based primary current injectors. These limitations are generally arising due to the high currents that they generate. This can make transportation and setup cumbersome, especially if the laboratory has limited space or if the equipment needs to be moved frequently. Apart from the size, the other well-known limitation of the primary current injector is the cost. They often require a significant investment due to their specialized design, high-power capacity and precision. Budget constraints may pose challenges for smaller laboratories or organizations with limited financial resources, and task specific design of primary current injector is good for an industry, based on the requirements. Most of the small-scale industries required 100A range current levels for testing purposes. With respect to such industrial requirement, the laboratory based primary current injectors have higher capabilities than the requirement and the consumers must bear an unnecessary cost. Apart from that, these laboratory-based primary current injectors are not easily movable. Therefore, the aim of this study is to develop a portable 100A primary current injector for the purpose of testing protective devices targeting small scale industrial requirements. The proposed primary current injector design consists of key components such as isolation circuit, converter circuit, control circuit and feedback circuit. It fulfills the fundamental objectives of being able to bring equipment as close as possible to the device under test and only requiring one person to perform the test. Also, the proposed prototype saves the testing preparation time, and it has high efficiency as the power losses are low.

Keywords: Primary current injector, protective device testing, transformer core design

**Corresponding author: rsenthu23@gmail.com*

AN IMPROVED CONTROLLER DESIGN FOR TRANSFERRING THE COLOMBO WASTE TO ENERGY POWER PLANT TO THE ISLANDING OPERATION SAFELY DURING THE FAILURES OF THE POWER SYSTEM

H.I. Gayan * and K.M.G.Y. Sewwandi
Department of Electrical and Computer Engineering, the Open University of Sri Lanka, Sri Lanka

The Colombo Waste to Energy Power Plant, Sri Lanka's First waste-to-energy facility, generates 10 MW of power by utilizing 700 tons of garbage daily. The fuel preparation process involves collecting and sorting municipal solid waste, which is then processed to remove any recyclable materials. The remaining waste is then burned in a boiler to produce steam, which drives a turbine to generate electricity. Since many sub processes are involved in the electrical energy generation process the auxiliary power consumption of this power plant is high when compared with the other fossil fuel fired power plants. The auxiliary power consumption is around 17% of the total power generation. On the other hand, some auxiliary systems are required to run continually even if the power plant is in shutdown state. Therefore, in a case of fault in the grid side the power plant should be transferred into the islanding operation without initiating a shutdown to cater the auxiliary demand. But based on the currently available controller logics it is not automatically transferred into the islanding operation and that causes significant loss of auxiliary power to the power plant during such incidents. Not only that but also most of the thermal power plants which are operating at Sri Lanka are not using automatically islanding transformation facility and all those power plants are using their emergency diesel generators to cater the auxiliary power when the grid power is not available. However, that is somewhat reasonable for the high-capacity power plants which are consuming a lesser amount of auxiliary energy. But in case of the waste to energy power plant, continuity of electricity generation during the grid faults is essential to cater the higher auxiliary power requirements and to run essential axillary systems without any interruption. To implement automatic islanding operation, the power plant controller logic should be changed. However, that is not a simple task as the incorrect commands can cause undesirable conditions. It can reduce the lifespan of the turbine and generator. Therefore, the aim of this research is to propose a reliable system to transfer the waste to energy power plant into islanding operation safely, during the failures of the power system. This system will be implemented while adhering to manufacturer's specifications.

Keywords: Waste to Energy Power Plants, Automatic Islanded Transformation, Steam Bypass Valve Control

**Corresponding Author: isurugayan4u@gmail.com*

ASSESSMENT OF ECONOMIC FEASIBILITY OF BATTERY ENERGY STORAGE DEVICE INTEGRATION TO ROOFTOP SOLAR PV CONSUMERS

T. A. N. P. Abeysumana* and K. A. C. Udayakumar
Department of Electrical and Computer Engineering, The Open University of Sri Lanka, Sri Lanka

Rooftop solar PVs are widely used at the distribution level. Most of these solar PV users are domestic customers and the main purpose is the reduction of the cost of energy. Integration of Battery Energy Storage Devices (BESD) to the solar PV in Sri Lanka is not frequent, and whether the integration of BESD to the solar PV brings the return of the investment is not certain. This study carries out the analysis of financial viability of use of BESD together with the solar PV for domestic consumers. The benefit of the study analysis is the charging of BESD using excess solar PV energy reducing export of the solar PV energy to the grid. The criterion for optimum BESD capacity has been identified. Furthermore, the formula for determining the BESD has been presented. The unit cost for solar PV energy and BESD cost formula is also given. Additional advantage of integration of BESD has been also discussed in this study. The proposed methodology has been used to determine the BESD capacity of the solar PV consumer. The results showed that BESD is not financially viable for any capacity of BESD. The optimum capacity of BESD and the cost saving has been presented at the end of the paper.

Keywords: Battery energy storage device, emergency power, peak shaving, solar photovoltaic

**Corresponding Author: nadunipabasara27@gmail.com*

MODE CHOICE OF URBAN COMMUTERS – A CASE STUDY ON PASSENGERS TRAVELLING ON THE 120 BUS ROUTE FROM PILIYANDALA TO COLOMBO

M.G.S. Udara*, J.A.R.R. Jayaweera, B.H.G.M.W.M. Amarasooriya and A.H.S. Sharic

Department of Management, Faculty of Management, Social Sciences and Humanities, General Sir John Kotelawala Defence University, Sri Lanka

One of the most important steps in the transportation planning process is mode selection, which has a direct impact on policy decisions. Understanding the factors that influence mode choice after the pandemic and economic crisis would undoubtedly aid urban and transportation planners in better preparing for future transportation management. Many research studies have been conducted to find the influential factors in mode choice before the COVID-19 pandemic and economic crisis. Limited research has been conducted to identify the influential factors of mode choice in the post-pandemic and current tough economic situation in Sri Lanka. The objective of this study was to investigate the factors affecting passengers' modes of transportation in the urban context of Sri Lanka after the pandemic and economic crisis in the country. The mode chosen by the commuters was the dependent variable. Socioeconomic characteristics of the commuter, characteristics of travel, and characteristics of transport facilities were taken as independent variables. A Google questionnaire was administered to a sample of 203 commuters who were travelling between Piliyandala and Colombo along the 120 bus route. Multinomial logistic regression was used to identify the influential factors in mode choice. The results outlined that there had been a statistically significant relationship between travel-based characteristics of commuters, such as trip purpose (education: coefficient value 10.202, significance 0.00), vehicle ownership (coefficient value -6.723, significance 0.036), and mode choice. Findings showed that passengers who owned private vehicles chose private vehicles over public transport vehicles, and commuters travelling for educational purposes chose public transport over private transport. Increasing bus transport service frequency, setting up bus priority lanes, offering discounted fares for students travelling on public transport, and increasing school bus services are recommended, based on the above findings.

Keywords: Mode choice, Economic crisis, Urban context, Sri Lanka, Covid 19, Factors

**Corresponding Author:* udharaagamage@gmail.com

A STUDY ON INDUSTRIAL POLLUTANTS DISCHARGED INTO THE DOWNSTREAM OF THE KELANI RIVER

W.A.K.S. Fonseka[1], S. Himanujahn[1], H.H. Dissanayake[2], and B.C.L. Athapattu[1]*

[1]Centre for Environmental Studies and Sustainable Development, The Open University of Sri Lanka, Sri Lanka

[2]Department of Civil Engineering, Colombo International Nautical and Engineering College, Sri Lanka

Sri Lankan economic growth and ecosystem collapse are interconnected issues as countries around the world struggle to establish an effective regulatory regime to control the discharge of industrial effluents into their ecosystems. This research aimed to assess the impact of industrial wastewater from various industries on the Kelani River. To determine the degree of chemical pollution in a receiving river as impacted by industrial effluents, the study was conducted in Kelani River. The study included 25 industries from food, textile, beverage, tile, chemical, and leather manufacturers, industrial zones, and service centers located in Colombo and Gampaha districts. Specific sites were selected to evaluate the water quality and extent of pollution, and water samples were collected and analyzed for several physicochemical factors, including pH, dissolved oxygen, total suspended solids (TSS), total dissolved solids (TDS), and the presence of heavy metals where some parameters were measured directly in the effluent using a pH meter, conductivity meter, DO meter, and COD reactor, respectively. The flow rate of treated wastewater was measured using flow meters or V-notch flow rate measurements. The findings revealed that all industries were discharging large amounts of pollutants into rivers, exceeding the permitted limits established by Sri Lanka's Central Environmental Authority. Particularly, high COD levels indicate significant organic matter and chemical pollution. The findings suggested that the river's water was contaminated and unfit for human consumption. Therefore, it is advised that improper waste disposal be discouraged. Although some values were below the allowable limits, the continued discharge of effluents into rivers may result in a serious buildup of contaminants., Unless the authorities enforce the laws governing the disposal of wastes, this may have an impact on people's quality of life. The study highlighted the urgent need for proper monitoring and regulation of industrial wastewater discharge in the Kelani River basin to safeguard the river ecosystem and public health, Policymakers, regulators, and industry stakeholders can benefit from the study's findings to develop and implement strategies to reduce the environmental impact of industrial activities on the Kelani River and its ecosystem.

Keywords: COD, Flow Rate, Kelani River, Pollutant Load

** Corresponding Author: bcliy@ou.ac.lk*

PREDICTING METHANE EMISSIONS OF OPEN DUMPS IN SRI LANKA FOR CARBON NEUTRALITY IN 2050

S. Himanujahn[1], W.A.K.S. Fonseka[2], and B.C.L. Athapattu[1,2*]
[1]Centre for Environmental Studies and Sustainable Development, The Open University of Sri Lanka, Sri Lanka
[2]Department of Civil Engineering, Faculty of Engineering Technology, The Open University of Sri Lanka, Sri Lanka

Municipal Solid Waste (MSW) contributes to greenhouse gas (GHG) emissions, particularly methane, in Sri Lanka's open dumps. To mitigate this issue, a study was conducted to analyse methane emissions and a solution was proposed: using a daily cover combined with biochar.The analysis employs a time series analysis model to estimate GHG emissions based on demographic and socioeconomic factors such as population and Gross Domestic Product (GDP). The results show that the emissions of methane from open dumps in Sri Lanka will continue to increase due to population growth, urbanization, and economic growth. The MSW generated during the period 2021 to 2050 is expected to increase due to inadequate public commitment to waste management, lack of proper waste segregation, and challenges in implementing the 3R principles. The study proposes the use of a daily cover combined with biochar produced from MSW to mitigate landfill gas emissions. The addition of biochar demonstrates a significant impact, reducing CH_4 emissions by 50.448 CO_2-eq Gg/yr by 2050. A case study at Karadiyana dump site reported a 29% reduction in CH_4 concentration when using biochar as a daily cover. The findings of the analysis show that 10% of GHG emissions can be absorbed by the daily cover laid on the waste at the dumpsite. The time series analysis model shows good potential for estimating national GHG emissions for the waste sector with a reasonable error. The study emphasizes the importance of prioritizing and implementing proper waste management practices to effectively reduce GHG emissions from the waste sector in Sri Lanka. The inadequate waste management practices, lack of proper waste segregation, and challenges in implementing 3R principles are the fundamental problems with current waste management practices. The review concludes that the use of a daily cover combined with biochar has the potential to significantly reduce GHG emissions from MSW in Sri Lanka.

Keywords: Biochar, Greenhouse Gas, Methane, Municipal Solid Waste

[*] *Corresponding Author: bcliy@ou.ac.lk*

ENGLISH LANGUAGE TEACHING

YOUNG FILIPINO FARMERS' PERCEPTIONS OF THE USE OF ENGLISH AS A MEDIUM OF INSTRUCTION IN AGRICULTURAL TRAININGS IN LA TRINIDAD, BENGUET

Josephine K. Aben*
Agricultural Training Institute, Benguet, Philippines

This study attempted to investigate the perceptions of young Filipino farmers about the use of English as a medium of instruction in agricultural trainings. La Trinidad's youth population comprises mostly Indigenous People who speak different dialects and hence, using the national language for communication is practically impossible. This study used descriptive survey method to collect, analyze, and interpret the perceptions of the participants. A questionnaire was administered to 78 young farmers between the ages 20 and 28. The Slovin's formula was used to determine the sample population.

The respondents were mostly in their early twenties and finished college degrees. They believed on new technologies because it gives good efficiency in terms of high yield, controlling pests, and more benefits such as income along the value chain. The transfer of agricultural technologies is understood better with the use of different training equipment and methodologies. Based on the study, the factors that are most impactful for successful training include use of effective teaching methods; trainers' qualification; and use of visual aids. Respondents assert the importance of learning agricultural technologies through English. The reasons given by respondents include reading technology materials written in English due to their enhance clarity; trainers' use English since it was the language used in their basic education; and participants employ English for communication. Moreover, the application of English to explain technologies was thought to be useful as modern technologies are also researched by other nationalities. Respondents admitted that lack of English proficiency will be a barrier to keep pace with the progress of other countries. Respondent's proficiency had an effect on their attitude to learn, un-learn and re-learn. Thus, they adopted ways of learning that they thought were best for them.

These young farmers believe that agricultural technologies learned during trainings through English enhances their knowledge, shifts their attitudes, changes their behavior, and updates traditional agricultural practices. Hence, they believe that English is necessary for communication, interaction and assessing scientific research in agriculture through social media platform.

Keywords : ESP, EMI

**Corresponding Author: abenjk3@gmail.com*

GRAMMATICAL ERROR ANALYSIS IN SPEECH AS PERFORMANCE AMONG UNDERGRADUATES IN SRI LANKA.

H. M. C. P. Jayawardena*
Department of English Language Teaching, University of Kelaniya, Sri Lanka

Proficiency in the English language includes the four skills of writing, speaking, listening, and reading. In considering the proficiency among students to undergraduates a reasonable deficiency in productive skills is noticed. The concerned aspect of "speech as performance" is a unified aspect of the three categories of speech and the most considerate among them. As speech as performance carries more grammatical accuracy and meaning other than the organization of content the producer has to be conscious and cautious about the content they are to deliver. Upon that, speaking carries a minor level of confidence and the undergraduates are not positive to engage in speaking due to stage fear. Hence, the types of errors conducted by undergraduates can be divided into errors and mistakes. However, to understand the errors committed by the undergraduates five undergraduates each from six universities were given a task of a public speech. speech. The total number of participants in the sample was thirty. The undergraduates were selected from the universities of Colombo, Kelaniya, Moratuwa, Peradeniya, Jaffna, and Ruhuna using purposive sampling. Purposive sampling was utilized to identify undergraduates from a non-linguistic background. Some observations were physically conducted while the other sessions were observed through recorded materials. After analyzing the errors committed by the undergraduates, they could be categorized into three categories such as omission, misinformation, and irregular placement of parts of speech. These categories included mistakes relevant to articles, auxiliary verbs, tense formation, irregular formatting of plurals, superlatives, and predicate placement. Moreover, the Speeches conducted by the undergraduates demonstrated a high preference to present a pre-prepared speech, written in papers. The observations revealed that the errors were the results of less preparation while some were caused by the negligence of minor grammatical formations. False identification of the function of articles and prepositions and mismanagement of tenses were abundant. The usage of incorrect passive voice instead of active voice was another reason for the higher number of errors. Hence, the study demonstrated that undergraduates heavily rely on written production while the errors committed need revision of grammar from basic stages to make a comprehensible output within speech production.

Keywords: grammatical errors, speech As performance, undergraduates, speech production

**Corresponding Author: hmcpjayawardena@gmail.com*

EXPLORING THE REASONS AND REMEDIES FOR SPEAKING ANXIETY IN THE ESL CLASSROOM: A STUDY BASED ON THE FACULTY OF ARTS, UNIVERSITY OF PERADENIYA

W.L.D.R.S. Jayawardena*

DELT-Faculty of Arts, University of Peradeniya, Sri Lanka

Speaking is one of the most essential to develop in the process of teaching/learning English as a second language. Many students experience anxiety when they try to speak in the ESL classroom. This study explores the reasons behind speaking anxiety among students along with the remedies used by instructors to reduce speaking anxiety in the ESL classroom. Since the study is exploratory in nature, qualitative research methods were employed in this study. The study was conducted at the Faculty of Arts, University of Peradeniya during the second semester of the academic year where the first-year undergraduates were following a compulsory oral English course. At the beginning of the academic year, students were divided into groups based on their competency level for English classes using a placement test. Many students in the basic competency level found it difficult to express themselves in English. Therefore, purposive sampling was used for this study and focus group discussions were conducted with 30 first year undergraduates belonging to the basic competency level. Interviews were also conducted with 10 instructors who taught ESL to students in the basic competency level. Thematic analysis was employed to analyze these data. The qualitative data gathered from focus group discussions revealed that the fear of making mistakes while speaking, having a limited vocabulary, lack of confidence, test anxiety, and fear of negative evaluation were the reasons behind speaking anxiety among the students. Making the classroom more learner-friendly, using pair work, using a variety of teaching materials, and conducting practice sessions for upcoming speech tests were revealed to be the remedies used by instructors to reduce speaking anxiety in the ESL classroom. While highlighting the reasons for speaking anxiety the study provides insights to teachers regarding the remedies to reduce speaking anxiety and help their students to develop their speaking skills.

Keywords*:* English as a Second language, Speaking anxiety, Undergraduates, Reasons, Remedies

**Corresponding Author:* ravishaj@yahoo.com

POPULAR CULTURE: A NEGOTIATION TOOL OF LITERARY TEXTS

Tharuniah Subramaniam*
Department of English Language Teaching, The Open University of Sri Lanka, Sri Lanka

The aim of the study is to investigate the significance of using popular culture and related illustrations in an English literature classroom context. This study specifically focuses on how popular culture references and photographs can facilitate the construction of meaning and bridge the gap between home and target culture of learners. The study also views the students' engagement in comprehending the literary text via quality class discussions. This study is done at an international school where the students are following the national English literature curriculum. Using popular culture elements helps the learners to comprehend the nature of the popular culture transition over time in relation to the literary text and target cultures that are under discussion in an effective manner. Popular culture references and related photographs are effective negotiation strategies for bridging the gaps between the known home culture and the unknown target culture, which assists the learners in their cognitive development.

Keywords: popular culture, negotiation tool, literary texts

**Corresponding Author:* stharuniah@gmail.com

EXPLORATION OF THE EFFECTIVENESS OF USING NON-TRADITIONAL CONTENT IN DEVELOPING LANGUAGE PROFICIENCY IN CORPORATE TRAINING

Rajeswari Kangayanatha Aiyer*
Post Graduate Institute of English, The Open University of Sri Lanka, Sri Lanka

Given the importance of communicative competence in a corporate environment, an exploration of effective content that motivates the staff has been undertaken in this study. Though English for Specific Purposes (ESP) has been viewed as the best approach, it has not been all encompassing as the specific needs of the work place, institutional needs and job requirements also need to be taken into consideration. Limited studies that analyse the efficacy of introducing English Literature in tertiary education do not give an insight into applying the same concept in work place setting. Hence, non-traditional content like business fables, movies and contemporary topics that reflect the social changes in the society have been utilized in this study. A mixed method study was conducted in three phases using presentations, social media posts and impromptu speeches as interventions. Data has been collected through online discussion forums and questionnaires from 28 employees and semi-structured interviews from the two partners of the management. The objectives of the study were to ascertain the level of success of non-traditional content in corporate training, the rate of improvement in critical thinking skills and the alignment of interests of the participants and the management. Results indicate that innovative ideas are welcome in corporate setting from both parties involved. The participants have expressed their satisfaction in improved soft skills necessary for work. In addition, they have shown increased acceptance of lifelong learning as part of their professional growth. The management has witnessed an increase in staff morale and motivation at work which has resulted in increased productivity.

Keywords: Corporate Training, non-traditional content, critical thinking skills, training objectives

**Corresponding Author: rajeswarika@gmail.com*

UNLOCKING THE ASSESSMENT PUZZLE: AN INVESTIGATION INTO UNDERGRADUATES' PREFERENCES FOR FORMATIVE AND SUMMATIVE ASSESSMENTS

Himesha Prabodini Alahakoon*

English Language Teaching Unit, Faculty of Built Environment and Spatial Sciences, General Sir John Kotelawala Defence University, Sri Lanka

Assessment plays a crucial role in the teaching and learning process, providing valuable feedback to students and evaluating their learning outcomes. This research focuses on exploring undergraduates' preferences for formative and summative assessments in the context of a government university in Sri Lanka. By conducting a qualitative analysis of data gathered from 43 participants of a purposive sampling, this study aims to contribute to the existing literature on assessment preferences of the undergraduates who learn English as a second language. An open-ended questionnaire has been utilized as the data collection tool and 43 voluntary participants have provided responses out of 70 of an entire sample. The gathered data has been analysed thematically. The study reveals several key findings regarding the participants' perceptions on formative assessments. Participants consistently recognized the importance of formative assessments and their positive impact on learning. The qualitative data emphasized the instrumental role of formative assessments in improving various English language skills. Participants emphasized the role of summative assessments as an overall measurement of language proficiency. They viewed summative assessments as an opportunity to demonstrate their achievement and provide a clear goal to strive for. Moreover, the participants stated that more effort should be devoted to summative assessments compared to formative assessments. The findings suggest the importance of incorporating a balanced approach to assessment, utilizing both formative and summative assessments in a complementary manner. To further enrich the field of assessment research, future studies could explore the influence of cultural backgrounds, teaching methods, and personal learning styles on students' assessment preferences.

Keywords: English as a Second Language, Formative Assessments, Higher Education, Preferences, Summative Assessments, Undergraduates

* *Corresponding Author: himeshaprabodini@kdu.ac.lk*

CHALLENGES FACED BY ADVANCED LEVEL ENGLISH TEACHERS WHILE TEACHING *LIFE OF PI*

Mayanthi Kulatunga Jayakody*

Centre for Educational Technology and Media, The Open University of Sri Lanka, Sri Lanka

Over the past few decades, there has been a significant growth of Magic Realist fiction in the international market evidencing that it is one of the most sought-after writing styles. The current General Certificate of Education (G.C.E.) Advanced Level English syllabus in Sri Lanka which was introduced in 2017 too includes a fictional novel belonging to the genre of Magic Realism; Life of Pi by Yann Martel. It is a clear deviation from Realism and is also the only truly Post Realist/Magic Realist text in the syllabus, and it is an unfamiliar genre from a teacher's perspective because the English syllabus until 2017 always contained fiction inclined towards Realism. In such a context, it seemed worthwhile exploring how challenging the introduction of Magic Realism has been to the relevant teachers. Accordingly, this study investigated on the challenges faced by a group of teachers that teach Life of Pi to G.C.E. Advanced Level students who offer English and on the possible strategies that could be employed to overcome them. The data collected from four such teachers were analysed using a thematic analysis based on the six-phase approach framework proposed by Virginia Braun and Victoria Clarke making this study exclusively relying on qualitative research methods. Analysis of the results indicated the lack of teacher training and insights on assessment and standardized testing and also a linear scaffolding in how this new and unfamiliar genre was introduced. It also suggests that teachers struggle with the genre due to their long-term familiarity with Realism. The data revealed that at times teachers attempted to 'fit' Life of Pi into their existing Realism-dominated understanding of literature. Several suggestions for overcoming these challenges were also identified. A limitation in the study was the number of participants, which was restricted by the dearth of teachers using the text. A future study could be conducted with participants representing more districts.

Keywords: Advanced Level English, Magic Realism, *Life of Pi*, teaching challenges

**Corresponding Author: mkjay@ou.ac.lk*

THE IMPLICATIONS OF TEACHING ENGLISH AS A SECOND LANGUAGE IN A SRI LANKAN STATE UNIVERSITY: A STUDY CONDUCTED IN THE FACULTY OF VETERINARY MEDICINE AND ANIMAL SCIENCE, UNIVERSITY OF PERADENIYA

H.M.A.S. Herath*, M.I.L. De Zoysa, K.G.D.T.L. De Alwis, and M.M.S.L. Yalegama

Department of English Language Teaching, University of Peradeniya, Sri Lanka

With the proliferation of degree programmes offered in the English medium across the world, endowing students with the linguistic assistance required to follow these degree programmes successfully, has been given paramount importance in the higher education sector. The Faculty of Veterinary Medicine and Animal Science, University of Peradeniya conducts its Bachelor of Veterinary Science (BVSc) degree programme exclusively in the English medium and thus, improving the veterinary undergraduates' academic literacy in English has become a primary concern. The responsibility of teaching English as a second language to undergraduates studying Veterinary Medicine and Animal Science falls under the purview of the English Language Teaching Unit of the Faculty. This study aims to critically explore the implications of teaching English as a second language to undergraduates and how they affect the delivery and the outcomes of the English Language Teaching Programme at the Faculty of Veterinary Medicine and Animal Science at political, social, epistemological and pedagogical levels. This research was qualitative in nature. The data was generated from 15 students from the Faculty of Veterinary Medicine and Animal Science's 1st, 2nd and 3rd years, selected through random convenience sampling and the members of the English language teaching committee and the English teachers of the faculty selected through purposive sampling. The data generated through semi-structured interviews and focus group discussions was transcribed, tabulated and coded. Recurring codes were identified as themes. The data under those themes were then analysed using critical content analysis. The findings of the study emphasized the significance of learning English to meet the requirements of the BVSc programme. It was also discovered that English for Specific Purposes (ESP) as opposed to English for General Purposes (EGP) was considered the preferred model in designing and delivering language lessons and the teaching approach used to deliver ESP courses should be Content and Language Integrated Learning (CLIL) where subject-specific content and language are integrated. Nevertheless, utilizing the CLIL approach presents a series of challenges, especially to English language teachers and has various socio-political implications. Thus, research-based and pedagogical recommendations must be introduced to address these challenges and enhance the language teaching-learning practices at the Faculty of Veterinary Medicine and Animal Science.

Keywords: English for Specific Purposes, Content and Language Integrated Learning, Academic Literacy

**Corresponding Author: herathamani@gmail.com*

PRIVATE TUITION FOR ENGLISH IN THE KURUNEGALA EDUCATION ZONE: MOTIVATION METHODS AND MATERIALS

Vivimarie Vanderpoorten Medawattegedera[1]* and Manoj Upathissa[2]
[1]Departmnet of Language Studies, The Open University of Sri Lanka, Sri Lanka
[2]Maliyadeva Aadarsha Maha Vidyalaya, Kurunegala, Sri Lanka

Sri Lanka, as a country with one of the highest literacy rates in South Asia, boasts of free education from the beginning of primary school, right up to undergraduate degree level. There are no school fees charged, and students are given free textbooks; meals have also been provided free of charge at various periods in the history of free education, with the aim of making education accessible to all. However, there are many analysts and activists who claim that education is not free. This is because the private tuition industry is a lucrative business throughout Sri Lanka, and almost all school-going children, including those who come from families that can barely afford the fees for private tuition, attend these classes as a norm. This study investigates the factors that drive students and their parents to seek private tuition for English in the Kurunegala Education Zone, and explores the pedagogy employed by a sample of private English tutors. The study, which used questionnaires to stakeholders classroom observation of English tuition classes and materials used in such classes, found that contrary to the popular belief, it is not the appearance of the tutors or the attractive quality of advertising that draw students to English tuition classes, but the desire of students and parents to learn English in a 'freer' and humour-filled environment, to learn to speak fluently and to do better at school and national examinations by learning grammar explicitly. Students are also drawn to private tuition teachers who consistently use the mother tongue for instruction in the ESL classroom.

Keywords: Private tuition, shadow education, ESL pedagogical practices

* *Corresponding Author: vvand@ou.ac.lk*

ENVIRONMENTAL SCIENCES

ENUMERATION OF HETEROTROPHIC, IRON-PRECIPITATING BACTERIA IN THE SOIL SAMPLES COLLECTED FROM URBAN WASTE DUMPING SITES, MATARA DISTRICT, SRI LANKA

D.M.S.K. Maduwanthi [1], S.D.L. Geeganage [1] and T.W.N.K. Perera [2*]

[1]Departmment of Mathematics, Faculty of Science, University of Ruhuna, Sri Lanka

[2]Departmment of Microbiology, Faculty of Science, University of Kelaniya, Sri Lanka

Heterotrophic, iron-precipitating bacteria are capable of using organic radicals from soluble organic iron salts. This is widely applied in the removal of iron from organic solutions and during the decomposition of organic iron compounds, ionic iron is released. The current study was designed to enumerate heterotrophic iron-precipitating bacteria in soil samples, collected from urban waste dumping sites in eight locations, in the Matara district, Sri Lanka. Generally, the identified area was almost flat and there were no complex topographic features. Surface soil, separately sampled from three sampling sites at each location, were used as the test samples. The pH value of each collected sample was recorded. Each soil sample (1.00 g) was added to sterilized water (9.0 mL), followed by tenfold serial dilutions. For the enumeration of the total viable heterotrophic iron-precipitating bacteria, serially diluted samples were pour-plated with Ferric Ammonium Citrate Nitrate Agar. All soil samples were analysed in duplicated agar plate-based assays and the number of colonies was counted after incubation of the plates at room temperature for 2-3 days. Quantitative determinations were made based on colony-forming units per gram (CFU g^{-1}) of soil and expressed with 95% confidence interval limits. Further, the bacterial colony counts per gram of each soil sample were arranged in a completely randomized design and One-way analysis of variance was applied with Tukey's multiple comparison test. The results showed that the counts were significantly different among locations. The significantly highest counts were reported for the dumping sites at Walgama (pH 7.15) and Walpala (pH 6.90) areas and the relevant counts were recorded as 3.492×10^5 CFU g^{-1} and 3.442×10^5 CFU g^{-1}, respectively. The lowest count was recorded at the dumping site near Dikwella lagoon (pH 8.95). The study demonstrates the dispersion of heterotrophic, iron-precipitating bacteria in urban waste dumping sites, within the selected region, indicating that high counts were reported in near-neutral soil environments. The current findings would serve as a baseline for the further expansion of the research topic towards the application of these bacteria, for the removal of iron from accumulated organic waste.

Keywords: Heterotrophic, Iron-precipitating, Colony-forming units, One-way analysis of variance

[*]*Corresponding Author:* nipunik@kln.ac.lk

A STUDY TO IDENTIFY THE BARRIERS FOR IMPLEMENTATION OF STRATEGIES TO MINIMIZE PLASTIC USAGE AT HOUSEHOLD LEVELS IN SRI LANKA

D.K.P.G. Yashodha Swarnamali Polgolla*, W.M.G. Randika Wickramaratne, and K.C. Weerakoon

Department of Zoology, The Open University of Sri Lanka, Nugegoda, Sri Lanka

Plastic pollution has damaged the terrestrial and aquatic ecosystems severely. This is leading to the destruction of the ecosystem, harming all living species. Considering the magnitude of the excessive toxic effect of plastic on the biosphere, as a remedial measure, rapidly increasing household-level plastic usage is required to be minimized. To find a possible solution to the thematic area, knowledge, practices and attitudes (KPA) of the community were assessed using a questionnaire. A total of two hundred and ninety-one (covering 19 districts in Sri Lanka) responses were collected from randomly selected spectators of the Kandy Parade within ten days in 2022. The collected data was analysed using a simple calculation method for close-ended questions. According to the significant findings of this study, 41.3% of the respondents were male and 58.7% were female. Out of them, 14.9% were below 20 years, 51.6% were 20-40 years, 27.6% were 40-60 years, and 5.6% were above 60 years. Further, 99.3% of the respondents were aware that plastic causes environmental pollution, 88.4% were aware that burning plastic can cause air pollution and 91.9% were aware that plastic can be recycled. Despite their awareness that plastics are harmful to the environment and should be recycled, 58.3% of them burn plastic, 6.9% bury under the soil, 29.9% give plastic to garbage collecting trucks and 4.9% hand over directly to recycling centres. 75.3% of respondents segregate plastic from other waste as a practice. 34.1% are mostly using single-use plastics than reusable plastics. The majority of the respondents suggested that reducing the usage of plastic, recycling, using eco-friendly alternatives and implementing policies will reduce plastic pollution. However, the majority are aware of plastic pollution despite the lack of taking action as a preventive measure. Findings will directly benefit authorities to rethink to develop a framework to overcome above-stated barriers with the assistance of like-minded institutions and communities. Finally, the findings provide the necessary evidence to implement mitigation measures to reduce pollution and achieve Sustainable Development Goals: SDG 01, SDG 12, SDG 13, SDG 14, and SDG 15 providing benefits to all living species, developing a circular economic model.

Keywords: mitigation, plastic, pollution, recycle, waste

**Corresponding Author: s17001221@ousl.lk*

FUTURE OF WATER CONSUMPTION IN SRI LANKA: A COMPARISON WITH A WATER-SCARCE AND A WATER-RICH COUNTRY

R.M.A.S.D. Rajakaruna[1*], M.M.M. Najim[2] and B.G.N. Sewwandi[1]

[1]Department of Zoology and Environmental Management, Faculty of Science, University of Kelaniya, Sri Lanka

[2]Faculty of Agriculture, Sultan Sharif Ali Islamic University, Kampus Sinaut, Km 33, Jalan Tutong, Tutong TB1741, Brunei

Rainwater, surface water, and groundwater sources fulfil the water requirement of the Sri Lankan population. Access to safe water in Sri Lanka is threatened by various factors, such as water pollution and annual rainfall variation. This study aims to evaluate the demand for fresh water in Sri Lanka in the past decade and compare it with the water demand in a high-income desert country, Saudi Arabia, and a developed temperate country, Germany. Future water demand has been predicted using population projections to indicate the importance of securing the availability of safe water in the future. The per capita water consumption of Sri Lanka (608.4 m^3/capita/year) is less than that of Saudi Arabia (719 m^3/capita/year) and higher than that of Germany (372 m^3/capita/year). Nevertheless, the highest water consumption is in Germany (30.56 Gm^3/Year) and the lowest in Sri Lanka (12.95 Gm^3/Year). The agriculture sector consumes the highest amount of water in both Sri Lanka (87.36%) and Saudi Arabia (83.08%), while it accounts for the least usage in Germany (1.27%). Out of the total water consumption in each country, industry utilizes the highest amount of water in Germany (64.18%), while the industrial contribution in Sri Lanka is low (6.42%). This clearly indicates the need to implement water conservation methods in agriculture to achieve sustainable water management. Population growth indeed increases the total water consumption of a country. This study concludes that in 2030 the total water consumption in all three countries, Sri Lanka, Saudi Arabia, and Germany, is expected to rise by 4.26%, 23.19%, and 0.75%, respectively, with the growth in population. The most dominant water-consuming sector in Sri Lanka and Saudi Arabia is Agriculture, while industrial water consumption is the highest in Germany. Therefore, it is imperative to implement strategies to reduce wastage and apply conservation and treatment technologies available in developed countries to enhance the availability of safe water. In Sri Lanka, policymakers should make rules to maximize the reuse of water and protect existing water resources.

Keywords: Developing country, Per capita water consumption, Water Consumption Projections, Water Demand, Water Withdrawal

**Corresponding Author: sdrajakaruna97@gmail.com*

ANALYSIS OF ISSUES TO WASTE DISPOSAL METHODS IN RUWANWELLA DS DIVISIONIN SRI LANKA

R.A.T.M.Senanayaka*

Department of Environmental Management, Rajarata University of Sri Lanka, Sri Lanka

The study was conducted in Ruwanwella during November to January 2022. Waste disposal methods pose a serious threat on the environment. The aim of this survey was to analyze the impacts of waste disposal methods. Two semi structured questionnaires and interviews were used to collect data from 30 housewives and 30 Advanced Level (A/L) students. Information was gathered using research articles and field observation. Burning of waste was the common method used by both groups (93%,63%) of the study area. Both study groups (100%) agreed upon consequences of these methods such as, air pollution and emergence of respiratory illnesses, blockage of drainage systems, deterioration of scenic beauty, water pollution and increase of mosquito breeding grounds. According to this study, 50% of housewives agreed that waste causes floods; 37% disagreed while 13% were not concerned. On the other hand, majority of a A/L students (80%) were unaware that improper waste disposal causes floods. It indicated that both groups lack awareness about the flood risk due to improper waste disposal methods and soil infertility. It is indicated that the trend of improper waste disposal is rapidly increasing day-by-day. Hence, it is suggested to increase the perceptions of the public by means of awareness programmes for housewives and school students, and imposing stringent rules in waste disposal management.

Key words: Waste, disposal, health, environment, effect, burning

**Corresponding Author: maduwanthi19980529@gmail.com*

PHOSPHATE REMOVAL USING GREEN SYNTHESIZED IRON NANOPARTICLES BY *Syzygium aromaticum*

K. A. P. Gaminda[1], D. T. Abeysinghe[1*], C. D. Jayasinghe[2] and R. Senthilnithy[1]
[1] Department of Chemistry, [2] Department of Zoology,
The Open University of Sri Lanka, Nugegoda, Sri Lanka

Water quality is mainly linked to wastewater contaminants and the number of contaminants in the water provides a good indication of the water quality. Among these contaminants, accumulation of the phosphorous in the water bodies promotes the eutrophication process. Phosphorous is a non-renewable mineral, therefore it's crucial to recover phosphorous from the wastewater. This study investigated the green synthesis of nano zero-valent iron particles (GZVI) by Syzygium aromaticum (clove) extract as a sorptive material to remove phosphate from wastewater. The Fourier Transform Infrared spectroscopy (FT-IR) and scanning electron microscope (SEM) characterized the green synthesized novel nanomaterial. The FT-IR analysis data confirms the formation of the zero-valent iron particles by the clove extract and the fabrication of the particles with various compounds such as polyphenols in the extract. According to the SEM images, the GZVI exhibits an irregular spherical shape with a size ranging from ~67 nm to micro level due to the cluster formation. The batch experiment was conducted using ~20 ± 1 mg of GZVI with a phosphate solution with an initial concentration of 20 ppm. According to the batch experiment, phosphate concentration was reduced to 11.9 ppm within the first 10 min and reached 9.7 ppm upon the 60 min incubation. The phosphate removal efficiency by GZVI at 10 min reached 40.59 % and reached 51.32 % at the equilibrium stage. Further, the application of the GZVI to remove phosphate exhibits a promising solution for eutrophication treatment.

Keywords: Green synthesis, *Syzygium aromaticum*, Phosphate removal, Eutrophication

[*] *Corresponding Author: dtabe@ou.ac.lk*

EVALUATING THE CORRELATION BETWEEN WATER DEPTH AND WATER QUALITY IN MINOR RESERVOIRS AND ASSESSING THE IMPACT ON WATER QUALITY FROM THE SLUICE DISCHARGE POINT IN PALAPATHWALA CASCADE SYSTEM AMBANPOLA, KURUNEGALA

D.D. Perera and T.D. Denagama*
University of Vocational Technology, Sri Lanka

Irrigation technology in Sri Lanka has a long history. It has gone through various changes over time. Ancient tank systems consist of several components such as Tank Bund (*Vew Bemma*), and Sluice Gate *(Sorrowua*). Most of them were established to maintain the quality of the stored water for required purposes and efficiently regulate water usage, but from time to time some of these components disappear from the system with the generations. A special feature of the above ancient system is "*Kata Sorowwa*"(Vertical Type sluice which consist of clay pots or blocks to regulate the water). The study is carried out in the Kurunegala Ambanpola area, where nine minor irrigation tanks are situated in a cascade system. All these village tanks are considered seasonal storage tanks. There is a completely dry period in those tanks. Normally in wet conditions, all these tanks have aquatic plants and vegetation on the water's surface. In the dry period, all those aquatic plants die and start to decompose, once the water storage rises, the decomposing process continues under anaerobic conditions. This process will lead to an increase in the acidity of water. Due to sedimentation, the most contaminated particles tend to deposit near the tank bed. Continuously releasing this bottom water can have negative impacts on the environment and as well as the natural water resources quality.

This research aims to investigate the correlation between water depth and water quality in minor reservoirs and evaluate whether the quality of surface water is greater than bottom water and also identify whether changing the sluice discharge point can make a difference in water quality or not, and investigate which parameters have the most significant relationship with water.

The water quality analysis includes temperature, pH, turbidity, total dissolved solids, and electrical conductivity. Data collection is carried out on a spatial and temporal basis. Water Samples were collected as a set of samples taken along a vertical line of water depth. It is decided to have a 0.25m interval of depth water sample as with the depth of the tank. Water samples were collected in every sluice location and an additional 2 sample sets were taken from along the tank bund axis to get an average value. Samples were taken in early January just after the rainfall in December. Sampling was repeated five times with a two weeks interval for more consistency and reliability of results. A comparison was done with water quality

standards for irrigation purposes as specified in the National Environmental (Ambient Water Quality) Regulations, No. 01 of 2019 on November 5, 2019.

The study reveals a strong correlation with water depth, with some parameters indicating variation over time. Temperature shows the strongest relationship with water depth. It is gradually increasing with the water height. pH has a strong relationship, though not as strong as temperature, with 85% of data sets showing a coefficient greater than 0.8. which means a very strong relationship value is increased with the water height. DO also shows a strong relationship such as the above two parameters. 89% of the data set shows good and strong relationships, but only 2 data sets deviate completely from the others. EC & TDS values are not indicating a clear relationship with the depth as per the results.

Keywords*:* Irrigation, Tanks, Sluice, Water Quality, Surface Water

[*] *Corresponding Author:* *tdenagama@yahoo.com*

EFFICIENCY OF THE COAGULATION AND FLOCCULATION METHOD FOR THE REMOVAL OF TURBIDITY AND ALGAE FROM THE SURFACE WATER OF DRY ARU

K. Loginy[1*], N. Anoja[1] and T. Mikunthan[2]
[1]National Water Supply and Drainage Board, Sri Lanka
[2]University of Jaffna, Sri Lanka

There is frequent water scarcity in Sri Lanka as a result of spatial and temporal variations in rainfall and changing weather patterns. Huge seasonal fluctuations of turbidity and algal density in Dry Aru affect the performance of the Water Treatment Plant in Kilinochchi (KWTP). As per the operation manual, raw water turbidity must be less than 80NTU before it enters Water Treatment Plant (WTP). However, the laboratory records indicate that the turbidity increases to 320NTU-350NTU during the rainy season and algal density increases to 50 x 10^4-75 x 10^4cells/ml during dry seasons stopping the plant's efficient operations. This study aimed to evaluate the turbidity and algal removal efficiency of the coagulation-flocculation process and to ensure the continuous operation of WTP during adverse water quality conditions. During the test period, raw water turbidity vary between 10.4 to 325 NTU and the average algal density was 57.63 x 10^4 cells/ml. Aluminium Sulphate (Alum) and Poly Aluminium Chloride (PACL) were tested as coagulant chemicals. The optimum performance of both coagulants was observed at the coagulation speed of 300rpm and 1st stage flocculation speed of 30rpm for 10 minutes and 2nd stage flocculation speed of 10rpm for 10 minutes and the settling time of 30 minutes. Alum's effective turbidity removal range was 60-140 ppm and PACL was 20-40ppm. Prechlorination didn't show significant improvement in the turbidity removal efficiency of both coagulants. PACL dose of 35ppm reduces turbidity from 325NTU to 1.92NTU with and without Prechlorination. The most abundant algal species in Dry Aru were Synechococcus, Chroococcus, Gloeocapsa, Microcystis, Oscillatoria, Anacystis, and Anabaena. The algal removal efficiency of PACL and Alum 87.86% and 85.44%, respectively. The algal removal efficiency of PACL increased from 87.86% to 90.74% and Alum increased from 85.44% to 88.93% when 1ppm prechlorination was used. It can be concluded that PACL is working more effectively than Alum for Dry Aru in terms of turbidity and algal removal. The turbidity removal efficiency of 98-99% and algal removal efficiency of 87.86% to 90.74% can be obtained by coagulation-flocculation process by using PACL as a coagulant and thereby raw water turbidity can be brought to the level indicated in the operational manual.

Keywords: Turbidity, Algae, Coagulant chemical, Coagulation Flocculation

**Corresponding Author: logikuga03@gmail.com*

THE DEVELOPMENT OF CHITOSAN AND IRON OXIDE NANOPARTICLES FUNCTIONALIZED WITH CHITOSAN SOLUTION TO HARVEST HARMFUL ALGAL BLOOMS IN THE BEIRA LAKE, SRI LANKA

Niluka Priyadarshanee [1], Poorna Piyathilaka [1*], Gayan Priyadarshana [2] and K.G. Kaushani [2]

[1] Department of Environmental Technology, Faculty of Technology, University of Colombo, Sri Lanka

[2] Department of Materials and Mechanical Technology, Faculty of Technology University of Sri Jayewardenepura, Sri Lanka

Harmful algal blooms (HABs), which include both prokaryotic and eukaryotic organisms, result in the from excessive growth of algae colonies that can produce hazardous impacts on human beings, fish, shellfish, aquatic mammals, and birds. In the presence of nutrients in the water bodies, harmful algal blooms can develop rapidly and drastically deteriorate the quality of water. Therefore, it is important to prepare a solution to harvest HABs from surface waters. This study was carried out to develop the best method to harvest HABs using Chitosan and Magnetic Iron Oxide nanoparticles. Magnetic Iron oxide nanoparticles were synthesized using the co-precipitation method and functionalized with chitosan. The prepared magnetic coagulant was then used in jar test experiments to find the optimum conditions required for the maximum flocculation efficiency of algae, using water samples collected from the Beira Lake, in Sri Lanka. A series of different concentration combinations were used to test the optimum condition. The reduction efficiency of the parameters including *Microcystis* spp and *Spirulina* spp cell density was evaluated. The magnetic iron oxide nanoparticle functionalized with chitosan coagulant significantly reduced cell densities by 87% of *Microcystis* spp, and 86% of *Spirulina* spp than the chitosan coagulant. It was found that the magnetic coagulant; from the coagulation/ flocculation treatment using magnetic iron oxide nanoparticles functionalized with chitosan coagulant, could be used as an efficient treatment to reduce the cell density of harmful algal blooms, in the water samples collected from the Beira Lake.

Keywords: Harmful Algal Blooms, Iron Oxide Nanoparticles, Chitosan, Coagulant

[*]*Corresponding Author: poorna@et.cmb.ac.lk*

THE IMPACT OF SERVICE QUALITY ON TOURIST OVERNIGHT STAYS IN COLOMBO AND GALLE, SRI LANKA: TOURISTS' PERSPECTIVES

Bawanthi Koralage[1*], Thiloka Fernando[1], Thuduhenage Nilakshika[1], Naduni Madhavika[2], Panadura Jayasinghe[1] and Sandali Ehalapitiya[1]
[1]Sri Lanka Institute of Information Technology, Malabe, Sri Lanka
[2]University of Tasmania, Australia

Sri Lanka is renowned for its stunning natural beauty and this fascinating island with a rich cultural heritage and diverse landscapes and ecosystems, makes it the perfect holiday destination among adventure and relaxation-seeking tourists. However, the Sri Lankan Central Bank estimates, that there has been a reported decline in tourist overnight stays in Sri Lanka in 2021 and research suggests service quality of hotels might have been one issue. Therefore, this study aims to determine how service quality in hotels affects the number of overnight stays of tourists in the coastal areas of Colombo and Galle. This study employed a quantitative research approach using self-administered questionnaires which covered a sample of 384 foreign tourists and 35 items of a five-point Likert scale were evaluated. The survey data collection process used cluster sampling techniques to ensure representative responses. Deploying simple linear regression analysis, the impact of service quality on tourists' overnight stays was identified. It was found that there is a significant positive impact of the service quality of hotels on tourists' overnight stays in Colombo and Galle. Thus, the hotels need to maintain high service quality that will increase the tourists' overnight stays while encouraging tourists to extend their visits. The study contributes to scant business and management literature on tourism and service quality.

Keywords: Tourists overnight stays, service quality, hotels, tourist's experience, tourist's satisfaction, coastal area

**Corresponding Author: bm20470654@my.sliit.lk*

ASSESSMENT AND MAPPING OF GROUNDWATER QUALITY FOR DRINKING PURPOSES: A CASE STUDY ON VALLIPURAM COASTAL AREA, JAFFNA PENINSULA, SRI LANKA

R. Sharmilaa[1]*, N. Anoja[2] and K.A. Sirisena[1]

[1]Department of Environmental Technology, Faculty of Technology, University of Colombo, Sri Lanka

[2]National Water Supply and Drainage Board, Jaffna, Sri Lanka

The people of the Jaffna Peninsula completely rely on groundwater for all of their water requirements. The Vallipuram water supply scheme has been started by National Water Supply & Drainage Board (NWS&DB) with the construction of four groundwater wells in the Vadamarachchi sand dune aquifer. However, due to the over-extraction of groundwater from these wells, there could be a severe groundwater imbalance in the area, where aquifers are depleting and the water table is lowering. Therefore, the present study was designed to identify the availability and quality of the well water surrounding a 1.5 km radius from the four NWS&DB dug wells, and 120 domestic wells were selected for the study. This study aims at the assessment and mapping of groundwater quality parameters and assessing the Water Quality Index (WQI) to determine the potability of groundwater. Sample collection and water quality analyses were conducted according to using standard procedures. The coordinates of each sampling location were established using Global Navigation Satellite System (GNSS) RTK Receivers at the site and an interpolation technique was used to analyze the spatial patterns of drinking water quality parameters in the case study area. The Weighted Arithmetic Water Quality Index method was used to find the suitability of water for drinking purposes. The test results revealed that turbidity, colour, TDS, total hardness, total alkalinity, Chloride, Fluoride, Total Iron, Calcium, and Sulphate concentrations exceeded the Sri Lankan drinking water quality standards values. Further, pH, nitrate, nitrite, and total phosphates are within the Sri Lankan Standards for all 120 wells. Heavy metals such as Arsenic and cadmium were not detected in any of the samples but lead contamination was detected in six samples. The microbiological results indicate that the entire study area was contaminated with total coliform and *E.coli* bacteria. According to the physical and chemical parameters, the WQI value varies from 4.5 to 287.2 and 72 wells are suitable for drinking purposes. When microbiological parameters were incorporated, a mere 3 wells were deemed suitable for drinking purposes. Therefore, it is highly recommended to conduct regular chlorination or disinfection of the wells.

Keywords: Groundwater, Jaffna peninsula, Water quality, Water quality index

**Corresponding Author: sharmisharmilaa05@gmail.com*

METAGENOMICS AND 'OMICS' TECHNOLOGIES FOR ENVIRONMENTAL BIOREMEDIATION: A REVIEW

K. Vivehananthan, E.D.C. Lilani* and I. Abeygunawardena
Department of Basic Sciences, Faculty of Health Sciences
The Open University of Sri Lanka, Nawala, Nugegoda, Sri Lanka

Metagenomics is the study of a community's collective genome. It is a culture-independent study which combines various molecular tools established over the previous century, allowing researchers to better investigate the variety of microorganisms, their interdependence and unleash the possibilities of biotechnology. This review is focused on how metagenomic study and some of its "omics" approaches help to identify environmental microorganisms and their applications in the bioremediation of environmental pollutants in different studies. Metagenomics is a rapidly expanding and diversified discipline of environmental biology that aims to learn more about the genomes of environmental microbes and entire microbial communities. In metagenomic studies, DNA is directly extracted from the community, cloned into a host bacterium, created into a library, and then sequenced or screened for expression of activities of interest. Mainly, two methods are used to obtain the genetic data after the creation of a metagenomic library. In functional metagenomics, the host bacteria express the recombinant DNA in either growth-suppressive or growth-promoting ways. In sequence-based metagenomics, complementary oligonucleotides (oligos) are used to seek out a specific gene, or cloned DNA is randomly sequenced using vector-based primers. Innovative "omics" technologies, like transcriptomics, metaproteomic, metabolomics and in-silico research, have made it possible to expand the scope of metagenomics studies. Environmental microbes play an important role in the degradation and detoxification of various organic and inorganic pollutants and the biogeochemical cycling of minerals in the ecosystem. Therefore, it's necessary to understand the mechanism of bioremediation of a specific pollutant and identify the key enzyme of catabolic gene of microorganisms involved. The findings of several "omic" approaches can be combined and utilized to examine the metabolic activities of the bacteria involved in bioremediation processes. Such techniques have made it possible to examine metagenomic contaminated samples comprising diverse bacteria in a realistic and cost-effective manner. Characterization of environmental microbes will provide a fresh window into the search for undiscovered bacteria with unique catabolic genes and enzymes for the breakdown and detoxification of toxins in contaminated environments. In conclusion all environmental microbes are genetically described via metagenomics together with "omics" technologies to apply in different studies.

Keywords: Metagenomics, Omic Approaches, Bioremediation

**Corresponding Author: chathurikalilani4@gmail.com*

PRELIMINARY STUDY OF THE IMPACTS ON SALT MARSH IN KANDAKULIYA-KALPITIYA

V.A. Wickramasinghe*, M.C.L. Zoysa, and H.P.S. Jayapala
Department of Coastal and Marine Resources Management,
Ocean University of Sri Lanka, Sri Lanka

Salt marshes are part of the coast and one of the most productive and valuable ecosystems, rich in biodiversity from various flora and provide habitats for fauna. They are considered as a blue carbon ecosystem, and therefore this coastal ecosystem will greatly help mitigate the effects of global warming that we are currently facing. Presently, these valuable coastal ecosystems are mostly destroyed by direct and indirect activities by human and natural incidents. This study has investigated the impacts on the salt marsh ecosystem in the Kandakuliya-Kalpitiya area. The main purpose of this research is to study the possible effects on the salt marsh ecosystem due to human activities and natural events and to understand the value of salt marsh ecosystems. The information was collected from 23rd March 2023 to 22nd April 2023 at Kandakuliya-Kalpitiya. The primary data were obtained mainly through direct field observation, field surveys, structured interviews, and photographs. According to observations, human activities have had the greatest impact on salt marshes. According to the counted field survey results, humans used 23% of these ecosystems for salt pans, 20% for unplanned and planned constructions such as hotels, 15% for roads, 13% for waste disposal, 12% for shrimp farms, 9% for playgrounds and 8% to use as off-road vehicles. Due to these human impacts, the places where the vegetation of salt marsh was destroyed have become empty lands nowadays. Donkeys also affect the salt marsh ecosystem by grazing on salt marshes as food. In addition to that natural impacts are caused on the salt marshes in the study area. According to the observations and structured interviews, the natural impacts are climate change, monsoon, inter-monsoon periods, and others. Species of the *Salicornia* genus: *S. brachiata* and *S. bigelovii* restoration, conservation, and management can be further improved with the designation of protected areas under stronger legislative protection, more effective enforcement, and community involvement. The time has come to protect these salt marsh ecosystems at the national level.

Keywords: Ecosystem, Human impact, Kandakuliya-Kalpitiya, Saltmarsh

**Corresponding Author:* *vishmaanupama9961@gmail.com*

OCEANOGRAPHY DETERMINANTS OF THE OCCURRENCE OF DOLPHINS AND WHALES IN SOUTHERN SRI LANKA

P.L.N. Lakmali [*] ***and D.D.G.L. Dahanayaka***
Department of Zoology, Faculty of Natural Sciences,
The Open University of Sri Lanka, Nawala, Nugegoda, Sri Lanka

Sri Lanka occupies a unique location within the equatorial belt in the Northern Indian Ocean. The southern waters of Sri Lanka is biologically abundant in cetacean species such as whales and dolphins due to the deep waters found quite close to the southern shore. The presence of cetaceans has been influenced by certain oceanographic conditions. The oceanographic determinants such as the Sea Surface Temperature (SST) and Chlorophyll-a (CHL-A) concentration, which could influence the richness and distribution of cetacean species in the southern coastal area of Sri Lanka, were investigated and their relationships were studied in the present study.

The SST and CHL-A concentration were obtained from satellite data from the Aqua Moderate Resolution Imaging Spectroradiometer (MODIS) NASA Level-3 (L3). Numerical simulations were made using MODIS/Aqua to investigate the coastal upwelling of the area.

The major upwelling region is located along the southern coast, in both the Northwest and Northeast monsoon periods, resulting from the southward flow converging along the southern coast. However, higher surface chlorophyll concentrations were observed during the Southwest monsoon. The region of the flow convergence and hence, the upwelling centre was dependent on the relative strengths of wind-driven flow along southern and western coasts. The elevated CHL-A concentrations persisted for several subsequent months and was attributed to coastal upwelling. In such situations, the nutrient availability of the Southern offshore is high during the Southwest monsoon. Therefore, the abundance of the cetaceans in the southern waters is high during the Southwest monsoon period and thus, directly correlates with the availability of nutrients.

The study has opened a space for oceanographic determinants for whale and dolphin forecasting, and it could assist the sector in the scheduling of whale and dolphin watching operations to minimize the cost while bringing high economic gain to the country.

Keywords: Chlorophyll-a Concentration , MODIS, satellite data, Sea Surface Temperature,

**Corresponding Author: lakshijayarathne1113@gmail.com*

SCREENING OF AMOXICILLIN DEGRADATION POTENTIAL BY AMOXICILLIN-RESISTANT BACTERIA

Darshi Liyanage[1], Gayani Yasodara Liyanage[2,3], Kosala Sirisena[1,2] and Pathmalal Manage[2,4]*

[1]Department of Environmental Technology, Faculty of Technology, University of Colombo, Sri Lanka

[2]Centre for Water Quality and Algae Research, Department of Zoology, University of Sri Jayewardenepura, Gangodawila, Nugegoda, Sri Lanka

[3]Department of Aquatic Bioresources, Faculty of Urban and Aquatic Bioresources, University of Sri Jayewardenepura, Gangodawila, Nugegoda, Sri Lanka

[4]Faculty of Graduate Studies, University of Sri Jayewardenepura, Gangodawila, Nugegoda, Sri Lanka

Currently, many antibiotic types have been introduced to the world according to their mode of action, bacterial spectrum, route of administration, chemical structure, etc. Despite the emergence of novel antibiotics in recent years, amoxicillin (AMX) remains one of the most prescribed antibiotics due to its classification as a β-lactam antibiotic with superior oral absorption and a broad spectrum of activity against many gram-positive and some gram-negative bacteria. The widespread use of amoxicillin has resulted in the accumulation of the compound in the environment, eventually, it is leading to generate antibiotic-resistant bacterial strains and produce toxicity in ecosystems. The present study aims to evaluate the AMX degradation feasibility of 55 AMX resistant bacteria isolated from the hospital wastewater samples. MT2 plate assay was used to screen the 55 bacterial strains. This assay aimed to identify bacterial strains that can grow in the presence of amoxicillin, utilizing it as their sole carbon source. The bacteria identified as AMX degraders were subjected to 96 well plate method to determine the highest degraders against environmental detection amoxicillin concentration. Eight bacterial strains were selected according to the absorbance level (>0.500): *Micrococcus luteus, Bacillus cereus* (DJ080579.1), *Bacillus subtilis, Lactobacillus bulgaricus, Lactobacillus* sp. (DI438712.1), *Enterobacter aerogenea, Bacillus cereus* (EU678635), and *Lactobacillus* sp. (HW413258.1). Furthermore, the biodegradation ability of selected 8 bacterial strains was evaluated against different concentrations of AMX based on environmental detection level. To complete that 10µg/l of overnight starved bacterial suspensions were added into the sterile antibiotic medium in triplicate at a final concentration of 2.5µg/l, 5µg/l, 7.5µg/l. The samples were incubated at 28^0C for 14 days. Analyses of antibiotic degradation were performed by Enzyme-Linked Immunosorbent Assay (ELISA) at 595nm through absorbance value. Most bacterial strains show their high potential for degradation at 2.5 µg/l concentration, with considerable potential observed at 5µg/l. As a trend, the high potential to degrade amoxicillin was shown at three different concentrations by *Bacillus cereus* EU67863. Accordingly, those

amoxicillin-resistant bacteria show their high potential to use biodegrading amoxicillin at the lowest concentrations (<5µg/l).

Keywords: Antibiotic, β - lactam Antibiotics, Amoxicillin, Amoxicillin Resistant Bacterial Strains, Biodegradation, ELISA

*Corresponding Author: pathmalal@sjp.ac.lk

HEALTH SCIENCES

NON-PHARMACOLOGICAL METHODS USED IN THE MANAGEMENT OF TYPE 2 DIABETES MELLITUS (T2DM) BY PATIENTS ATTENDING A DIABETIC CLINIC AT A TERTIARY CARE HOSPITAL IN COLOMBO, SRI LANKA

H.M.L.P.B. Herath[1], J.P.M. Kamalsiri[1], P. Inthuja[1*], K.G.G. Priyangika[2] and D. Vidanage[2]

[1,2] Department of Nursing & Midwifery, Faculty of Allied Health Sciences, General Sir John Kotelawala Defence University, Sri Lanka

Type 2 diabetes mellitus (T2DM) is a major public health problem with high morbidity and mortality. The latest findings, reported that Sri Lanka had the highest rate of diabetes in Asia with a prevalence of 23%. As control of T2DM is vital, this study aimed at assessing the awareness, practices, and associated barriers to using non-pharmacological methods in the management of T2DM in a selected group of diabetics.

A mixed method study was conducted (quantitative and qualitative) among the patients who attended the diabetic clinic at University Hospital-KDU. A conveniently selected sample of 138 was recruited to the study. Data collection was done through a self-administered questionnaire and by one-to-one interview. Gathered data were analyzed by using SPSS 25.0 and by thematic analysis.

The majority (61.6%) of the sample were females. The mean blood glucose level of the sample was 138.40 mg/dl (SD ± 46.145). The mean duration of diabetes was 10.62 (SD±7.97) years while 34.8 % had a positive family history of T2DM. Around 61.6% had 'fair knowledge' of non-pharmacological management of T2DM. Diet control was followed by 62.2%, exercises (Aerobic, Stretching, etc.) by 16%, and stress management by 1.9% of the participants. The average duration of exercise is 10 minutes per session. No association was found between knowledge and gender whereas the duration of exercise was statistically significant with the gender (p=0.013). In qualitative analysis, 'low income' and 'family-centered food culture' were identified as the most common barriers to diet control. 'Lack of time' and 'aging' were the main reasons for poor adherence to exercises while poor weight control was noted due to 'lack of mindful diet' and a 'busy lifestyle'.

The practices were not up to the standards of current recommendations. It highlights the need to improve the motivation of participants to adapt to a healthy lifestyle by overcoming possible barriers.

Keyword**:** Type 2 Diabetes Mellitus, Awareness, Practices, Barriers

**Corresponding author: inthupera@gmail.com*

AN ATTEMPT TO ESTABLISH A CUTOFF VALUE FOR PERIPHERAL BLOOD ABSOLUTE MONONUCLEAR CELL COUNT TO PREDICT THE VIABLE CD34 COUNT IN MULTIPLE MYELOMA PATIENTS UNDERGOING AUTOLOGOUS PERIPHERAL BLOOD STEM CELL TRANSPLANTATION

T.D. Hewapathirana[1*], T.C. Perera[1], R. Tudugala[2], S. Suresh[3] and D.U. Kottahachchi[1]

[1]Department of Medical Laboratory Science, [2]Department of Radiography and Radiotherapy, Faculty of Allied Health Sciences, General Sir John Kotelawala Defence University, Rathmalana, Sri Lanka.

[3]Department of Hematology, Apeksha Hospital, Maharagama, Sri Lanka

Autologous Peripheral Blood Stem Cell Transplantation (PBSCT) has emerged as a vital therapeutic intervention for multiple myeloma (MM) patients. However, the success of PBSCT relies on various factors, including the composition of peripheral blood cells. Specifically, the absolute mononuclear cell count in peripheral blood (AB_MNC_PB) has been identified as a potential predictor of the viable CD34 cell count (V_CD34) in MM patients undergoing autologous PBSCT. Determining this cut-off value improves autologous PBSCT effectiveness in multiple myeloma.

The aim of this study was to establish a cutoff value for AB_MNC in peripheral blood to predict V_CD34 in the peripheral blood of MM patients undergoing PBSCT. This enables decentralization of the process of PBSCT by replacing the flow cytometer (FC) with the automated hematology analyzer (AHA) or manual method.

MM patients at the age of 40-65 years, and admitted to the Bone Marrow Transplant Unit in Apeksha Hospital, Maharagama were selected for the study (n=45). The results of AB_MNC_PB from AHA and V_CD34_PB from FC were obtained and, AB_MNC_PB was enumerated manually after performing differential counts (DC) counts on the day of harvesting. Statistical analysis was performed using IBM SPSS v26. First, the data were separately tested for normalization, followed by correlation bivariate analysis and, receiver operating characteristic (ROC) curve analysis to establish relationships and cutoff values for AB_MNC_PB.

V_CD34_PB_FC and AB_MNC_PB enumerated from both manual and AHA showed normal distributions ($p>0.05$). Only AB_MNC_PB_AHA represented a weak positive significant ($p=0.038$) correlation with V_CD34_PB. As there was no direct strong correlation between them, a cutoff value was obtained for AB_MNC_PB using the ROC curve. Accordingly, the cutoff value of AB_MNC_PB is 7000/µL at V_CD34_PB of 92.3/µL with a sensitivity (86.7%), specificity (56.2%), and area under the curve (AUC) of 0.696 ($p=0.000$). However, AB_MNC_PB_Manual did not provide reliable results.

AB_MNC_PB_AHA can be used as a predictive marker to determine V_CD34_PB_FC as an alternative for FC. Furthermore, these initial findings should be validated by performing the same process with a large cohort of MM patients.

Keywords: Multiple Myeloma; Autologous Peripheral Blood Stem Cell Transplantation; Mononuclear Cells; Flow Cytometer

**Corresponding author: dtharushikakdu@gmail.com*

PSYCHOSOCIAL EXPERIENCES OF TEENAGE GIRLS DURING THE COVID-19 PANDEMIC GAMPAHA MOH AREA

M.H.J. Sandareka, H.L.I.G. Kumari, T.A.D.W. Kulathunga, P.H.B.U. Amarasinghe, and K.A .Sriyani*

Department of Nursing, Faculty of Health Sciences, The Open University of Sri Lanka, Sri Lanka

The COVID-19 pandemic imposed substantial psychological and social consequences on individuals and families, especially teenagers' lives. They have lost their education and social contacts with family, relatives, peers, and teachers. However, their experiences are poorly studied, with special reference to teenage girls both globally and locally. Therefore, the present study aimed to explore the psychological and social experiences of teenage girls during the COVID-19 pandemic. A qualitative approach and phenomenological design were utilized. Fourteen teenage girls (13–19 years old) were selected from the Gampaha MOH area using purposive and snowball sampling techniques. Face-to-face, semi-structured, in-depth interviews were conducted using an interview guide until the data saturation point was reached. In addition, participants' facial expressions and body gestures were noted. All the interviews were recorded and transcribed verbatim, and a thematic data analysis approach was performed. This study was approved by the Ethics Review Committee of the University of Kelaniya. Three themes, including adapting to new conditions, psychological discomfort, and attitudes towards the disease, emerged under psychological experiences. Most teenage girls made alterations to their routine activities. They feared getting infected, hospitalization, and the severity of complications, including death, and were excessively worried about the lack of peer relationships to share their feelings. The social experiences of teenagers were revealed through three themes: relationships with others, continuity of education, and family income. Teenagers were happy about the caring relationship with their neighbours, relatives, and peers and satisfied with the medical guidance that they received during the infected period. Though most of the teenagers were worried about the missed syllabus and postponement of scheduled examinations, some were happy about the school closure due to their decreasing tiredness from travelling traveling by bus. While some of them thought of online education as a new way to continue their education in a changing world, others thought of it as a boring method of learning. Further, teenagers experienced financial issues in their families during the pandemic. In conclusion, the COVID-19 pandemic and its restrictions have had a significant impact on teenage girls' lives. Therefore, it is needed to provide more support to teenagers and their families to buffer the challenges they faced during and after the pandemic.

Keywords: COVID-19 pandemic, teenager girls, psychological experiences, social experiences

**Corresponding Author: kasri@ou.ac.lk*

EVALUATION OF *IN VITRO* ANTI-INFLAMMATORY AND ANTIBACTERIAL PROPERTIES OF TUBEROUS ROOTS OF *Mirabilis jalapa* (SINHALA NAME: HENDIRIKKA)

D. S. H. S. Peiris[1*], D. T. K. Fernando[1], S. P. N. N. Senadeera[3], C. B. Ranaweera and A. K. Chandana[2]

[1]Department of Medical Laboratory Sciences, [2]Department of Basic Sciences, Faculty of Allied Health Sciences, General Sir John Kotelawala Defence University, Sri Lanka

[3]Department of Medical Laboratory Sciences, Faculty of Health Sciences, The Open University of Sri Lanka, Sri Lanka

Mirabilis jalapa Linn. (Sinhala name: Hendirikka) commonly called the four-o'clock plant or Marvel of Peru, is a popular ornamental plant also valued for its folklore remedies worldwide. This plant is found to be rich in ethnomedicinal properties and pharmacological properties. According to the Compendium of medicinal plants: a Sri Lankan Study, volume iv, ancient Sri Lankans have used *M. jalapa* tuberous roots as a purgative and it is also used to treat mild diarrhoea, edema, and bruises. The present study was carried out to evaluate the anti-inflammatory and antibacterial activities of aqueous and organic (methanol, dichloromethane, and hexane) solvent extracts of tuberous roots of *M. jalapa.*

The anti-inflammatory activity was observed using two *in vitro* models: Egg albumin denaturation inhibition assay and the human red blood cell membrane stabilization (HRBC) method. For anti-bacterial activity, both well and disc diffusion methods were utilized against wound pathogens *Staphylococcus aureus, Escherichia coli,* and *Pseudomonas aeruginosa*.

According to the results of our study, it reveals that the tuberous root extracts of *M. jalapa* have shown significant anti-inflammatory potency. In the egg albumin denaturation inhibition assay, the highest anti-inflammatory potency was exhibited by the methanol extract with an IC_{50} (Half-maximal inhibitory concentration) value of 137.8 µg/mL while in the HRBC method, the aqueous extract showed the highest potency with an IC_{50} value of 197.4 µg/mL. There was no significant antibacterial activity shown by all four extracts. However, there were some zones of inhibition observed against *S. aureus* in the well diffusion method. The highest antibacterial activity was expressed by the dichloromethane extract, with a concentration of 400 mg/mL and the inhibitory zone was 15.33 ± 0.33 mm, followed by the hexane extract with an inhibitory zone of 14.00 ± 2.08 mm at the same concentration of 400 mg/mL. In the meantime, the dichloromethane extract showed an inhibitory zone of 11.00 ± 0.58 mm at a concentration of 200 mg/mL against *S. aureus*.

The present study reveals that the tuberous roots of *M. jalapa* have promising anti-inflammatory activity while not having a significant antibacterial activity against selected pathogens *S. aureus*, *E. coli*, and *P. aeruginosa*.

Keywords: *Mirabilis jalapa* Linn, folklore, anti-inflammatory, anti-bacterial*

**Corresponding Author:* sajanipeiris98@gmail.com

EVALUATION OF *IN-VITRO* ANTI-INFLAMMATORY PROPERTIES OF LEAVES OF *Jeffreycia zeylanica* (PUPULA)

Thumuli Samaraweera[1*], Thummini Samaraweera[1], Nimesha N. Senadeera[2], and Chathuranga B. Ranaweera[1]

[1]Department of Medical Laboratory Sciences, Faculty of Allied Health Sciences, General Sir John Kotelawala Defence University, Rathmalana, Sri Lanka

[2]Department of Medical Laboratory Sciences, Faculty of Health Sciences, The Open University of Sri Lanka, Nawala, Sri Lanka

The medications known as non-steroidal anti-inflammatory drugs are frequently used to treat inflammation and relieve pain. But non-steroidal anti-inflammatory drugs have adverse side effects, as an alternative we can use plant extract**.** *Jefferycia zeylanica* (Pupula) is an endemic plant which is used to treat inflammatory conditions.

This study was aimed to investigate the *in vitro* anti-inflammatory activity of aqueous, methanol, dichloromethane, and hexane extracts of *Jeffreycia zeylanica* leaves using the egg albumin denaturation method and Human Red Blood Cell membrane stabilization method.

Matured leaves of *J. zeylanica* were collected, washed, and air dried. Then the leaves were ground into a fine powder using a grinder. The extractions were obtained using the maceration method and concentrated using a rotary vacuum evaporator. The egg albumin denaturation and Human Red Blood Cell membrane stabilization methods were used to evaluate the anti-inflammatory activity of the plant. Diclofenac sodium was used as the positive control.

In egg albumin denaturation method, hexane leaves extract (IC50 154.9 µg/mL) showed the highest inhibition of protein denaturation compared to Diclofenac Sodium (IC50 179.2 µg/mL). **P values and R^2** of the plant extracts suggested a statistically significant correlation ($P < 0.05$) between concentration and % inhibition of egg albumin denaturation. In the Human Red Blood Cell method, Diclofenac sodium indicated an **IC_{50} value of 77.05 µg/mL. Dichloromethane extract of *J. zeylanica* leaves indicated an IC_{50} value of 188.6 µg/mL. In this method also, all the plant extracts indicated a** statistically significant correlation ($P<0.05$) between concentration and % protection of red blood cell membrane. **Dichloromethane** extract showed the highest efficacy and potency similar to the positive control diclofenac sodium.

Jeffreycia zeylanica leaves extracts showed considerable anti-inflammatory activity. Hexane leaves extract of *J. zeylanica* indicates the highest potential activity using the protein denaturation method. The **dichloromethane** leaf extract of *J. zeylanica* indicated the highest potential activity using the Human Red Blood Cell membrane stabilization method. Further studies are necessary to determine

the mechanisms and to evaluate active compounds that affect the anti-inflammatory activity of the plant.

Keywords: Anti-Inflammatory activity, Egg Albumin Denaturation Method, HRBC Method, *Jeffreycia zeylanica*, Endemic.

* *Corresponding Author: rbbud@ou.ac.lk*

RELATIONSHIP BETWEEN GENES INVOLVED IN ANTIBIOTIC RESISTANCE AND BIOFILM PRODUCTION IN BIOFILM-FORMING BACTERIA

K. Vivehananthan, S. Thevashayinath* and I. Abeygunawardena
Department of Basic Sciences, Faculty of Health Sciences, The Open University of Sri Lanka, Nawala, Nugegoda, Sri Lanka

The majority of bacteria in nature reside in complex sessile communities known as biofilms that are firmly attached to biotic or abiotic surfaces. The diverse microbial organisms present in biofilms as a compact group of microbial consortia show extraordinary resistance to conventional biocides, antibacterial treatments, and the immune defense responses of the host. The formation of these sessile communities and their intrinsic resistance to antibacterial treatments are at the root of many persistent and chronic bacterial infections. The increased tolerance of bacteria in biofilms towards antibacterial compounds and the host immune system constitutes a central issue in the treatment of bacterial infections. Studies proved that specific physiological growth conditions of biofilm and genetic interactions within the biofilms caused a dramatic increase in tolerance to the antibacterial agents. The expression of biofilm-related genes is highly correlated with phenotypic biofilm development. Therefore, this review focuses on the genes involved in antibiotic resistance, biofilm production and its expression. There are various methods available for analyzing gene expression in biofilm formation. Especially, microarray analyses *in vivo* expression technology has recently been used to study gene expression in biofilms. Recent genomic studies have identified many of the genes and gene products differentially expressed during biofilm formation, revealing the complexity of this developmental process of biofilm. It has been demonstrated that the levels of gene expression between biofilm and planktonic populations differ significantly. These differences could be the result of quorum-sensing mechanisms or the adaptability of bacteria to show increased tolerance to different stresses. However, a comparison of the differentially expressed gene sets identified in biofilm bacteria reveals that no common expression pattern for biofilms has been identified yet. The genes associated with biofilm formation are found to be up- and down-regulated differently in different scenarios. However, understanding the genetic and molecular basis of bacterial community behavior will lead to potential therapeutic targets that could consequently lead to reductions in mobility and mortality rates.

Keywords: Biofilm, Biofilm forming genes, Antibiotic resistance

**Corresponding Author: sajanthaa@gmail.com*

QUALITY EVALUATION OF PARACETAMOL SPLITTING TABLETS AVAILABLE IN COMMUNITY PHARMACIES IN JAFFNA MUNICIPAL COUNCIL AREA, SRI LANKA

S. Thuvaragan [1*], K. Darshani [1], T. Pralackshi [1] and T. Manoranjan[1 2]
[1]Faculty of Allied Health Sciences, [2]Faculty of Science,
University of Jaffna, Sri Lanka

Paracetamol is a widely used over-the-counter medicine which is an analgesic and antipyretic. It is frequently subjected to splitting for giving accurate doses to children. Not only whole tablets but also half tablets should have equivalent good quality to ensure the safety, efficacy and cost-effectiveness of treatment. This study evaluated the quality of whole and split tablets from ten brands of paracetamol 500mg tablets available in the Jaffna municipal council area. The tablets were examined for physical characteristics and hardness, friability and disintegration tests according to British pharmacopoeia (BP) 2017 specifications. Further, the half tablets obtained after splitting by hand and tablet cutter were subjected to weight variation, friability, disintegration and uniformity of content tests adopted from British Pharmacopoeia (BP) 2017 specifications. Furthermore, splitting tablets were checked for compliance with the subdivision test prescribed by European Pharmacopoeia and the loss of weight requirement prescribed by the United States, Food and Drug Regulatory Authority (US FDA). All hand and tablet cutter split tablets failed to comply with BP 2017 weight variation standards. All splitting tablet products met the friability specification where friability percentages range of hand and tablet cutter split tablets ranges were 0.07-1.0 and 03-1.0 %. Also, the hand and cutter split tablets of different brands' disintegration time ranges were 072-4.68 to 0.83-6.23 minutes respectively. Four brands of hand split tablets failed to comply with both the subdivision requirement and the US FDA weight loss requirement. No significant difference was observed between weight loss of tablet splitting and the hardness of whole tablets in the tablet splitter ($p=0.3861$) and hand splitting method ($p=0.3162$). Further, all cutter split paracetamol tablets failed to meet pharmacopeial and FDA standards. Only four brands of hand split tablets out of ten brands complied with weight variation and weight loss tests. Appropriate split cutter should be used to split the tablets accurately.

Keywords: Paracetamol, Quality, Tablet Splitting

[*] *Corresponding Author: sthuvaragan@univ.jfn.ac.lk*

AN ATTEMPT TO ASSESS THE 10-YEAR RISK FOR ATHEROSCLEROTIC CARDIOVASCULAR DISEASE FROM TOTAL CHOLESTEROL TO HIGH-DENSITY LIPOPROTEIN RATIO AMONG A GROUP OF HEALTH AND ADMINISTRATIVE STAFF OF UNIVERSITY HOSPITAL-KDU

T.N. Wakwella[1*], D.I.K. Welivitigoda[1], R. Tudugala[2], S.P.N.N. Senadeera[3], C.B. Ranaweera[1], D.U. Kottahachchi[1] and N. Wijesinghe[4]

[1]Department of Medical Laboratory Sciences, [2]Department of Radiography and Radiotherapy, Faculty of Allied Health Sciences, General Sir John Kotelawala Defence University, Rathmalana, Sri Lanka

[3]Department of Medical Laboratory Sciences, Faculty of Health Sciences, The Open University, Nawala, Sri Lanka

[4]Faculty of Medicine, General Sir John Kotelawala Defence University, Rathmalana, Sri Lanka

Cardiovascular disease (CVD) is the most common cause of death worldwide. Identifying risk factors for CVD is crucial for risk assessment, and preventing adverse outcomes. The Atherosclerotic Cardiovascular Disease (ASCVD) risk estimator has been developed to reduce the 10-year predicted ASCVD risk and guide for primary prevention.

This study was aimed to assess the predictability of a 10-year risk for ASCVD from total cholesterol to high-density lipoprotein ratio **(**TC: HDL) using the ASCVD risk estimator.

A total of 65 volunteer participants of the health and administrative staff of UH-KDU between ages 40-70 years were selected for the study. The "ASCVD-Risk-Estimator-Plus-Mobile and Web-App-American College of Cardiology" was used for the estimation of ASCVD risk. The lipid profile parameters of the participants were performed manually. The TC:HDL was grouped into three; Group-01:TC:HDL<3.5, Group-02:3.5≤TC:HDL<5.0, Group-03:TC:HDL≥5.0. Statistical analysis was performed using IBM-SPSS_V26. First, the data were tested for the normalization. Since none of the parameters followed the normal distribution, a non-parametric Mann-Whitney U test was applied for sub-group-wise analysis. Finally, the Kruskal-Wallis Test was used to determine the statistically significant mean difference of the three sub-groups of non-parametric data. The non-parametric Spearman bivariate analysis was performed for the two sets of data to get significant correlations.

Mean values of ASCVD_10 and Low-Density Lipoprotein (LDL) were continuously increased from Group-01 to Group-03 (ASCVD_10: Group-01:1.933, Group-02:4.362, Group-03:6.595; LDL: Group-01:93.64, Group-

02:126.99, Group-03:158.64). The Kruskal-Wallis Test showed a significant difference (p=0.00) in mean values for ASCVD_10 and LDL, based on all three TC: HDL groups. In the sub-group-wise analysis by Mann-Whitney U Test, the ASCVD_10 and LDL still showed significant ($p<0.05$ & $p<0.01$) differences among all groups. In the Spearman bivariate analysis, both the ASCVD_10 and LDL showed significant ($p<0.00$) moderate correlations ($r=0.462$) with the whole group data of TC: HDL.

These results indicate significant relationships between the TC: HDL and ASCVD_10 and also between the TC: HDL and LDL. The initial findings provide evidence for the potential predictability of ASCVD_10, but additional research is required to establish the more strengthen relationships to improve the accuracy of the predictions.

Keywords: TC: HDL, 10-year ASCVD Risk, LDL

[*]*Corresponding Author:* *wknthilini@gmail.com*

STUDY THE VARIATIONS OF LYMPHOCYTES IN PERIPHERAL BLOOD AND BONE MARROW IN ACUTE LYMPHOBLASTIC LEUKEMIA PATIENTS UNDERGOING THE INDUCTION PHASE OF THE CHEMOTHERAPY

N.V. Warnakulasuriya[1*], D.N. Wanigasinghe[1], R. Tudugala[2], P. Herath[3] and D.U. Kottahachchi[1]

[1]Department of Medical Laboratory Science, [2]Department of Radiography and Radiotherapy, Faculty of Allied Health Sciences, General Sir John Kotelawala Defence University, Rathmalana, Sri Lanka

[3]Department of Hematology, Apeksha Hospital, Maharagama, Sri Lanka

Leukemia (ALL) is the second most common acute leukemia in adults. It has two main categories; B ALL and T ALL. The current method for monitoring ALL is through bone marrow aspiration, which can be difficult to perform and time-consuming. Therefore, finding an alternative method to detect ALL is absolutely required.

This was aimed to study the variations of Lymphocytes in Peripheral Blood (PB) and Bone Marrow (BM) in different chemotherapy phases of B & T ALL.

A total of 105 newly diagnosed ALL patients in ages 5-50 years; 75 with B ALL and 30 with T ALL, attended the Haematology Clinic at Apeksha Hospital, Maharagama was selected for the study. Laboratory investigations; Lymphocyte percentage in Peripheral Blood (L%_PB) was obtained from analyzer reports and verified through a manual Differential Count, Lymphocytes in Bone Marrow (L%_BM) and, Blast cell percentage in Bone Marrow (BL%_BM) from myelogram reports. Blast-to-Lymphocytes-Ratio in the BM (BLR_BM) was calculated. The patients were followed throughout the Initial (D0), Induction I & 2 (D8 & D29) chemotherapy phases. Statistical analysis was performed using IBM SPSS v26. First, the data were tested for normalization, followed by the Wilcoxon Signed Ranks Test considering two groups at a time.

Since the data did not follow the normal distribution non-parametric tests were used. In B ALL, Wilcoxon Signed Ranks Test results revealed that the L%_PB showed increased mean values while D8-D29 showed mild decreased mean values with a statistical significance ($p=0.000$). The L%_BM too followed a similar pattern with a significance ($p=0.000$) in all the phases of D0 to D29. BLR_BM followed the opposite pattern of the L%_BM with a significance ($p=0.000$) in all the phases. In T ALL the results are similar and, the L%_PB was only in D0-D8, L%_BM in D0-D8 & D8-D29, and BLR_BM in D0-D8 & D0-D29.

Initial findings revealed that the chemotherapy has induced the Lymphocytes of PB and BM by regulating the Lymphoblasts in the BM as the mean values of BLR

decreased at the end of the induction phase and, to be validated by increasing the number of patients.

Keywords: Acute Lymphoblastic Leukemia, Induction Chemotherapy, Blast-to-Lymphocyte-ratio, Bone marrow lymphoblasts.

[*]*Corresponding Author: nethmiviranya98@gmail.com*

A RETROSPECTIVE STUDY OF PLATELET INDICES IN THE ABSENCE OF THROMBOCYTOPENIA IN COVID-19 PATIENTS UNDERGONE TREATMENT AT UNIVERSITY HOSPITAL, GENERAL SIR JOHN KOTELAWALA DEFENCE UNIVERSITY (UH-KDU)

H.N. Ranasinghe[1*], R.D.K.K. Kumarasinghe[1], K.G.K.G. Jayawardana[1], I. Somaratne[2] and D.U. Kottahachchi[1]

[1] Department of Medical Laboratory Sciences, Faculty of Allied Health Sciences, General Sir John Kotelawala Defence University, Rathmalana, Sri Lanka

[2] Department of Para Clinical Sciences, Faculty of Medicine, General Sir John Kotelawala Defence University, Rathmalana, Sri Lanka

Hematological parameters like platelets (PLT) and platelet indices (PLT-IND) were affected more frequently in COVID-19. Although, most patients with complications have shown thrombocytopenia associated with changes in the PLT-IND, still there were seriously ill patients without thrombocytopenia.

The purpose of this study was to find out the effects of PLT associated indices on COVID-19 patients in treatment at University Hospital-General Sir John Kotelawala Defence University **(**UH-KDU), who were not presented with thrombocytopenia.

The study was conducted with 100 COVID-19 infected patients; ages between 18 – 90 years and confirmed using Real Time Polymerized Chain Reaction (RT-PCR) tests in August to October 2021 at UH-KDU. They have not been associated with thrombocytopenia for all 7 days. The recorded data of PLT and PLT-IND of day 1 to 7 were obtained from the Department of Haematology, UH-KDU. A statistical analysis was performed using IBM-SPSS-Version_21. First, the data were tested for normalization, followed by Wilcoxon Signed Rank Test analysis to compare their means between 2 to 7 days.

The mean values of PLT and Plateletcrit (PCT) continuously increased from day 1 – 7 within their normal range while the Platelet Distribution Width (PDW) showed almost constant. Mean Platelet Volume (MPV), Platelet Large Cell Count (PLCC), Platelet Large Cell Ratio (PLCR) had minor variations. Since they did not follow normal distribution, the non-parametric Wilcoxon Signed Rank Test was performed. Pairs of PLT and PCT showed a significant difference ($p<0.05$) among the mean values of them from day 1 – 5 meanwhile PLCC showed a significant difference ($p<0.05$) from day 1 – 3. However, none of the parameters were able to show a significant difference from day 1 – 7.

The significant increasing tendency of PLCC in day 1 – 3 indicates that the bone marrow made an early attempt to make large platelets even in the absence of thrombocytopenia in COVID-19. However, as the PLT continuously increased

from day 1 – 7, the mean PLCR did not show any significant difference. These initial findings should be validated by increasing the number of patients and obtaining the PLT and PLT-IND for consecutive days.

Keywords: COVID-19, platelets, thrombocytopenia, platelet large cell count

**Corresponding Author: hasiniranasinghe2295@gmail.com*

KNOWLEDGE AND ATTITUDES ON PATIENT COUNSELING AMONG PHARMACISTS AT STATE HOSPITALS IN CENTRAL PROVINCE, SRI LANKA

R.W.M.J.P. Jayasekara[1], R.B.J. Buddika[2*], W.M. Chathurani[2] and N.D.D.Wickraramasinghe[2]

[1]The National Hospital, Kandy, Sri Lanka

[2]Department of Pharmacy, Faculty of Health Sciences, The Open University of Sri Lanka

Patient counselling is an important aspect of healthcare, particularly in pharmacy practice. Effective patient counseling can improve medication adherence and reduce adverse effects. This study aimed to assess the knowledge and attitudes of pharmacists toward patient counseling in state hospitals in Central Province, Sri Lanka. A cross-sectional study was conducted among pharmacists working in state hospitals in Central Province, Sri Lanka. A self-administered questionnaire was used to collect data on the knowledge and attitudes of pharmacists toward patient counseling. A total of 119 pharmacists participated, with a majority of the pharmacists (81%) having obtained the Diploma of Pharmacy offered by the Ministry of Health, while 9% had a degree qualification in pharmacy and 9% had other degrees as their highest educational qualification. A large proportion (69%) of the pharmacists had more than 10 years of experience working as hospital pharmacists. The study identified multiple factors that prevented pharmacists from engaging in patient counseling, including lack of knowledge (60%), not updating on drug information (67%), and high patient load (82%). Despite these barriers, 99% of pharmacists agreed that patient counseling was one of the duties of pharmacists. Only 38% of the pharmacists responded that they would feel embarrassed if they did not know how to answer questions from patients. These findings suggest that pharmacists may feel comfortable seeking additional information or resources to improve their knowledge and better serve their patients. The majority of the pharmacists had positive attitudes toward patient counseling, with some gaps and barriers identified. Efforts should be made to address the identified barriers, such as providing more training and resources, updating drug information, and managing patient load, to improve patient counseling services. Additionally, strategies to promote continuing education and professional development may be useful in enhancing the knowledge and skills of pharmacists. Overall, this study highlights the importance of patient counseling as a key responsibility of pharmacists in promoting optimal patient outcomes and underscores the need for ongoing efforts to support pharmacists in this vital role.

Keywords: Knowledge, Attitudes, Patient Counselling, Pharmacists, Hospitals

[*]*Corresponding Author: rbbud@ou.ac.lk*

HUMANITIES AND SOCIAL SCIENCES

AN INQUISITORIAL EXAMINATION OF PUBLIC POLICIES ENACTED FOR ANCIENT SOCIAL WELFARE (FROM THE ANURADHAPURA KINGDOM)

H.K. Pabasara*

Department of History and Archaeology, University of Ruhuna, Sri Lanka

This study examines public policies enacted for social welfare during the Anuradhapura Kingdom, a historical period in Sri Lanka that spanned from the 4th century BCE to the 11th century BCE. This research sheds light on the policies and initiatives implemented to promote social welfare within the kingdom by delving into ancient texts, inscriptions, archaeological evidence, and historical accounts. The research acknowledges the challenges of studying archaic policies due to limited written records and the need to interpret archaeological findings. However, by employing an interdisciplinary approach and integrating historical research with various sources of evidence, this study aims to provide valuable insights into the social welfare policies enacted during the Anuradhapura Kingdom. Qualitative research methodology was used here. Accordingly, the literature survey collected the data, and primary and secondary sources were used. The investigation focuses on several key areas, including providing citizens with basic needs such as food and water. It also examines the availability and accessibility of healthcare and medical services, promoting education and knowledge dissemination, social support systems for vulnerable groups, infrastructure development, and the legal frameworks governing social welfare. By understanding the ancient policies and practices that supported social welfare in this historical context, this research contributes to our broader understanding of the evolution of social welfare and governance systems throughout history. Furthermore, it offers a basis for comparison with contemporary approaches to social welfare, highlighting potential lessons that can be learned and applied in the present day.

Keywords: Anuradhapura Kingdom, Infrastructure, Vulnerable, Social Welfare, Public Policies

* *Corresponding Author: kavinn178@gmail.com*

A HISTORICAL STUDY OF THE RISE AND FALL OF CHRISTIANITY IN CHINA DURING THE TANG AND YUAN DYNASTIES

Sanduni Mahesha Samarasinghe*

Department of Humanities, Aquinas College of Higher Studies, Sri Lanka

China is a communist country that is multi-ethnic and multi-religious. Buddhism, Islam, Taoism, Confucianism, Judaism, Chinese folk religions, and Christianity are among the different religions and beliefs that exist in China. China has been ruled by several dynasties throughout its history. According to the historical and literary sources on China, Chinese church history can be traced back to the Tang dynasty in the seventh century. After the decline of the Tang dynasty, Christianity disappeared from China. Once more Chinese Christianity was restored and expanded during the Yuan period in the thirteenth century. After the collapse of Yuan dynasty, Christianity once more disappeared in China. My research problem is "What are the historical factors that influenced the absence of a history of Christianity in China that continuously existed and spread during the Chinese imperial reigns ruled by different royal dynasties?" The main objective of this study is to examine the historical factors that influenced the disappearance of Christianity in China during the Tang and Yuan dynasties. The study of the Tang dynasty's archaeological findings of the beginning of Chinese Christianity, as well as the Yuan dynasty's origins and spread of Christianity during the Yuan dynasty, are the other objectives of the research. The historical research method was used for this qualitative study. After taking the historical evidence into consideration, the causes of Chinese Christianity's rise and fall throughout the Tang and Yuan dynasties were critically examined. At the end of the research, it was determined that the political support and religious freedom of each dynasty played a vital role in how quickly Christianity expanded. After the collapse of those dynasties, Christianity did not receive political patronage and religious freedom. And the Nestorian missionary service centers of the missionaries in Persia who spread Chinese Christianity were attacked by Islamic invaders. As a result, following the Tang and Yuan periods, Christianity vanished from China.

Keywords: China, Christianity, Dynasties, Church History, Tang, Yuan

**Corresponding Author:* sadunim7@gmail.com

A GIS-BASED EVALUATION OF THE EFFECTIVENESS OF BREAKWATERS FOR COASTAL CONSERVATION, A CASE STUDY OF THE WEST COAST OF SRI LANKA

M.A.S. Manoj Madduma Arachchi*

Faculty of Graduate Studies, University of Sri Jayewardenepure, Gangodawila, Nugegoda, Sri Lanka

Sea level rise driven by global warming is considered one of the major consequences caused by climate change. As a tropical island, Sri Lanka is one of the most vulnerable countries subject to climate change and one face of it is the increased coastal erosion around the country. The Sri Lankan government has implemented different projects to reduce the country's coastal erosion; one project is constructing breakwaters and groins in areas with high erosional rates. The objective of this study was to measure the difference between the erosional and accretional levels of the Kalutara shoreline during two periods before the construction of hard structures and after the construction of those structures. Shoreline changes between 1985 and 2022 have been extracted from the west coast of Sri Lanka from Kalutara to Beruwala using Google Earth satellite images from two different periods (1985 to 2010 and 2012 to 2022). The first period is the period where the breakwaters' construction was initiated and three satellite images from 1985, 2004, and 2010 have been used to extract the shorelines for this period. The second period is the period where the breakwaters have been fully constructed and eleven satellite images from each year (2012 to 2022) have been used to extract the shoreline for this period. Digital Shoreline Analysis System (DSAS) was used to detect the shoreline change over time by creating 769 and 756 transacts for each period respectively at a simple right angle along the entire coast at 10m intervals. The endpoint and linear regression rates quantified the average erosion at rates of 1.08–1.21 m/year and the average accretion at rates of 1.85–2.05 m/year within the first period. The average erosion at rates of 0.79–0.82 m/year and the average accretion at rates of 0.82–0.86 m/year within the second period. The percentage of transects that are erosional is 80.05% for the first period and it has reduced to 56.75% during the second period while the percentage of transects that are accretional is 19.95% for the first period and has increased up to 43.25% during the second period. The results show that the breakwaters and groins are useful for preventing coastal erosion and promoting sediment accretion.

Keywords: Breakwaters, Climate Change, Coastal Erosion, Digital Shoreline Analysis System (DSAS), Google Earth

*Corresponding Author: manojmaddumaarachi@gmail.com

NAVIGATING THE CHALLENGES AND OPPORTUNITIES OF RENEWABLE ENERGY IN SRI LANKA'S MARITIME DOMAIN

A. P. Amila Prasanga* and T.C.B. Bulathgama
Institute of National Security Studies, Sri Lanka

The demand for energy is increasing, while the need to address the impacts of climate change poses challenges for island states like Sri Lanka, located in the Indian Ocean. This research examines the potential of renewable energy sources in Sri Lanka's maritime domain, assessing the associated challenges and opportunities. Employing a mixed-methods approach, both qualitative and quantitative data are utilized. A comprehensive literature review on maritime renewable energy sources and an analysis of Sri Lanka's energy consumption patterns serves as the basis of this study. Furthermore, expert interviews with professionals from relevant fields are conducted to gain an in-depth understanding of the feasibility and potential of various renewable energy sources, including wind, solar, tidal, and wave power. The findings indicate significant potential for renewable energy in Sri Lanka's maritime domain. The country's extensive coastline and strong winds offer favorable conditions for wind power generation while coastal areas receive abundant solar radiation, highlighting the potential for solar energy production. However, several challenges need to be addressed to fully exploit this potential, including high upfront costs, intermittency of certain renewable energy sources, and the requirement for new infrastructure to support renewable energy production and distribution. This research also identifies several opportunities associated with renewable energy sources in the maritime domain, such as enhancing the resilience of Sri Lanka's maritime infrastructure against extreme weather events like cyclones and storms, and generating new employment opportunities. In conclusion, this study emphasizes the importance of exploring the potential for renewable energy sources in Sri Lanka's maritime domain as a crucial step towards developing sustainable and resilient energy systems. The findings provide insights into the challenges and opportunities related to renewable energy sources in the maritime domain and offer strategies to overcome these challenges. The research outcomes can serve as a valuable starting point for future research and policy development towards sustainable and resilient energy systems, particularly in island states like Sri Lanka.

Keywords: Climate Change, Renewable Energy Sources, Maritime Domain, Sri Lanka, Islands States

* *Corresponding Author: apa.prasanga@gmail.com*

YOUTH UNEMPLOYMENT IN SRI LANKA – A STATISTICAL ANALYSIS FROM 2012 TO 2021

W.M.D.L.W. Wickramasinghe[1] and D.D. Liyanahetti[2*]
[1]Agro Micro Investments Limited, Monaragala, Sri Lanka
[2]Department of Social Studies, The Open University of Sri Lanka, Sri Lanka

Unemployment is a key macroeconomic concern of any economy and it has been a persistent issue in Sri Lanka during the past two decades. In such a context, youth unemployment shows a sharp increase in Sri Lanka creating concerns in the areas of policy making, employment opportunities, and youth attitudes. The objective of this study is to analyze the youth unemployment issue in Sri Lanka employing correlation and descriptive statistical analyses techniques, identifying possible causes and/or trends for the prevalence of the issue. The results revealed a strong correlation between the randomly selected variables concerned with youth unemployment. The variables used are GDP growth rate, gender, age group, and provincial youth unemployment. It also suggests that the promotion of entrepreneurship skills, being open to employment opportunities, and the adoption of suitable policies in reducing youth unemployment could pave the way to address the issue of youth unemployment in the country. At the end, this study intends to contribute to the existing body of literature on youth unemployment by analyzing how this issue persists in Sri Lanka using statistical analysis.

Keywords: Youth Unemployment, Gender, Economic Growth, Education Level, Attitude, Government Policies

[*]*Corresponding Author: ddliy@ou.ac.lk*

TRADITIONAL MEDICINE AS A TOURISM PRODUCT: VALUE CREATION TO TRADITIONAL MEDICINE IN SRI LANKA

M.A.K.N Jayasena [*] ***and W.T Hanska***
The Open University of Sri Lanka, Sri Lanka

Globally, a number of people travel long distances in search of quality indigenous medical treatments. In Sri Lanka, the indigenous medical system is one of the best tools for promoting the tourism industry. Wellness is a relatively new trend that has registered an impressive growth rate within tourism. Worldwide, many people are traveling to destinations that provide wellness facilities. In Sri Lanka, tourism service providers, especially the hotels were quick to cash in and target these facts to create a palette of wellness services. The belief in the Sri Lankan indigenous medicine system among tourists is evident by the fact that both local and foreign tourists tend to visit indigenous medical treatment centres for the purpose of medical treatments. Hence, the objectives of this study were to identify the demographics of the tourists who are interested in the Sri Lankan traditional medical system, and to examine the opportunities and challenges to promoting Sri Lanka's traditional medical system as a tourism product. Further, the inductive research approach was adapted to conduct the research and the data was collected through 15-semi structured interviews from different stakeholders who are related to the Sri Lankan traditional medical system, such as ayurvedic doctors, and service providers, suppliers, and counsellors. The data was analysed using the qualitative content analysis technique and the purposive sampling method was adapted to conduct the study. The age limit, gender, and nature of living conditions were identified as the categories of the demographics of the tourists whereas the quality of services, resources and strategic locations, demand, and transportation were identified as opportunities. The study reveals a lack of institutional support and a lack of regulatory frameworks as being challenges. In addition, this study provides implications for the future development of Sri Lanka's traditional medical system.

Keywords: Health Tourism, Traditional Medicine, Traditional medical system, Tourism, Sri Lanka

[*]*Corresponding Author: makja@ou.ac.lk*

SCOOTER LADIES: AN ANALYSIS OF WOMEN'S MOBILITY IN THE CITY OF COLOMBO, SRI LANKA

Anton Piyarathne* and Lavangi Ranasinghe

Department of Social Studies, The Open University of Sri Lanka, Sri Lanka

Sri Lankan men and women are negotiating their attitudes, actions, and traditions in order to best survive within a changing economic structure. The country which had been a traditional agricultural society continuously has been linked to a global economic structure by various governments following the colonial economic model even in the post-independent period. In this context women happened to leave home and workplace viz a viz daily while attending to various traditional responsibilities held by women with regard to child rearing and maintenance of the homes etc. The male dominant mode of transport has been a challenge for them as they are often subjected to various forms of harassments and women started negotiating this and started slowly to get control of their own transportation. Most of the women started riding scooters in male dominant roads, i.e., male drivers and conductors more on the road. Most of the girls in the Asian region in general ride scooters mainly to travel to their workplaces whilst several girls used to ride light motorcycles in eastern countries. The vulnerability of the rider meeting with an accident is less for scooter users compared with the standard motorbike riders as it is easier for the rider to place their legs on the ground faster which creates a high level of confidence. Some ride scooters to go to their offices and working places, take children to and from the schools or tuition classes, and do daily shopping at the market etc. This is an area not adequately explained by researchers with special reference to the survival strategies of women or their adaptability with the changing socio-economic and competitive environment. Against this backdrop a qualitative research was conducted by the authors with the scooter riding women mainly in the city of Colombo which reveals that the introduction of scooters to the Sri Lankan motorcycle market has very much benefitted the women in Sri Lanka. The women were able to take their children to school, tuition classes, and also to go to office without becoming vulnerable to sexual harassments in the male dominant transport system in Sri Lanka. Moreover, those who started to ride scooters found it easier to get benefits from the changing Sri Lankan economy while fulfilling at the same time their traditional roles as daughters, and wives in a safer and more convenient manner.

Keywords: Scooter riders, women in Sri Lanka, male dominance, transport, sexual harassment, Sri Lanka

**Corresponding author: apiya@ou.ac.lk*

AN INVESTIGATION OF ANXIETY AND DEPRESSION AMONG OFFICER CADETS DURING THE ARMY BASIC TRAINING IN SRI LANKA ARMY

Savathri De Silva and Malathei Dissanayake*
Sri Lanka Army, Sri Lanka

Depression and Anxiety are mental health conditions that have been extensively studied in the world and Sri Lanka across varying populations. Army officer cadets are a group that is vulnerable to developing such conditions due to the military training process and adjustment issues they face. However, the mental health conditions of the Army officer cadets and mental health disparities between officer cadets have seldom been studied. The present study investigated the prevalence rates of depression and anxiety among officer cadets in Sri Lanka Army. In addition, the present study aimed to examine the relationship between anxiety and depression among officer cadets during basic army training and examine whether levels of anxiety and depression vary depending on the level of education and duration of the training. The current study employed the Depression, Anxiety and Stress Scale- 21 (DASS-21) and General Health Questionnire-30 (GHQ-30) to assess the prevalence rates of depression and anxiety among 250 Army officer cadets. The results indicated that army officer cadets had a significant prevalence rate of anxiety (42%) and a low prevalence rate of depression (22%) Army officer cadets were said to experience mild to extremely severe levels of anxiety and mild to moderate levels of depression. A positive linear relationship was also observed between levels of depression and levels of anxiety among officers. Moreover, there is no significant relationship between anxiety, depression, and duration of the training, however, there is a significant relationship between levels of depression and education. The results and implications of this study are discussed in light of further research.

Keywords: Anxiety, Army officer cadets, Depression, mental well-being

**Corresponding author: vishmika1106@gmail.com*

LAY DOWN ON A BED OF KOHOMBA: FOLKLORIC HEALING PRACTICE OF THE *KOHOMBA KOLA SATTUWA* AND ITS MEDICAL SIGNIFICANCE

***Lal Medawattegedara*[1*] *and Nishantha Karunarathna*[2]**

[1]*Department of Languages, Faculty of Humanities and Social Sciences, The Open University of Sri Lanka, Sri Lanka*

[2] *Postgraduate Institute of Humanities and Social Sciences, University of Peradeniya, Sri Lanka*

Folkloric healing practices and modern medicine do not necessarily see each other eye to eye: traditional practice is perceived as 'outdated' owing to its' reliance on the 'unseen' and 'unobserved'; modern medicine is considered empirical and rational. The present study wishes to disrupt these discourse patterns and use a Foucaultian line of thought to locate the conditions that create such perceptual thoughts even when the two practitioners (traditional and modern) were engaged in the same task: 'seeing' and 'narrating' an aliment which occupies the 'body' of a patient. Using the theoretical stances of folklore, modern philosophy, critical reading and modern medicine this paper attempts to re-read a Lankan folk healing ritual titled *Kohomba Kola Saththuwa* (Margosa Leaves Treatment) which involves the Kohomba (Margosa) leaves. This inter-disciplinary paper locates the folkloric conditioning that governs the ritual through a theoretical stance called the 'world view' and runs the 'world view through the modern medical discourse. The meeting of two different types of discourse, one 'folkoric' and the other 'pragmatic,' is used to locate the conditions that govern the notions of 'seeing' and 'narrating' in the discipline of medicine for cultural comprehension as well as to understand how modes of cultural comportment write themselves into spaces that govern a body, the doctor's eye and the illness.

Keywords: Folklore, Healing Ritual, Modern Medicine, Narrating, Seeing, World View

**Corresponding author: lmeda@ou.ac.lk*

IDENTITY POLITICS IN PRASANNA VITHANAGE'S FILM *GAADI: CHILDREN OF THE SUN*

Sureshika Piyasena*
Independent Researcher

Through narrating the story of the Rodi tribe, the movie *Gaadi: Children of the Sun* by Prasanna Vithanage, delves into identity politics in Sri Lanka during the Kandyan Kingdom. Although it is set in this era it mirrors the current social fabric in many ways. In the movie the main protagonist Tikiri, is the young wife of Bulathgama Disawa. Bulathgama Disawa conspires against King Sri Vikrama Rajasingha together with Ehelepola Adigar, but their plan to overthrow the king of Indian dissent backfires. As a result, all the women including Tikiri must choose between drowning themselves or marrying a man of the Rodi caste. Tikiri is the only woman who decides to live and is taken by the first Rodi man who reaches her from across the river. The fact that they opt to die rather than be our part of the Rodi tribe itself is very telling about the ideas of honour and sense of identity that women embodied.Identity is one of the main themes in the film as Tikiri grapples with class, gender and caste identity. In an interview Vithanage asks the question, "Is identity more important than the sanctity of life?" which embodies the main focus of the movie. Tikiri is adamant not to give up her identity as a person of upper class and caste which results in many deaths in the wake of a national crisis. Her upper caste husband is juxtaposed with her new husband who is from the Rodi tribe to add to this theme.This paper is a discussion of the theme of identity in the film in the light of Benedict Anderson's theory of "imagined communities." The shift in Tikiri's identity in terms of class and caste together with her gender is revealing of the role that caste and class play in identity politics in Sri Lanka. The research method is one of qualitative analysis while applying Anderson's theory to the narrative. The movie presents a unique instance when a person's class and caste changes in an instant and this simultaneously undercuts the validity of caste while also showing how engraved caste is in society as Tikiri negotiates with her identity that is thrust upon her.

Keywords: Identity Politics, Class, Caste, Gender

* *Corresponding Author: sureshikapiyasena@gmail.com*

UNLOCKING THE SECRETS: A CONTENT ANALYSIS OF THE REPRESENTATION OF WOMEN'S SEXUAL FANTASIES IN SRI LANKAN PORNOGRAPHIC VIDEOS

P.Y.O. Perera*

Department of Medical Humanities, Faculty of Medicine, University of Colombo, Sri Lanka

Internet pornography has become increasingly prevalent due to technological advancements. Existing research indicates that women's sexual fantasies in pornography are often depicted in unrealistic and stereotypical ways, reducing them to passive, submissive objects devoid of agency. This study conducts a comprehensive content analysis of women's sexual fantasies portrayed in Sri Lankan pornographic videos, considering behaviours, scenarios, and power dynamics. It assesses the portrayal of agency, autonomy, and consent, with a focus on gender equality, gender norms, and cultural values. The study utilizes a purposive sampling method to select most viewed 60 videos from the three most visited adult websites in Sri Lanka, according to their rankings in 2022. This researcher conducts the content analysis, employing a coding scheme developed based on the research objectives to examine the themes, scenarios, behaviours, power dynamics, agency, and cultural values depicted in the videos. The findings challenge prevailing trends and present a distinctive representation of power dynamics, agency, and gender norms. Women are portrayed as having equal power and agency in sexual activities. Romantic fantasies emerged as the predominant theme, while the schoolgirl fantasy also featured prominently. The data reveal that private homes are the most common setting, and vaginal sex is the most frequently depicted activity. These findings underscore the complex interplay between reinforcing and challenging traditional gender norms. The deliberate construction of power dynamics and the portrayal of agency in these videos highlight the creators' role in shaping narratives. The study concludes with recommendations for further research to examine the impact of schoolgirl fantasies, assess their influence on viewer attitudes, and explore evolving sexual and gender dispositions in Sri Lanka. This study sheds light on the demands and sexual interests of Sri Lankan pornography users and their attitudes towards women's sexuality and sex. It provides valuable insights into the specific context of Sri Lanka, allowing for a deeper exploration of the cultural factors that influence the portrayal of women's sexual fantasies and the responses of viewers.

Keywords: Pornography, Woman, Sexual Fantasy, Gender norms, Cultural Values

**Corresponding Author:* oshadaperera54@gmail.com

FOOD CONSUMPTION PATTERN OF ADOLESCENTS IN UDUTHTHURAI GRAMA NILADHARI DIVISION OF THE JAFFNA DISTRICT

Menaka Sivakaran*

Home Economics, Faculty of Arts, University of Jaffna, Sri Lanka

Adolescents are the future backbone of a nation. The adolescent period is the transition period between child and adult. The dietary pattern of this period influences the nutritional status in later stages of life. The nutritional status of adolescents would affect the nutritional status of a community. Good nutrition is essential for optimal health. The recent economic crisis in Sri Lanka makes most of the families to eat less, cheaper and poor nutritional foods. This study is conducted with the objectives of identifying fruit, vegetable and dairy consumption patterns and reasons for limited food diversity among adolescents between 17 to 19 years old in Uduththurai Grama Niladhari division of the Jaffna District. Data collection was made from fifty adolescents from the division by household visits, observing cooking facilities, interviewing the participants, administrating a questionnaire, a 24-hour dietary recall and collecting a week's food diary entry. Adolescents should consume 3-5 servings of fruit and vegetables in their diet. Fruit and vegetables in the diet provide vitamins, minerals and dietary fiber. Those foods help to prevent micronutrient deficiencies. Dairy products provide valuable protein, vitamin B, calcium and phosphorus for adolescents. From the dietary assessment, the participants did not meet the recommended level of fruit, vegetable and dairy consumption. According to the food diary entry (7 days), none of the participants had consumed cow's milk, goat's milk, or dairy products such as ghee, butter, buttermilk, paneer, cheese and yogurt. Below 30 % of the adolescents between 17 to 19 years old had consumed green leafy vegetables on a weekly basis. Banana is the only fruit consumed daily by at least 4% of the participants. The focused group discussion helped identify further factors for the lack of consumption of fruit, vegetables and dairy products: the increased fuel prices to purchase milk and vegetables from faraway places, increased prices of imported fruits in the market, less land available for livestock rearing, food cost for the livestock and the hot climate for cattle. Less consumption of such food items leads to protein and micronutrient deficiency which will affect the health of the future workforce of the country. Awareness should be made to increase the consumption of such food items and the foods should be made available by introducing a farmer's market and a Milk Board in the community.

Keywords: Adolescents, Food Consumption, Uduththurai, Nutrition, Jaffna

*Corresponding Author: jmenakaj@yahoo.com

LAW

FUNCTIONAL SEPARATION OF PRIMARY AND SECONDARY RULES IN INTERNATIONAL LAW: THE REALITY OF TWO STEP APPROACH

Kapila De Silva*
Sri Lanka Air Force, Sri Lanka

This research examined the nature of the functional division existing between primary and secondary rules in the current International Law when determining international liability. The discussion of this study figures out the degree of success that the International Law Commission (ILC) attained with the adoption of the Article for Responsibility of States for Internationally Wrongful Acts (ARSIWA) which reaffirms the distinction between primary and secondary rules in International Law. As a whole, the discussion of the research concerned two objectives to achieve. The first objective of the research is to elaborate on actual facts that affect maintaining the distinction between primary and secondary rules when determining the international responsibility of states as a two-step process. The secondary objective is to ascertain whether the conceptual autonomy proposed by the ILC between the primary and secondary rules has led to significant barriers and complexities in governing International Law. Based on its findings, this research revealed that there are specific criteria that overlap with the autonomous function of primary and secondary rules, especially the precondition of the legal capacity of an international actor, defences of circumstances precluding wrongfulness, and the trend of application of the "*lex specialis*" notion in determining responsibility in International Law. In the discussion, the research exemplifies the pragmatic statutes of the functioning of independent or autonomous functions between primary and secondary rules to determine liability in International Law based on several case laws decided by the International Court of Justice (ICJ) and other primary and secondary sources. Finally, this research argues that the distinction between primary and secondary rules **prima facie** exists but has paved the way for creating uncertainties in international jurisdictions in practical application due to the unrealistic precondition of international legal capacity and other residual criteria. To achieve the research objectives, the researcher uses a relevant theoretical framework and adopts a qualitative research methodology that is fundamentally library-based and primarily based on an extensive literature review.

Key words*;* primary rules, secondary rules, Article for Responsibility of States for Internationally Wrongful Acts (ARSIWA), legal capacity, lex specialis

[*]*Corresponding Author: kapilaaf@gmail.com*

TOWARDS EFFECTIVE PROSECUTION, PROTECTION AND PREVENTION: ADDRESSING LEGAL GAPS IN SRI LANKA'S FIGHT AGAINST HUMAN TRAFFICKING

B. M. Prineetha Bandaranayake*

Department of Legal Studies, The Open University of Sri Lanka, Sri Lanka

Human trafficking is a heinous crime that violates the human rights of its victims. Every year, numerous individuals fall prey to traffickers both domestically and abroad. Sri Lanka, too, has been identified as a source, transit and, to a certain extent, a destination for individuals subjected to human trafficking. Therefore, the crucial challenge is to determine whether Sri Lanka has an adequate legal framework to combat human trafficking and protect the rights of the victims. The objectives of the research are: (a) to examine the domestic and international legal framework, (b) to analyze the effectiveness of domestic legal provisions compared with international law, (c) to recommend necessary improvements to strengthen the capacity to investigate, prosecute and prevent instances of human trafficking in Sri Lanka. Reviewing the existing domestic law reveals that the country has adequate substantive provisions to counter human trafficking. However, there is a lacuna in effectively implementing the substantive law. The early identification of trafficked individuals is of utmost importance. It enables their proper recognition as victims and facilitates relevant support and protection. Failing to identify and assist these victims promptly not only hampers the effectiveness of the criminal justice system in collecting evidence against traffickers but also exposes the victims to harm further and intensifies their existing trauma. The lack of knowledge and focus among relevant officers and their reluctance have made it difficult to arrest and prosecute perpetrators of human trafficking. Moreover, the slow pace of court proceedings and the unwillingness of victims to participate in investigations have further complicated matters. The research suggests that Sri Lanka needs to improve its efforts to investigate, prosecute, and prevent human trafficking by strengthening the procedural legal framework, enhancing the capacity of law enforcement agencies, and providing training and education to relevant officers. Additionally, it is crucial to raise awareness among the public about the harms of human trafficking and the importance of reporting suspicious activities. By taking these steps, Sri Lanka could make significant progress in the fight against human trafficking and fulfill its obligations to protect the human rights of its citizens.

Keywords: Human Trafficking, Procedural Obstacles, Recommendations, Sri Lanka, Substantive Laws

[*]*Corresponding Author: bmban@ou.ac.lk*

SURGICAL ROBOTS RIDING ON HUMAN SURGEONS: A LEGAL ANALYSIS

Ayodhya Prabhashini Rathnayake*
Department of Public Law, Faculty of Law, General Sir John Kotelawala Defence University, Sri Lanka

'Robotic Surgery' is an advanced technology in modern medicine which has an impact on surgical procedures. If an elaborated definition is given, robotic surgery is a combination of computer technologies and robot systems for the performance of medical procedures. As an emerging field of medicine, the doubt arises whether the robotic surgeons are subject to the same ethical code of human surgeons. In a science fiction of Isaac Asimov, he identified three laws of robotics in the context of interacting with humans. The three laws so identified are respectively, 'a robot must not harm a human being', 'a robot must obey the orders given to it by the human beings except where such orders would conflict with the first law' and 'a robot must protect its own existence.' Robotic surgeons are praised due to the benefits they have for both fellow human surgeons and patients. Robots have the skill to provide human surgeons with better view, precision and flexibility. Patients are simultaneously benefited with the presence of them due to lower risks of infection, smaller incisions and lower blood loss. However, although the surgeries performed by the robots are considered sophisticated, there is a hidden risk of failure as well. Thus, a doubt arises on the imposition of liability for an error committed by a robot in the course of surgery. Is that the general professional liability which falls under the purview of medical law and ethics? Is it apt to recommend a separate legal framework in Sri Lanka to govern robotic surgery? The methodology adopted in the research is qualitative in nature and it is library-based desk review. The author has focused on the content analysis of secondary sources of law. In the concluding perspective, the author holds the view that the failures on the part of the robotic surgeons can be covered by both medical malpractice and defective product liability.

Keywords: Robotic surgeons, Medicine, Liability, Ethical code

[*]*Corresponding Author: ayodhya.rathnayake@kdu.ac.lk*

COPYRIGHT AND PLAGIARISM IN AN ERA OF ChatGPT: A LEGAL ANALYSIS

Ruwanthika Ariyaratna[1*], Sanath Wijesinghe[1] and Chaminya Adikari[2]
[1] Department of Legal Studies, the Open University of Sri Lanka, Sri Lanka
[2] University of the Visual and Performing Arts, Sri Lanka

The main objective of this research is to analyze the challenges posed by ChatGPT to copyright protection and prevention of plagiarism in educational and scholarly works, particularly considering some policy recommendations. ChatGPT, an open artificial intelligence (AI) model which can produce conversational type contents based on the context, has created a revolution in the technology-driven world. ChatGPT has sophisticated applications in many industries, ranging from education to healthcare and entertainment to customer service. However, the educators and scholarly community have concerns about the potential impact of ChatGPT on the protection of copyright and prevention of plagiarism. They argue that the increasing use of ChatGPT could create a leeway to disregard the interests associated with the copyrighted works and to dilute academic integrity of educational and scholarly work by the users. Therefore, there is an emerging concern on the necessity of responding to these issues by regulating or perhaps closely scrutinising the ethical and responsible use of ChatGPT. This research intends to make some policy recommendations addressing the concerns raised by educators and scholarly community regarding the use of ChatGPT to generate educational and scholarly content.

Keywords: *ChatGPT, Copyright, Plagiarism*

[*]*Corresponding Author: ruwanthika.ariyaratna@gmail.com*

WAY FORWARD FOR AMENDING RESTRICTIONS ON WORKING HOURS OF WOMEN IN SRI LANKA

J.A.D.U. Jayasinghe and V.G.E.S.W. Dissanayake*
Department of Legal Studies, The Open University of Sri Lanka, Sri Lanka

According to statistical data provided by the Ministry of Higher Education in 2021, 68% of graduates from academic programs in state universities are female and 32% are male. However, when considering the overall labour force in Sri Lanka during the same period, it was found that only approximately 30-36% consisted of female workers. It is noteworthy that this disparity, where male labour force participation has consistently exceeded that of females, has persisted for several decades in Sri Lanka. The existence of such a significant gap in women's labour force participation can be attributed to various factors. The prevailing economic crisis in Sri Lanka has caused an uphill struggle across all realms of human endeavour, irrespective of gender. Consequently, it is evident that educated women, possessing both knowledge and agency, have the potential to exert a substantial and transformative influence on the current crisis. Therefore, the primary objective of this study is to identify the legal factors contributing to the persistent lag in women's labour force in Sri Lanka with special reference to the Shop and Office Employees (Regulation of Employment and Remuneration) Act No.19 of 1954 and the Factories Ordinance No. 45 of 1942. The secondary objectives of the study are to examine whether the Sri Lankan legal framework is in accordance with the ILO standards, to examine the applicability of constitutional guarantees towards the restrictions on working hours of women in Sri Lanka, and to investigate best practices in Nepal and Austria in order to provide policy recommendations. The research methodology utilized for this study will incorporate both online and library-based research approaches. Secondary data will be collected from ILO Conventions and other international instruments, scholarly articles, journals, reports and books. Based on the above, this study concludes that the existing legislation concerning nighttime and overtime employment has had an impact on discouraging women from entering and remaining in the labour force of Sri Lanka. Therefore, the study recommends that the relevant provisions relating to the working hours of women in Sri Lanka should be amended.

Keywords: Women, Labour force, Labour laws, Night Time and Overtime, Equality

*Corresponding Author: vgdis@ou.ac.lk

OFFENCES INVOLVING CATTLE: A CRITICAL EXAMINATION OF THE CATTLE RELATED STATUTES IN 19TH CENTURY CEYLON

K. Rivindu de Zoysa*

Department of History, University of Colombo, Sri Lanka

The abolition of cattle slaughter is a topic that emerges and disappears in Sri Lankan society from time to time. A quick glance at Sri Lankan legal history would reveal a number of cattle related statutes enacted during the British period. This study focuses on the early attempts of the British colonialists to criminalize the cattle body and the research question is: Why did the British regulate the cattle body despite not having any moral sentiments towards them? The objective of this study is to critically investigate how the cattle body was regulated by the British colonial administration and the reasons for such regulation. This research employed a qualitative methodology to provide an in-depth analysis of the subject. 'Collecting documents as data' is used as the method of data collection, and qualitative content analysis is used as the method of data analysis, taking 12 statutes out of 26 cattle-related statutes enacted in the 19th Century as the units of analysis. As the study only focuses on the early attempts of the British (1800-1840), only the Proclamations and Regulations are taken into consideration. Two main data-driven coding categories, *prohibitions* and *property,* are generated. Offences were set out by prohibiting the slaughter, conveyance, and movement of the cattle body, which resulted in the penalization and criminalization of the cattle body. It was further criminalized by being a property that had the potential to be sold, stolen, or possessed. The potential of having a possessed and stolen body enabled criminalization in terms of the general moral wrong and criminal offence of theft or being stolen. The analysis of these statutes reveals that the offences set out were not consistent. They were not general criminal offences but were special and *regulatory offences*. The criminal liability of each offence was a result of provisional, contemporaneous social reality rather than any general culpability or moral sentiment. In conclusion, it can be stated that the British colonial lawmakers enacted the statutes solely on the basis of social realities rather than for any subjective, symbolic, moralist, or Buddhist-Hindu ideals.

Keywords: Criminalizing, Colonial law making, Cattle slaughter, Legal History

* *Corresponding Author: rivindudezoysa@gmail.com*

REVISITING THE LAW ON RETURN MIGRATION & REINTEGRATION: A PUBLIC LAW PERSPECTIVE FOR ECONOMIC RECOVERY

H.K.M Harshana de Alwis*
Additional Magistrate, Kandy, Sri Lanka

Sri Lanka being a foreign remittance dependent economy, rectifying flaws in the migration law in pursuance of an approach based on legitimate expectation and international migration conventions and thereby strengthening migration process is decisive in confronting the current economic crisis. Return migration and reintegration are strikingly significant elements in migration law regime, which lacks consistent and predictable policy and positive action and the same are inevitably connected with brain drain scenario. Migration for foreign employment involves a series of positive effects such as returnee migrants bringing back their skills and work experience, expatriates abroad contributing to foreign remittances, migrant returnee employees transferring their knowledge or technology to developing countries in increasing productivity and economic development. Thus, this research paper focuses on developing a mechanism to remedy the said drastic gaps in return migration and reintegration by resorting to the widely operative doctrine of legitimate expectation, co-related notion of public trust doctrine giving effect to directive principles of state policy and International Law Migration conventions. The legal regime relating to migration in Sri Lanka comprises the Sri Lanka Bureau of Foreign Employment Act as amended by Act No. 56 of 2009 (SLBFE Act), National Labour Migration Policy (NLMP), other policy declarations like Strategic plan 2022-2026, Operational Manual, International Law conventions like Convention on the Protection of Rights of All Migrant Workers etc. However, Sri Lanka seems to have been deprived of advantages of migration considerably on account of the failure on the part of the Sri Lanka Bureau of Foreign Employment or relevant authorities to place the required focus on return migration and reintegration as well as the brain drain scenario. Research papers, handbooks, manuals policy declarations and newspaper articles are analyzed in comprehending the dilemma in the migration law regime. Even though the doctrine of legitimate expectation and international law conventions are frequently resorted to by our superior courts in the environmental protection law regime such approach is hardly utilized in the migration law context. Thus, the remedial approach for this burning social issue could be engineered by resorting to a broad form unorthodox legitimate expectation in the sphere of administrative law and fundamental rights law based on declarative undertakings contained in NLMP, Strategic Plan SLBFE, National Action Plan on Return and Reintegration etc. The persuasive effect of International Law Conventions like the Convention on the Protection of Rights of All Migrant Workers is another integral facet of the legal remedy. A series of superior court judgments in the sphere of administrative law and fundamental rights based republican features of the 1978 Constitution ranging from the

landmark *Eppawala Phostpate case, Heather Theresa Mundy, recent fundamental rights application against Chunnakam ground water contamination* to writ application against *deforestation of Wilpattu Reservation* demonstrate fertile grounds for justifying such broad legitimate expectation. Said line of decisions based on public trust doctrine focusing on inalienable sovereignty of the people under Article 3 of the Constitution, mandatory duty on all organs of state under Article 4(d), imputing pragmatic effect to directive principles of state policy and fundamental duties in conjunction with public trust doctrine and persuasive effect of international law conventions provide a conducive platform for innovative interpretation of legitimate expectation in the migration context in journey for economic recovery. Despite this form of approach based on legitimate expectation, public trust doctrine and international migration conventions being hardly resorted to in the migration law regime, a paramount duty is vested in the judges to interpret migration laws dynamically and innovatively within desirable legal limits especially in light of the pressing social necessity for remedying the drastic gap or the dilemma concerning return migration and reintegration.

Keywords: Return Migration and Reintegration, National Labour Migration Policy, Legitimate Expectation, Public trust doctrine, International Migration Conventions

[*]*Corresponding Author: halwis2@yahoo.com*

THE IMPACTS OF THE ANTI-TERRORISM BILL 2023 ON FUNDAMENTAL RIGHTS: A CRITICAL LEGAL ANALYSIS WITH REFERENCE TO THE CONSTITUTIONAL FRAMEWORK OF SRI LANKA

Nazeefa Kariapper*

Department of Legal Studies, The Open University of Sri Lanka, Sri Lanka

The Constitution of Sri Lanka recognizes and guarantees fundamental human rights to all individuals within its territory. These rights are entrenched in Chapter III of the Constitution titled as Fundamental Rights. The proposed Anti-Terrorism Bill (ATB) has been a subject of extensive debate and scrutiny due to its potential impact on fundamental human rights. This situation warrants a comprehensive examination of the provisions of ATB, its legislative history, and the objectives it seeks to achieve. In this context, the main objective of this research is to critically analyze the impact of the ATB on fundamental rights within the context of the Sri Lankan Constitution. Accordingly, the study explores the impact of the ATA on specific fundamental rights such as freedom of speech, assembly, privacy, and fair trial. Also, the study focused attention on the practical implications of this legislation on individuals and society as well. This study mainly focuses on the specific the research question of whether the proposed ATB violates the prevailing fundamental rights legal regime and whether it infringes the fundamental rights. This research employs a doctrinal legal research methodology based on literature review of primary sources including the 1978 Constitution and legislation, secondary sources and tertiary sources encompassing books and articles to investigate the compatibility of the ATB with the fundamental human rights guaranteed under the Sri Lankan Constitution. Results revealed that the ATB will adversely impact the fundamental human rights with potential for infringement and arbitrary exercise of power. Hence in conclusion, this research recommends the compelling necessity for a critical legal analysis of the provisions of ATB and developing remedial legal provisions to safeguard the fundamental human rights. Furthermore, this research provides significant contribution to counter terrorism by extending a comprehensive evaluation of existing fundamental rights protection and judicial remedies available to mitigate potential abuses arising from the ATB. Moreover, it delves into the complex legal landscape surrounding the ATB and contributes to the ongoing conversation about counterterrorism measures, civil liberties, and the necessity to find a proper equilibrium between security considerations and protection of fundamental rights.

Keywords: Anti-Terrorism Bill, Fundamental Rights, 1978 Constitution, Freedom of Speech, Counterterrorism

**Corresponding Author:* nazeefa.zk@gmail.com

RETHINKING THE FUTURE: LEGAL FRAMEWORK FOR SUSTAINABLE TOURISM IN SRI LANKA, WHERE ARE WE? WHERE TO GO?

V.T.G.D.Ama Karunarathne*
University of Colombo, Sri Lanka

Tourism is a beacon of hope that could flourish the economic facet of Sri Lanka. However, coupled with its long-term competitiveness, its negative effects can cause damage to the social, cultural, and environmental spheres in the country. Drug addiction, displacement, emergence of a materialistic community, environmental degradation, damaged traditional way of life and social values and serious health risks are some of the drawbacks of tourism that demand attention. In that context, Sustainable Tourism is the best restorative option that a country could seek. Many nations in the world are focusing on Sustainable Tourism Legislation though Sri Lanka still holds onto an idle phase in it. Accomplishing Sustainable Tourism is a multiple faceted joint venture where efficient legislation and regulation bears a pivotal role in it. The purpose of the study is to examine Sustainable Tourism in a legal standpoint and to analyze the legislative instruments in Sri Lanka.

The study rests on qualitative data analysis and is carried out on a theoretical level which mainly discusses international tourism law instruments such as Manila Declaration, the 2030 Agenda for Sustainable Development and World Charter for Sustainable Tourism and national legislation as well as policies such as Tourism Act no 38 of 2005, Sri Lanka Sustainable Development Act, No. 19 of 2017 and Draft National Policy on Tourism for Sri Lanka. The paper only intends to gauge the adequacy of tourism legislation on "Sustainability" and does not extend to discuss the practical strategies and projects to be implemented to enhance sustainable tourism. The international community has urged the States to implement legislation on Sustainable Tourism. Even though there is no direct reference on Sustainable Tourism in the Sustainable Development Act, its provisions (in)directly encourage Sustainable Tourism. The Tourism Act focuses more on the formation of an institutional framework but does not represent a reliable centralized authority with legislative powers to create general rules on Sustainable Tourism. However, Section 3, 12 and 17 are progressive. With comparison to other legislation, Draft National Policy on Tourism in Sri Lanka shows a cumulative growth in integrating Sustainable Tourism. Myanmar, holding the 59th place in Sustainable Tourism index, has set distinct examples in its tourism law. The author encourages to fuse and recognize the concept of sustainability within the tourism legislation of Sri Lanka and to adopt flexible legislative techniques consistent with international legislation. Tourism is a trans-sectoral subject and the author suggests a well-balanced holistic approach with other related laws.

Keywords- Sustainable Tourism, Sustainable Development, Sustainable Tourism legislation, Tourism Act

**Corresponding Author: amakarunarathne@gmail.com*

UNCLOS III: AN EFFORT TO REDISTRIBUTE SEA POWERS IN FAIR AND EQUITABLE MANNER FOR THE DEVELOPING COUNTRIES

B.M.A.H.H. Balasuriya*

Faculty of Law, General Sir John Kotelawala University, Sri Lanka

As Water covers most of the space on earth, oceans are a very important natural factor that should be governed through a competent and well-structured legal order. Even though land territories are divided and governed by different nations under different jurisdictions, it was difficult to regulate and govern sea areas as it does not belong to anyone. However, after the establishment of the United Nations, the International community was concerned with regulating sea areas, in distributing powers regarding seas with all the nations notwithstanding the sea power and other economic and political factors. The United Nations Convention on the Law of the Sea 1982 is a well-structured attempt of the international community to establish a non-biased legal order to govern sea areas that focused on distributing powers fairly and equitably between developing and developed nations. This Study mainly focuses on the United Nations Convention on the Law of the Sea 1982 which is considered a comprehensive law on the Law of the Sea, and willing to discuss the legal fraternity that has been established by the Convention 1982 regarding sovereignty rights of Nations, economic development, environmental conservation and acquisition of seabed in the high seas. The focus of this study is doctrinal research based on statutory laws, case laws, law reports and law journals in Sri Lanka. Based on Conventional articles, this will critically analyze how the provisions of the Convention on the Law Sea have been fairly and equitably distributed among the developing coastal nations of the world. The findings of this article show that the Convention of Law of the Sea has tried to distribute power among all the nations including developing nations by specifying their rights and obligations through the articles to protect the rights of developing countries. The sea is a natural entity that carries vast economic and political value, and most of developing nations try to own it and benefit from it for their own. In this context, the convention of the Law of the Sea of 1982 is a reasonable effort to distribute power as fairly and equitably as possible for developing countries through provisions of the convention.

Keywords: UNCLOS III, Fair and equitable, Distribution of provisions, Developing Countries, Law of the Sea

* *Corresponding Author: hansika.balasuriya@kdu.ac.lk*

MANAGEMENT

INFLUENCE OF CULTURAL DIMENSIONS ON LEAN IMPLEMENTATION OF THE BANKING SECTOR IN SRI LANKA

Jayashi Silva*
London Metropolitan University

The research study identifies the influence of the organizational cultural dimensions on lean implementation with regard to Commercial Banks in Sri Lanka. The research papers in existent to cater to the relationship and impact of organizational culture on lean implementation in the Banking Sector are highly scarce and almost none in Sri Lankan Banks. As there is an inclination towards Banks adopting a lean culture where already four major private commercial banks have commenced, it is imperative to have proper research to implement lean in a beneficial manner. Accordingly, the research was carried out to bridge the gap and the research methodology used for the same was, a cross-sectional survey data collected from the four commercial banks in Sri Lanka that have already implemented lean concepts based on the four organizational cultural dimensions of Denison's Model: Adaptability, Mission, Involvement, and Consistency to understand the correlation and its success. Results revealed a positive relationship between the organizational cultural dimensions where the higher adaptability, mission, involvement and consistency dimensions, the success of the lean implementation at the Bank was advanced. Hence the research contributes to bridging the gap of an empirical study on the impact of lean implementation and culture relating to private commercial banks in Sri Lanka as an evaluation for current lean practices implemented by Banks as well as provides insights for other banks and service sector industries to adopt lean practices without a failure. The study also reveals that the banks should deploy a comprehensive, positive approach to organizational culture to enhance the performance of the banks through lean concepts.

Keywords: Lean Implementation, Organizational Culture, Commercial Banks in Sri Lanka

*Corresponding Author: jayashisilva@gmail.com

EXPLORING UNDERGRADUATES' MONEY-MANAGEMENT LIFE: INSIGHT FROM THE UNIVERSITY OF PERADENIYA, SRI LANKA

A.P.D.S. Gunaratne* and S.C. Munasinghe
The Open University of Sri Lanka, Sri Lanka

Undergraduate students play a crucial role in the economy due to their potential as future earners of substantial income. The primary objective of this study was to investigate the potential influence of financial attitude, financial knowledge, financial socialization agents, and locus of control on the money management behaviour of undergraduate students enrolled at the University of Peradeniya in Sri Lanka. The objective of this quantitative study is to ascertain the variables that exert influence on financial behaviour. Researchers used convenient sampling methods to select 375 individuals from a population of 11,560 at the University of Peradeniya in Sri Lanka, consisting of nine faculties. The data collection instrument employed in this study was a questionnaire. Data were collected from a sample of undergraduate students, excluding those from the Management Faculty, to make generalizations about the entire student population. This exclusion was made due to the expectation that Management Faculty undergraduates possess higher knowledge and skills in money management. Based on the findings, it is apparent that financial attitude, financial knowledge, and financial socialization agents substantially influence the money management behaviour of undergraduates at the University of Peradeniya, Sri Lanka. However, there is insufficient statistical evidence to support the notion that locus of control significantly impacts the money management behaviour of undergraduates at the University of Peradeniya, Sri Lanka. The findings of this study will provide valuable insights for financial institutions, governmental bodies, as well as current and prospective undergraduate students within the country.

Keywords: Undergraduates, Money Management Behaviour, Financial Attitude, Financial Knowledge, Financial Socialization Agents, Locus of Control, Sri Lanka

**Corresponding Author: sanduni.edu@gmail.com*

HOW DO THE INFLUENCING FACTORS OF WILLINGNESS TO WAIT IN QUEUES AFFECT CUSTOMER SATISFACTION IN THE SRI LANKAN RETAIL SUPERMARKET INDUSTRY?

Ishara Ranasinghe*
School of Business, ESOFT Metro Campus, Sri Lanka

Customers who are purchasing goods from the retail supermarkets have to wait in queues and it seems to be an irritating issue because people become more competitive and they used to give higher value to the time. Therefore, the waiting time of the customers in queues may affect customer satisfaction significantly. The objective of this study is to identify how the external factors influencing willingness to stay in queues affect customer satisfaction. The ultimate findings of the study contribute a lot to the improvements in the queuing system and waiting environment in the Sri Lankan supermarket industry. The supermarket industry in Sri Lanka is becoming an interesting sector in the Economy of Sri Lanka. The supermarkets are being shined by changes occurring in the social and economic environment as well as by the rise in per capita income.

Since the existing literature does not discuss the effect of influencing factors of willingness to wait in queues (the queuing management by the company and waiting for environment improvements) on customer satisfaction in the Sri Lankan Retail Supermarket Industry, this new research attempts to investigate the effect of influencing factors of willingness to stay in queues towards customer satisfaction. The results of this study reveal that there is a significant relationship between influencing factors of willingness to stay in queues and customer satisfaction.

This study was conducted based on supermarkets in the Colombo district and the customers who participated in this study were also from the Colombo district. This does not reflect the satisfaction of all the ultimate customers of the supermarket industry in Sri Lanka, especially the level of satisfaction of the customers outside the Colombo district is not evaluated under the scope of this study. Supermarkets should consider more on the waiting environment and should develop the waiting environment in a more comfortable and friendly manner to keep the customers satisfied. Supermarkets should consider the speediness and efficiency of the billing counters to reduce the waiting time of customers.

Keywords: Customer Satisfaction, Influencing Factors of Willingness to Wait in Queues, Queuing Management by the Company, Waiting Environment Improvements

*Corresponding Author: isha2020ranasinghe@gmail.com

PHYSICAL SCIENCES

AN INTEGRATED MODEL OF THE CAPACITATED VEHICLE ROUTING PROBLEM AND THE VEHICLE SCHEDULING PROBLEM AT THE MULTI-DOOR DEPOT

S. R. Gnanapragasam[1,2*] and W. B. Daundasekera[3]
[1]Department of Mathematics, The Open University of Sri Lanka, Sri Lanka
[2]Postgraduate Institute of Science, University of Peradeniya, Sri Lanka
[3]Department of Mathematics, University of Peradeniya, Sri Lanka

The goal of an efficient supply chain (*SC*) is to supply or deliver the shipments to the right place in the right quantity at the right time with a low cost. To be an efficient *SC*, the coordination and integration of the activities in the *SC* are mandatory. Routing vehicles to collect the shipments from the suppliers with minimum travelling cost is an optimization problem in the *SC*. Once the shipments are collected from the suppliers, the routed vehicles must return to the depot which generally has *multi-doors*. When the doors at the depot are limited and busy, the returned vehicles have to wait to unload the accumulated shipments. Therefore, properly coordinating and scheduling these vehicles to those doors at the depot to minimize the waiting time is considered to be an optimization problem in the *SC*. Therefore, in this study, *routing vehicles* to collect the shipments from suppliers and *scheduling vehicles* to doors at the depot, based on *first come first serve* basis, are simultaneously solved. Hence, the objective of this integrated vehicle routing and scheduling problem (*VR&SP*) is to minimize the total cost which contains the following components: *vehicle travelling cost* between suppliers, *loading cost* at the suppliers, *vehicle waiting cost*, *unloading cost* at the depot and *vehicle operations cost*. A mixed integer quadratic programming (*MIQP*) model is developed to solve the integrated *VR&SP*. The *Branch and Bound* algorithm is employed to obtain the exact solution to this *MIQP* using *LINGO* optimization software. Since *LINGO* is not capable of handling large-scale instances, only the small-scale instances are taken into account. The input data are generated randomly and the compatibility of the developed model is verified by numerical illustrations. Therefore, it can be concluded that this model solves the vehicle routing to suppliers and vehicle scheduling to doors simultaneously. Since *VR&SP* is a *NP*-hard problem, heuristics or meta-heuristic methods are proposed to solve the large-scale instances. Furthermore, this *VR&SP* model can be extended to vehicle routing with cross-docking (*CD*) problem. Therefore, it is recommended to attempt an integrated model combining *VR&SP* with *CD* as a future study.

Keywords: Multi-door Depot, Vehicle Routing, Vehicle Scheduling.

[*]*Corresponding Author:* srgna@ou.ac.lk

STUDY OF ANTIOXIDANT PROPERTIES OF SILVER NANOPARTICLES SYNTHESIZED BY PALMYRA PULP AND SPROUT EXTRACTS IN THE PRESENCE OF SOLAR IRRADIATION

Samudrika Aththanayake [1,2], Gobika Thiripuranathar[2*] and Sagarika Ekanayake[1]

[1]Department of Biochemistry, Faculty of Medicine, University of Sri Jayewardenepra, Gangodavila, Nugegoda, Sri Lanka

[2]College of Chemical Sciences, Institute of Chemistry Ceylon, Rajagiriya, Sri Lanka

The process of green nanoparticle (NP) synthesis is a biologically feasible process due to the presence of a diverse array of bioactive compounds. The aim of this research was to synthesize silver nanoparticles (Ag NPs) utilizing palmyra fruit pulp and sprout extracts under solar irradiation and compare their antioxidant properties. Ag NPs were synthesized with aqueous extracts of palmyra fruit pulp and sprouts with $AgNO_3$ solution as the ion precursor. Qualitative phytochemical analysis was conducted to identify the phytochemicals present in the plant extracts. UV-Vis, FTIR, SEM, TEM, and XRD were used to characterize the synthesized Ag NPs. To evaluate the antioxidant activity of NPs, DPPH, ABTS, and FRAP assays were conducted. The phytochemical screening of plant extracts revealed the presence of primary and secondary metabolites. Both extract-mediated synthesized Ag NPs had surface plasmon resonance peaks in the range of 430-440 nm. FTIR results confirmed that functional groups of bioactive compounds are present on the surface of phytogenic Ag NPs. SEM revealed spherical particles in both extracts whereas TEM revealed that the sizes of pulp and sprout-mediated NPs were 17 ± 2 nm and 13 ± 3 nm, respectively. The XRD spectra confirmed that pulp and sprout-mediated Ag NPs were pure crystalline. The DPPH radical scavenging capacity for the pulp and sprout-mediated Ag NPs showed IC_{50} values of 22 ± 2 ppm and 21 ± 1 ppm, respectively and ABTS radical scavenging assay indicated that IC_{50} values as 91 ± 1 ppm and 60 ± 2 ppm, respectively. Similarly, phytogenic Ag NPs displayed higher FRAP scavenging power than the respective extracts. Sprout-mediated Ag NPs have a higher antioxidant potential than pulp-mediated Ag NPs due to their smaller size. Hence, biosynthesized pulp NPs could be utilized as a sustainable source for various industrial applications.

Keywords**:** Aqueous extract, Antioxidant activity, Palmyra fruit pulp, Sprout, Silver nanoparticles

[*]*Corresponding Author: *tgobika@ichemc.edu.lk*

COMPARATIVE STUDIES ON THE CHARACTERIZATION, ANTIMICROBIAL AND ANTIOXIDANT PROPERTIES OF ALGINATE-BASED EDIBLE BIODEGRADABLE PACKAGING FILMS LOADED WITH ASCORBIC ACID AND CINNAMON ESSENTIAL OIL

K.G. Kaushani[1,2], N.M.C. Nissanka[3], K.A.A. Dilhari[4], M.M. Weerasekera[3], R.A. Jayasinghe[5], A.H.L.R. Nilmini[1], N.P. Katuwavila[6] and G. Priyadarshana[1*]

[1]Department of Materials and Mechanical Technology, Faculty of Technology, University of Sri Jayewardenepura, Sri Lanka

[2]Faculty of Graduate Studies, University of Sri Jayewardenepura, Sri Lanka

[3]Department of Microbiology, Faculty of Medical Sciences, University of Sri Jayewardenepura, Sri Lanka

[4]Department of Basic Sciences, Faculty of Allied Health Sciences, University of Sri Jayewardenepura, Sri Lanka

[5]Department of Civil and Environmental Technology, Faculty of Technology, University of Sri Jayewardenepura, Sri Lanka

[6]Department of Biomedical Science, Faculty of Science, NSBM Green University, Sri Lanka

There is a growing demand for innovative green packaging developed using novel biodegradable materials instead of synthetic packaging to reduce the environmental pollution caused by their accumulation, improve safety, and extend the shelf life of foods. This study aimed to develop seaweed-based active edible packaging films from alginate (Alg) containing different concentrations (0.5%, 1%, and 1.5%) of antioxidants such as ascorbic acid (AA) and cinnamon essential oil (CEO) using $CaCl_2$ as the crosslinking agent employing the casting method. The films were characterized and compared for their physical, mechanical, thermal, optical, antioxidant, and antimicrobial properties, and biodegradability, considering the effect of antioxidant concentration. Increasing the concentration of AA and CEO resulted in increased film thickness and decreased moisture content, which ranged from 0.14 mm to 0.27 mm and 9.6% to 29.5%, respectively. Alginate-based films containing CEO (Alg+CEO) demonstrated a significantly higher water resistance ($p<0.05$) compared to alginate-based films containing AA (Alg+AA), which was attributed to the hydrophobicity of CEO. The biodegradability of Alg+AA films increased with increasing AA concentration, while Alg+CEO films demonstrated a decrease with increasing CEO concentration. All films demonstrated a soil biodegradability rate of over 70% within 28 days. There was a decrease in tensile strength with increasing AA and CEO concentrations, while the addition of CEO led to increased elongation at break. Both films showed a significantly increased ($p<0.05$) total colour difference (ΔE) with increasing antioxidant concentration. The Alg+CEO films exhibited better antimicrobial activity compared to Alg+AA films against Gram-positive (*Staphylococcus aureus* and *Bacillus cereus*) and Gram-negative (*Klebsiella pneumoniae* and *Escherichia coli*) bacteria, and the

incorporation of 1% AA and 1% CEO were the most effective concentrations against Gram-positive and Gram-negative bacteria. The DPPH free radical scavenging activities of 1.5% Alg+AA films (IC_{50} = 0.06 mg/mL) were higher than those of the 1.5% Alg+CEO films (IC_{50} = 0.15 mg/mL). These results proved the potential of AA and CEO-incorporated alginate-based films, which could be used as sustainable green packaging due to their excellent antioxidant and antimicrobial properties.

Keywords: Alginate Films, Antimicrobial, Antioxidant, Ascorbic Acid, Cinnamon Essential Oil

* *Corresponding Author:* *gayanp@sjp.ac.lk

A NEW FOURTH-ORDER FINITE DIFFERENCE APPROXIMATION FOR FISHER KOLMOGOROV-PETROVSKY-PISKUNOV EQUATION

C.T. Fernandopulle*, W.A. Gunarathna and M.A.M. Mohamed
Department of Physical Sciences, Faculty of Applied Sciences, Rajarata University of Sri Lanka, Mihintale, Sri Lanka

Fisher Kolmogorov-Petrovsky-Piskunov (KPP) Equation (FE) is a nonlinear partial differential equation which is used to model physical scenarios involving the effects of both linear diffusions and nonlinear reactions. The FE arises in numerous applications, including brain tumor dynamics, population dynamics, chemical reactions, etc. Existing analytical methods for the FE often fall to give closed solutions and thus computational techniques have more commonly been used to attain a solution to the FE. The finite difference approximation (FDA) has widely been used to obtain a discrete solution to the FE. Combined with Crank-Nicholson (CN) technique, some second and fourth-order accurate CNFDAs appear in the literature too. This study aims to construct a fourth-order finite difference scheme for the FE. To achieve this, first, a pre-conditioned operator (P_h) for the second is derived. Acting P_h on the second derivative, a fourth-order approximation is obtained for the pre-conditioned second derivative. Second, the non-linear part of the FE is linearized using the lagging technique. Third, acting P_h on the FE and using the CN technique, a new CN finite difference scheme is derived for the FE. The preceding CN scheme is fourth-order accurate in space (with grid size h) and first-order accurate in time (with grid size τ). Furthermore, choosing$\tau = h^4$, a fully fourth-order accurate CN is obtained. Numerical results are obtained through numerical tests and compared with the corresponding results obtained from a recently derived fourth-order compact CN approximation. It demonstrates that the proposed fourth-order CN scheme is more accurate than the compact CN scheme.

Keywords: Crank-Nicholson Scheme, Lagging Linearization, Preconditioned Operator, Second Order Central Difference Approximation

*Corresponding Author: ctharushi97@gmail.com

A NEW EXPLICIT FORM FOR HIGHER ORDER APPROXIMATIONS OF DERIVATIVES AND ITS IMPLEMENTATION

J. A. M. P. Weerasinghe*, W. A. Gunarathna and M. A. M. Mohommad
Department of Physical Sciences, Faculty of Applied Sciences, Rajarata University of Sri Lanka, Mihinthale, Sri Lanka

Numerous applications of derivatives abound in many areas such as science, engineering, economics, mathematics, medicine, optimization, etc. There is great demand in those applications for higher-order accurate computational techniques. In many situations, due to the limitations of the use of analytical methods, computational techniques have been preferred. Finite difference method is a simple computational technique, in compaction with other methods such as finite element and finite volume techniques, is used to discretise derivatives. The Taylor series is often devised to obtain finite difference forms for derivatives. In this method, a linear combination of the Taylor series of a function at various grid points are used to derive finite difference forms for derivatives. For higher-order approximations, this process includes heavy hand computations and solving large linear systems, making computational procedures cumbersome. In this study we consider higher order approximations for the first and second derivatives. For sufficiently smooth function $f(x)$ and grid size h, we define the weighted average operators: $A^1_{h,s_1,s_2,\dots,s_p} f(x) = \sum_{i=1}^{p} \lambda_i Q^1_{h,s_i} f(x)$ and $A^2_{h,r_1,r_2,\dots,r_p} f(x) = \sum_{i=1}^{p} \mu_i Q^2_{h,r_i} f(x)$ for the first and second derivatives, respectively, where $Q^2_{h,r_i} f(x) = (f(x + r_i h) - 2f(x) + f(x - r_i h)(r_i h^{-2})$, $Q^1_{h,s_i} f(x) = (f(x + s_i h) - f(x - s_i h)(s_i h)^{-2}$,$r_i$, and s_i, $i = 1, 2, \dots, p$, are some real numbers. Then it is shown that the foregoing derivatives approximate the first and second derivatives with an accuracy of order $2p$. Furthermore, an explicit formula is constructed in the numerator-denominator forms to find the weights, λ_i and μ_i of these operators. Using the symbolic math tool box, the MATLAB codes are developed to implement the explicit formula. To attain efficient computations, separate MATLAB implementations are presented for the numerator and denominator parts of the explicit formula. Then, using the MATLAB codes, generic weight coefficients for accuracy order 4, 6, 8, and 10 are also obtained in symbolic form. Numerical tests are also presented to show the effectiveness of the proposed difference approximations.

Keywords: First and second derivatives; Finite difference approximations; Taylor series

* *Corresponding Author:* *malkipiyumali@gmail.com

MATHEMATICAL MODELLING FOR FINGERO-IMBIBITION PHENOMENON INFLUENCE OF THE MAGNETIC FIELD DURING DIFFERENT NANO FLOODINGS

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

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka

[2]Department of Mathematics, The Open University, Nawala, Nugegoda, Sri Lanka

[3]Department of Mathematics, University of Peradeniya, Peradeniya, Sri Lanka

Thermal, chemical, and flooding methods of enhanced oil recovery have been used to increase the production of residual oil in reservoirs. In recent years, some studies have investigated new strategies such as injecting nano-fluid, boosting performance using new technologies, and incorporating magnetic fields, to improve oil recovery. During the Enhanced Oil Recovery (EOR) process, the fingero-imbibition phenomenon occurs when oil filled porous medium encounters another phase that preferentially wets the medium and the wetting phase flows into the medium while the native phase flows out. The event caused by the varying wetting capacities of the phases is referred to as the imbibition phenomenon. Furthermore, if a porous medium filled with one phase is displaced by another phase of lower viscosity rather than its regular displacement of the entire front, protuberances may form as a result of the fluid injection through the porous medium at a relatively high speed, causing the fingering phenomenon. In this study, we developed a new mathematical model to determine the injective fluid saturation of the fingero-imbibition phenomenon while accounting for the influence of the magnetic field and utilizing several nano-powders (aluminum oxide, magnesium oxide, and silicon dioxide) as injective fluid for an inclined oil layer through a homogeneous porous medium. To solve the model, which is a nonlinear partial differential equation, the Method of Directly Diffing the Inverse Mapping was used. Using the obtained results, we can see that the saturation of nano-water of fingero-imbibition phenomenon increases along with the distance as well as the inclination angle for a fixed time. The saturation of injected fluid increases due to the magnetic field effect, which is greater than it is without the magnetic field effect. The results show that the brine mixed with aluminum oxide has the maximum saturation compared to the others, and the mixture with magnesium oxide has the lowest saturation. We can conclude that the brine with aluminum oxide benefits EOR since the oil recovery factor is directly proportional to the saturation of the injective fluid.

Keywords: Enhanced oil recovery, Gravitational effect, Magnetic field, Method of Directly Diffing the inverse Mapping, Nano powders

[*] *Corresponding Author: tharidew@gmail.com*

EMPLOYMENT OF A SIMPLE ELECTRODEPOSITION TECHNIQUE TO FABRICATE ZINC OXIDE FILMS AND ANALYZING THEIR APPLICABILITY FOR CADMIUM SULPHIDE QUANTUM DOT SENSITIZED SOLAR CELLS

Harini Wijeratne**and V.P.S. Perera
The Open University of Sri Lanka, Nawala, Nugegoda, Sri lanka

Zinc Oxide (ZnO) is a promising n-type semiconductor material which is very beneficial for solar cell applications due to its desirable properties such as, wide bandgap, low cost, abundance in nature, nontoxicity and its high chemical and mechanical stability. There are many other techniques that could be used to deposit ZnO according to previous work. However, the electrochemical deposition (ECD) technique adopted in this work which contains Zinc nitrate and Zinc acetate in 1:5 ratio in the deposition bath is a simple convenient method which is cost effective that uses inexpensive, abundant chemicals and could be achieved within a short period of time relative to the other techniques.

ZnO is a wide band gap semiconductor which cannot absorb the solar radiation effectively specially in the visible wavelength region of the solar spectrum. Therefore, a narrow band gap semiconducting material such as Cadmium Sulphide (CdS) in the form of quantum dots (QDs) is used for sensitization. In this scenario, these CdS QDs have been prepared by using the reverse Successive Ionic Layer Adsorption and Reaction (SILAR) process by using $Cd(NO_3)_2$ and Na_2S in deionized water to provide Cd^{2+} cations and S^{2-} anions in the precursors.

The ZnO photoanodes thus sensitized with CdS were sandwiched with a Pt-coated Fluorine doped Tin Oxide (FTO) counter electrode and the capillary space between them was filled with polysulfide electrolyte.

The morphological characterization was done using the Scanning Electron Microscopic (SEM) studies in order to study the nature of morphology of the grains produced by ECD technique. J-V characterization of QDSSCs demonstrated a maximum current density of 1.32 $mAcm^{-2}$ with an efficiency of 0.15% for seven Reverse SILAR cycles and the maximum efficiency, η of 0.24% was observed with the voltage of 589.50 mV for 10 Reverse SILAR cycles. The optical properties of ZnO/CdS films were studied with UV-Visible spectroscopy and observed a gradual decrease in the bandgap with the increase in CdS loading in the ZnO films. The impedance spectroscopic analysis showed that the charge transfer resistance at the QD sensitized ZnO and electrolyte interface increased with the number of reverse SILAR cycles.

Keywords: Zinc Oxide, Quantum dots, Sensitization, Cadmium Sulphide, Reverse SILAR method, Electrodeposition

**Corresponding Author: *wijeratneharini@gmail.com*

NATURAL DYE EXTRACTED FROM *Elaeocarpus serratus* LEAVES TO FABRICATE NEAR-INFRARED DYE-SENSITIZED SOLAR CELL

S. Davisan*, V.P.S. Perera and D.L.N. Jayathilake
The Open University of Sri Lanka, Nawala, Nugegoda, Sri Lanka

In this investigation, a natural dye was extracted from ripe leaves of *Elaeocarpus serratus* (D1), known as Sri Lankan olive or Weralu to fabricate a near-infrared (IR) dye-sensitized solar cell. For comparison, Dye extracted from *Clitoria ternatea* flower (D2) known as Nilkatarolu was used. Dye-sensitized solar cells were fabricated by using dye-coated TiO_2 films deposited on a fluorine-doped tin oxide glass plate as the anode, platinum-coated FTO glass as the cathode, and iodine/tri-iodide as the redox electrolyte.

Optical properties of the dyes were characterized by UV-Vis spectroscopy and the results showed characteristic absorption peaks at 665 nm for D1 and 574 nm and 623 nm for D2. Photovoltaic parameters of the devices were obtained by using a J-V measuring unit coupled to a computer with an IR LED Light source (850nm) of 100mW/cm^2 intensity. DSSC fabricated with D1 dye showed a short circuit current density *(J_{SC})* of 45 µA/cm^2, open circuit voltage *(V_{OC})* of 173.4 mV and Fill Factor *(FF)* around 0.438 with an Efficiency*(η)* of 0.003%, whereas the device sensitized with D2 dye showed only a J_{SC} of 7 µA/cm^2 and V_{OC} of 21.4mV. Incident Photon to Current Efficiency (IPCE) measurements demonstrated that the *Elaeocarpus serratus* leaf natural dye exhibits better photovoltaic performance in the near-IR region compared to the *Clitoria ternatea* flower dye.

Keywords: DSSC-Dye Sensitized solar cell, Natural Pigments, FF-Fill factor, IPCE-Incident photon to current efficiency, near-infrared

*Corresponding Author: s.day.vision0407@gmail.com

AN IMPROVED HYBRID CRYPTOGRAPHIC ALGORITHM USING CHAOTIC MAPS

A. M. S. P. Attanayake* and N. Yapage
University of Ruhuna, Matara, Sri Lanka

Chaos theory, chaotic maps, in particular, is playing an increasing role in data encryption and decryption. This research study investigates the application of chaos theory to image encryption and proposes a novel algorithm for image encryption that was derived from two different chaotic maps: Arnold's Cat Map and Bülban Map. In addition to gaining an understanding of the mathematical characteristics, especially the chaotic nature of the two chaotic maps, the objective of the present work is to develop an effective method for encrypting images using the above two chaotic maps. First, the image was encrypted using the two maps individually to analyse their behaviour and encryption patterns and then the maps were combined into a single algorithm. The encryption technique was developed using MATLAB version 2017b. The usefulness of the map was determined by calculating the cross-correlation, vertical, horizontal, and diagonal correlations of the encrypted image, together with its entropy, PSNR (Peak Signal-to-Noise Ratio), and the amount of time that had elapsed before encryption began. In addition, a key sensitivity investigation was carried out to establish the key's level of resistance to force. The fact that the correlation values were substantially closer to zero served as conclusive evidence that the encryption algorithm is successful across all image file types.

The effectiveness of the encryption technique was determined by the entropy levels of the data as well as the PSNR values. In addition, a trial-and-error method was employed to figure out the parameter range in which the Bülban map would display chaotic characteristics.

The proposed algorithm was tested using black-and-white images (512×512 pixels) in the TIFF (257KB), PNG (834KB), and JPEG (111KB) file formats. The ability to encrypt colour images in any format can similarly be developed with this method. Based on the results obtained by encrypting the images using single maps and the hybrid map, it was found that the hybrid map was more efficient. In comparison to utilizing only one of these maps for image encryption, employing both Arnold's Cat Map and Bülban Map with iteration number 170 for Arnold's Cat Map significantly improves the accuracy of the encryption process.

Keywords: Cryptography, Chaotic maps, Image encryption, Arnold’s cat map, Bülban map

* *Corresponding Author: sarasi.attanayake96@gmail.com*

SYNTHESIS AND CHARACTERIZATION OF ELECTRODEPOSITED Cu_2O THIN FILMS AT DIFFERENT pH ON FTO GLASS IN LACTATE MEDIUM

A.H.M.N.N. Bandara, V.P.S. Perera*, G.K.R. Senadeera and K.N.D. Bandara
Department of Physics, Faculty of Natural Sciences, The Open University of Sri Lanka, Sri Lanka

In this study, nanostructured cuprous oxide thin films were synthesized by electrochemical deposition on FTO substrates in lactate bath (~60 °C) with different pH conditions. The investigations were focused on structural and surface morphological features of the film and their influence on electrical and wetting characteristics. SEM images exhibited micro-structured grain distribution with grain shapes diverted from compact, pallet to cubic nature with increasing pH of the bath and promising high sensitive films prepared at pH 10 and 10.5. Evidence in support of the explanation of these measurements was further verified by the contact angle measurements which revealed an increment from 73° to 103° with increasing pH indicating a reduction in wetting nature. According to the capacitance-voltage and spectral response analysis, the *p*-type conductive behaviour of Cu_2O resulted in pH 8.5-11 of the electrodeposition bath. Under stable atmospheric conditions, *p*-Cu_2O films electrodeposited at pH 10.5 exhibited the highest flat band potential of 2.64 eV and high conductivity due to enrich acceptor density of 6.61×10^{18} per cm^3.

keywords **:** cuprous oxide (Cu_2O), electrochemical deposition (ECD), lactate bath, surface morphology**,** fluorine doped tin oxide (FTO)

**Corresponding Author: vpper@ou.ac.lk*

CHARACTERIZATION DYE EXTRACTED FROM *Amherstia nobilis* FLOWERS AS A SENSITIZER OF SOLAR CELLS

M.W.M.K. Mannawadu* and V.P.S. Perera
The Open University of Sri Lanka, Nawala, Nugegoda, Sri Lanka

As a sensitizer for dye-sensitized solar cells (DSSC), a natural dye extracted from the pink flower of the *Amherstia nobilis* (Pride of Burma) plant was used in this research. Flower petals 20g were cut into little pieces 50ml of ethanol was added, and it was kept at room temperature for 24 hours in order to extract the dye. A thin film of TiO_2 nanoparticles was deposited on fluorine-doped tin oxide (FTO) glass plates to fabricate the solar cell. FTO glass coated with platinum was used as the counter electrode, and iodin/tri iodide(I_2 / I_3^-) was used as the electrolyte. The solar cell was tested with a light source with an intensity of 100mW/cm^2. The open circuit voltage (V_{oc}) of this cell was 511mV and its short circuit current (I_{sc}) was 2.811mA. The cell had an efficiency of 0.865% and a fill factor of 0.601. The energy gap between the HOMO and LUMO levels of the dye was calculated as 2.2eV using the Tauc plot according to the data obtained for the UV visible absorption spectrum which has given an absorption peak at 527nm. The cyclic voltammogram was assisted in finding out the LUMO level of the dye by observing its redox potential which is approximately -1.20V vs the Ag/AgCl reference electrode. It was identified that the LUMO level of the dye extracted from *Amherstia nobilis* flower is positioned at a higher level, feasible to inject electrons to the conduction band of TiO_2 energetically, which resulted in a higher voltage, current, and efficiency for this dye.

Keywords: DSSC, TiO_2, Solar cell, Doctor-blade, IPCE, I-V Characteristics

* *Corresponding Author: * malshamannawadu@gmail.com*

INCLUSION COMPLEXES OF CAROTENOIDS EXTRACTED FROM PEANUT BUTTER FRUITS PULP WITH β-CYCLODEXTRIN TO ENHANCE THE AQUEOUS SOLUBILITY OF CAROTENOIDS

A.M.Y.W. Wijebandara and D.D.D.H. Alwis*

Department of Chemistry, Faculty of Natural Sciences, The Open University of Sri Lanka, Nawala, Nugegoda, Sri Lanka.

Carotenoids (car) are naturally occurring multifunctional plant pigments. Car consists of a long-conjugated polyene chain having 40 carbon with eight isoprene units. Peanut butter fruits (**Bunchosia glandulifera**) are a good source of car, vitamins, polyphenols and natural sugars. β-carotene, lutein, and zeaxantheins are among the major types of car present in Peanut butter fruits pulp. They have excellent antioxidant properties, provitamin A sources, and prevents chronic diseases such as cancer. Despite these functions, carotenoids have major limitations as a nutraceutical supplement, such as less water solubility and susceptibility to processing and storage due to oxygen sensitivity and photosensitivity. To overcome these limitations encapsulation technology is used in the food and pharmaceutical industry. The goal of this study was the formation of inclusion complexes with selected carotenoids extraction from Peanut butter fruits extraction and β-cyclodextrin using nano-encapsulation techniques which are co-precipitation and extended co-precipitation. Inclusion complexes enhance the bioavailability and solubility of β-carotene. β-cyclodextrin acts as a host molecule and the guest molecule is β-carotene. Solvent extraction was used for an efficient β-carotene extraction process from Peanut butter fruits. Characterisation of β-carotene was done by using UV-Visible spectroscopy, FT-IR, and high-performance liquid chromatography. Inclusion complexes were prepared from car and β-cyclodextrin in a 1:1 stoichiometric ratio. The complexes were characterized by using UV-Vis spectroscopy and FT-IR. UV-Vis spectral analysis, it is clear that intensity of maxima in the inclusion complex prepared by extended co-precipitation is more than compared to maxima of inclusion complex prepared by co-precipitation, suggesting a better inclusion by extended co-precipitation method. In the FT-IR spectra important changes in the polymeric hydroxyl stretching region (3000-3600 cm^{-1}) appeared more in both types of inclusion complexes. The obtained data showed that the extended co-precipitation method resulted in better yield compared to co-precipitation.

Keywords – carotenoids (car), β-cyclodextrin, encapsulation, co-precipitation, Peanut butter fruits

**Corresponding Author:* ddalw@ou.ac.lk

AN EBT-BASED "ZINC DIPICOLYL SULFONAMIDE" COMPLEX AS A POTENTIAL COLOURIMETRIC SENSOR FOR INORGANIC PHOSPHATE

K. A. S. Thathsarani[1], O. G. C. K. H. B. Udawatta[2] and P. V. H. K. Ranasinghe[3*]

[1,2]Department of Chemical Sciences, South Eastern University of Sri Lanka, Sri Lanka

[3]Department of Chemistry, The Open University of Sri Lanka, Sri Lanka*

Dipicolylamine (DPA), a tridentate ligand with three nitrogen atoms, is ideal for sensing applications. Its selectivity towards biologically active metal atoms and anions allows for the design of sensors capable of detecting analytes in biological and environmental samples. Our research focuses on designing a sensor that utilizes a zinc complex of a dipicolyl sulfonamide ligand, $Zn(N(SO_2)(1\text{-nap})dpa)Cl_2$ (1-nap = 1-naphthalenyl; dpa = dipicolylamine), to detect inorganic phosphates in water bodies. The sensor employs an indicator displacement method using Eriochrome Black T (EBT) as the indicator. A pure sample of $Zn(N(SO_2)(1\text{-nap})dpa)Cl_2$ complex (ZnDPSA) was used as received to prepare the sensor complex in-solution (H_2O) by mixing the complex and EBT in a 1:4 ratio at pH 9: The exact stoichiometry was obtained by Job's Plot method using UV/Vis spectral data and the optimal pH was determined by monitoring the maximum absorbance at 540 nm. The association constant between ZnDPSA and EBT calculated using the Benesi-Hilderbrand plot is $0.290\times10^3\ mM^{-1}$ while the association constant between ZnDPSA and phosphate ions was calculated to be $1.5781 \times 10^4\ mM^{-1}$. This ten-fold difference indicates the higher affinity of the ZnDPSA complex towards phosphate ions. Upon the presence of phosphate ions, the designed sensor produces a rapid and distinguishable colorimetric response (the pink colour turns into blue indicating that phosphate ions replace the bound EBT), making it a suitable phosphate detector. However, the lower limit of detection for phosphate ions was established at 0.1751 mM (SD = 0.0169) indicating a moderate level of sensitivity compared to other available Zn-based phosphate sensors. Interestingly, the UV/Vis experiments have demonstrated that the selectivity of the new sensor towards phosphate ions is significant: The interference study shows that the sensor colourimetrically responds only to phosphate ions but not to other common ions such as Cl^-, NO_2^-, SO_4^{2-}, HCO_3^-, and CO_3^{2-}. The sensitivity of the designed sensor could be further improved by modifying the sulfonamide linker of ZnDPSA.

Keywords: Zinc Dipicolyl Sulfonamide complex, Inorganic phosphate detection, UV/Vis studies, EBT indicator

[*]Corresponding Author: koran@ou.ac.lk

THE OPEN UNIVERSITY OF SRI LANKA
P.O.BOX 21, NAWALA, NUGEGODA
www.ou.ac.lk