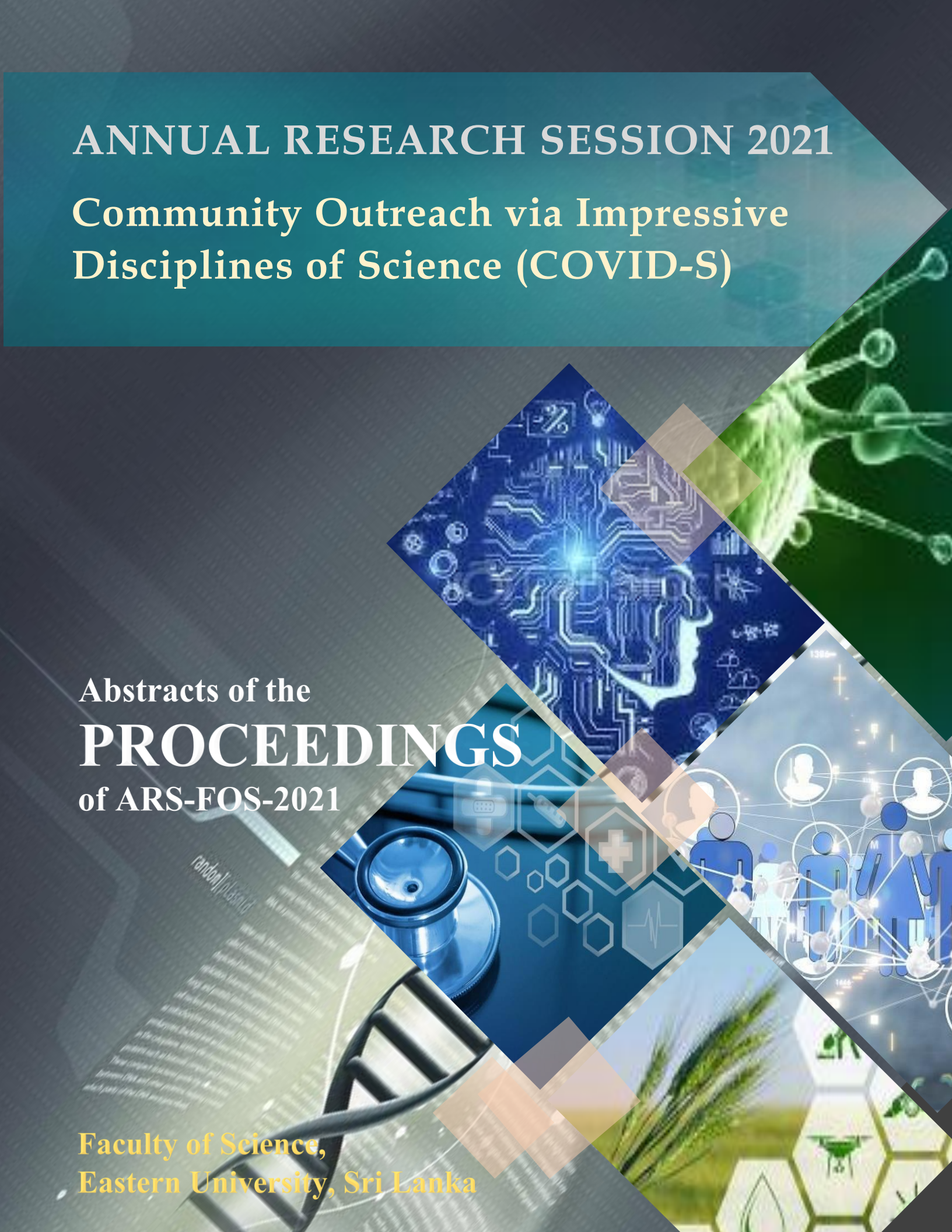
ANNUAL RESEARCH SESSION 2021

Community Outreach via Impressive Disciplines of Science (COVID-S)



Abstracts of the

PROCEEDINGS

of ARS-FOS-2021

Faculty of Science,
Eastern University, Sri Lanka

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of the

Annual Research Session
Faculty of Science
ARS-FOS-2021

"Community Outreach via Impressive Disciplines of Science (COVID-S)"

14th December 2021
Faculty of Science
Eastern University, Sri Lanka

Annual Research Session, Faculty of Science 2021 (ARS-FOS-2021)

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Annual Research Session, Faculty of Science 2021 (ARS-FOS-2021)

The Annual Research Session of the Faculty of Science (ARS-FOS-2021) on sciences is organised to hold on 14th December 2021. This is an annual event organized by the Faculty of Science, which is the research dissemination under the research policy of Eastern University, Sri Lanka. Even though we regret being prevented from physically holding the research session at the Eastern University, Sri Lanka, due to the worldwide spread of the COVID-19 epidemic, we are looking into the potential of holding an innovative virtual research session as a substitute.

The theme of the research session is "Community Outreach via Impressive Disciplines of Science (COVID-S)". This research session will provide a platform for discussion of recent rapid advances via research and development in the sciences. The research session scope includes subareas of sciences including but is not limited to Biological Sciences, Physical Sciences, Health Care Sciences, Agricultural Sciences, and Social Sciences.

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Message from the Vice-Chancellor

Professor F. C. Ragel
Vice-Chancellor
Eastern University, Sri Lanka

I am delighted to note my message for the Annual Research Session, Faculty of Science-2021 (ARS-FOS-2021), Eastern University, Sri Lanka (EUSL). The ARS-FOS-2021, is a scholarly forum that especially focuses on disseminating the undergraduate research findings to relevant stakeholders.

Research is integral part of university education and all of us are bound to engage and promote research at different levels. Our new Research Policy as per to the Goal-2 of our Strategic Plan promotes research in two fronts; i.e., for socio-economic development of the region and nation, and for generation of new knowledge of global significance.

As per to the new research strategy, the Annual Research Sessions of EUSL are mainly focused on dissemination of undergraduate students' research findings on issues that are significant to the region, the environment and the local community. Therefore, faculties are encouraged to collaborate with key external public and private organizations in the region and integrate Honors Degree research projects, thereby disseminating the findings. The university is committed to provide research grants to extend such potential preliminary research findings to the next level. The university has developed awards for excellence in research with regional/national significance to encourage this exercise. The University Business Linkage (UBL) is facilitating quality and performance enhancement of small and medium scale enterprises (SMEs) by linking undergraduate research to find solutions to the problems of SMEs.

On the other hand, EUSL in its new research policy, is promoting research of global significance by recognizing research publications in reputed journals (i.e., journals indexed by Web of Science, Scopus, etc.) that would contribute to enhance the global ranking of Eastern University. We have established output-based award schemes for researchers who perform high quality research and produce high impact research findings of global significance, so that these grants can be used to further enhance their research activities. I would like to urge the academic community to aim at such high impact research of global significance which would enhance your research visibility and repute. I highly commend the contribution by the Faculty of Science on this regard; out of over 200 publications with EUSL affiliation in journals indexed by Web of Science and Scopus, about 65-70% have been from Faculty of Science, particularly in the field of Physical Sciences. Moreover, high-quality research output in the field of General Relativity and High Energy Physics has placed EUSL in first rank among Sri Lankan universities by nature indexing during the last couple of years. I congratulate the faculty on its significant achievements in research of global significance.

ARS-FOS-2021, is a scholarly gathering organized by Faculty of Science that provides the

platform for research students, scientists and industrialists to share and disseminate the findings of regional significance. The theme of ARS-FOS-2021, 'Community outreach via impressive disciplines of science", focuses on research with tracks dedicated to Biological Sciences, Physical Sciences, Healthcare Sciences, Agricultural Sciences and Social Sciences. ARS-FOS-2021 aims to disseminate the undergraduate research findings to the relevant stakeholders, by giving opportunity for students to share their research experiences in a professional environment, and receive constructive and timely feedback from participating scholars and industrialists. Through this exercise it is expected to disseminate findings to related external public and private organizations in the region, and open avenues towards community wellbeing.

I thank with appreciation the enthusiasm and efforts of the Dean, the organizing committee, academics and students of the Faculty of Science in organizing the research session in corroboration with the new research policy of EUSL, and congratulate all of you for the success being achieved on the objectives.

Message from the Dean

Prof. P. Peratheepan
Dean, Faculty of Science
Eastern University, Sri Lanka

It is my great privilege and pleasure to convey my sincere felicitations for the Annual Research Session, ARS-FOS-2021 hosted by our Faculty of Science in the theme of "Community Outreach via Impressive Disciplines of Science (COVID-S)", despite the multiple challenges imposed by the unprecedented global pandemic. The theme of the annual research session is highly appropriate in the current complex milieu and also portrays the diverse mix of research excellence with the requisite potential for creativity and innovation among the academic staff and students. Indeed, the ARS-FOS-2021 will offer a great platform for researchers in the field of science and allied sciences for greater integration of multi-disciplinary, cross-disciplinary, and interdisciplinary approaches for sharing and disseminating its rich and advanced research outcomes.

On behalf of the faculty, I would like to express our sincere gratitude to the keynote speaker, Senior Professor Ajith de Alwis, Dean, Faculty of Postgraduate Studies, University of Moratuwa, for accepting our invitation to deliver the keynote speak despite his heavy busy schedule. We are immensely grateful to the Vice Chancellor, EUSL, Professor F.C. Ragel for his guidance and support to make this in line with the Research Policy, approved by the Council. I would also like to convey my warm thanks to Chair of ARS-FOS-2021 Dr. M. Koneswaran, members of the Organizing Committee, reviewers, panel of chairs, and students, and the multitude of administrators and support staff alike for your continued commitment to uphold research and development in the faculty. Our sincere thanks to the distinguished researchers and presenters who have contributed scientific articles to the session.

I believe that the ARS-FOS-2021 will provide a great platform for all to engage in meaningful scientific deliberations and discussions to bring to an upper level. I sincere wish the ARS-FOS-2021 will be a resounding success.

Message from the Chairperson

Dr. M. Koneswaran
Chairperson
ARS-FOS-2021

On behalf of the Organising Committee, I am delighted and honoured to convey this message to the Annual Research Session 2021 hosted by the Faculty of Science, Eastern University, Sri Lanka (ARS-FOS-2021).

Due to the Covid-19 pandemic, this year's the research session will be conducted online to ensure the safety of the participants. Our theme of "Community Outreach via Impressive Disciplines of Science (COVID-S)" was created to focus on disseminating the undergraduate research findings to relevant stakeholders. ARS-FOS-2021 received 20 extended abstracts and full papers from the research findings of the Honors Degree research projects. After a rigorous review process, the editorial committee accepted 17 abstracts for inclusion in the conference proceedings. We believe that the research outcomes disseminated at ARS-FOS-2021 will give opportunities for sharing and exchanging original research ideas and opinions, gaining inspiration for future research, and broadening knowledge about various fields in advanced science.

ARS-FOS-2021 is enriched by the keynote speech of a renowned Scientist, Prof. Ajith de Alwis, Dean, Faculty of Postgraduate Studies, University of Moratuwa. This keynote speech would offer a great opportunity for all attendees to hear the latest findings in the research.

As a chair of research session, I realise that the success of the conference depends ultimately on many people who have worked with us, in planning and organising the research session. I am constantly amazed by the support given by the Vice Chancellor, Prof. F.C. Ragel who has a real enthusiasm and genuine desire to upgrade research in the University. I express our sincere gratitude to the Dean, Faculty of Science, Prof. P. Peratheepan, for his support, cooperation and encouragement throughout the planning of ARS-FOS-2021. I am very grateful to the Editor-in Chief of ARS-FOS-2021, Prof. A.G. Johnpillai for his hard work on editing the conference proceedings. I express my heartfelt gratitude to the keynote speaker for accepting our invitation with much enthusiasm. The organising committee of the ARS-FOS-2021 is greatly acknowledged for their hard work and sense of responsibility.

Last but not least, I thank you the presenters, for enriching the conference by your presence. I hope you will enjoy the content, get new ideas, and above all, have a great deliberation.

It is my sincere wish that ARS-FOS-2021 will be a resounding success.

Message from the Editor-in-Chief

Prof. A. G. Johnpillai
Editor-in-Chief
ARS-FOS-2021

It gives me an immense pleasure and also a great honour to be invited to share my experiences through this message which gives an account of the peer review process exercised by the Editorial Board to bring out publishable research articles from authors for presentation at the Annual Research Session 2021 conducted by the Faculty of Science (ARS-FOS-2021), Eastern University, Sri Lanka (EUSL).

These expositions were the outcomes of the research work carried out by the undergraduate students of the Faculty of Science, EUSL.

Seventeen submissions, ten Full Papers and seven Extended Abstracts were accepted for presentation at the ARS-FOS-2021 based on the recommendations of the two reviewers who were chosen internally and externally for each submission in consideration of their expertise in the area of research.

Internal reviewers were chosen from the EUSL and the external reviewers were selected from University of Peradeniya, University of Ruhuna, University of Sri Jayewardenepura, University of Moratuwa, University of Jaffna, Open University of Sri Lanka and South Eastern University of Sri Lanka.

Thus, it is with great appreciation and gratitude that I express my sincere thanks to each one of the reviewers whose cooperation and timely efforts were extremely helpful to make the final decision as to the suitability for publication of the submissions and to ensure the success of the ARS-FOS-2021.

I would like to thank the Editorial Board Members for their advice in reviewing the submissions.

I sincerely express my thanks to the Chairman/ARS-FOS-2021, Dr. M. Koneswaran whose trust and unstinted support throughout helped me to complete the review process in time. It was indeed a pleasure working with him.

Finally, I like to thank all the authors who have contributed to the ARS-FOS-2021 and wish you all a happy reading.

Brief Biography of the Keynote Speaker

Professor Ajith de Alwis
University of Moratuwa
Sri Lanka

Prof. Ajith de Alwis completed his PhD at University of Cambridge, UK after receiving his BSc in Chemical and Process Engineering at the University of Moratuwa. He also holds a Master of Business Administration (MBA) from Postgraduate Institute of Management (PIM) of University of Sri Jayewardenepura. He is the recipient of numerous awards in recognition of his scholarly work, most notable being the Senior Moulton Medal of Institution of Chemical Engineers (UK), Danckwerts-Maxwell Award from University of Cambridge for the best PhD Thesis and the University of Moratuwa Research Awards from 1997 to 2007, 2013-2014.

Prof de Alwis is a Senior Professor at the Department of Chemical and Process Engineering at the University of Moratuwa and is also one-time Director of the University of Moratuwa-Cargills Food Process Development Incubator. He served as the Chairman of Engineering Research Unit (ERU) of University of Moratuwa from 2005-2007. Prof de Alwis was also a post-doctoral research fellow at University of Reading, UK and Visiting Scientist at the Indian Institute of Science (IISc) in Bangalore. He has published many research articles and book chapters in various international and local journals. He was also the Science Team leader for Sri Lanka Institute of Nanotechnology (SLINTEC) from its inception in 2008 to 2011, and Chairman of the National Nanotechnology Committee at NSF from 2011-2012.

He is a member of various local and international professional bodies; the Cambridge Philosophical and Commonwealth Societies, the American Institute of Chemical Engineers (MAIChE), the Editorial Board of the European Journal of Food & Bioproducts, Fellow of the National Academy of Sciences Sri Lanka, Life Member of Sri Lanka Society for the Advancement of Sciences, the National Expert Committee on STEM Education of the Ministry of Education to name a few, and also the founding President of Sri Lanka Biogas Association of Sri Lanka. He served as a member in the Board of Scientific Counsellors of National Institute for Occupational Safety and Health (NIOSH). He is serving in the Intellectual Property Advisory Committee of the National Intellectual Property Office (NIPO), Sri Lanka, since 2015.

Prof Ajith de Alwis is currently the Dean of Faculty of Postgraduate Studies, University of Moratuwa and also the Project Director of the Coordinating Secretariat for Science, Technology and Innovation (COSTI) Sri Lanka.

He is also a regular columnist to the Daily FT (www.ft.lk/columns) on Science, Technology and National Development.

Keynote Speech

Transforming University for Impactful Outreach – University as a Live-in Lab!

Professor Ajith de Alwis
University of Moratuwa

Community outreach by the University is under the lens. A university is always present within a community. Does the community value the presence of the university in its midst? So many disciplines are taught and skills imparted to an internal community who too arrive from outside with the hope of becoming better. However, this internal stream once passes through the system responds differently at the end. The country has always experienced brain drain and that is a sad aspect that emanates out of our higher education institutes. In multiple ways lots of grievances are aired and flight is an easy recourse taken up by many. There is imperative to ensure that what one does has a chance of impacting lives. Some argues that it does not matter in this day and age where you decide to contribute. Many a local community has lost out in the process.

Alexander Fleming had a burning desire to find an answer to infections in order to save lives. He worked from his lab in one university and succeeded. The attitude and persistence mattered a lot. Finally supported by 'serendipity' too he succeeded and effectively mankind benefitted. Are we take this as a rare instance and resigned ourselves to a much easier approach as a researcher? Today in a much more complex world teamwork and collaborations matter a lot more. Universities should provide an enabling environment for the researcher. Allow the space for the researcher to flourish. This need not only be at postgraduate level. One can unleash the undergraduates too to problem solving enabling immediate deployment of material under study for problem solving. Communities provide many an opportunity for engagement. There is not much effort needed to identify problems or existing impediments to growth in any location. The best path to ensure community outreach is by ensuring that their problems becoming feed material for learning and research. Solutions coming out can bring the institution and community together.

The approach may be by making the University a live-in Lab. Across disciplines subject matter could be allowed to be tested on addressing problems. The immediate issue of LPG gas related incidents is an example. From science to social studies to communications can join hands in addressing conflicts and challenges posed by this situation. The curricula delivery understanding and accepting this mode of learning is a necessity. Answering practical aspects of the current challenges to devising a completely different energy service model could be carried out by forming different teams. The university definitely has internal abilities yet our compartmentalized ways of education prevent such scenarios from materializing. When the university is converted to a Live-lab environment teaching depends on problems. The realization of a solution can have far reaching consequences as the problems are most certainly not only confined to one location.

The concept of Live-in Lab for the University requires taking on challenging assignments. Forming groups where collaboration is the key comes next. Pacing interactions and driving for solutions

challenges students to skill themselves. The outcome we always desire in terms of a university education arrives in a differently at the end but the results are much better and long-lasting if carried out in this manner. The bonding of the university to the town could only be better this way.

May impactful research thrive!

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Title	*Hypergeometric equation in modelling charged relativistic stars*
Authors	*Saparamadu D. I. N* and Thirukkanesh S*

Time	*11.05 – 11.25*
Abstract ID	*ARS-2021-FS-M-02*
Title	*New linearizing invertible point transformations for a nonlinear third order ordinary differential equation*
Authors	*Saparamadu D. I. A* and Johnpillai A. G*

Time	*11.25 – 11.45*
Abstract ID	*ARS-2021-FS-M-03*
Title	*On regular locally closed sets*
Authors	*Wijerathne J. M. U. D* and Elango P*

Time	*11.45 – 12.05*
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Title	*Ip-Closed maps in ideal topological spaces*
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SESSION 2: CHEMISTRY

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Title	*Synthesize and characterization of eco-friendly bio lubricants from plant-based oils*
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Title	*Consumption pattern and determination of vitamin c, total phenol and antioxidant content of selected wild edible green weeds of commelinaceae family*
Authors	*De Silva N. C. I* and Mathiventhan U*

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Title	*Composition of the phytoplankton as bio indicators with relevant to seasonal and water quality variations in selected locations of Batticaloa lagoon*
Authors	*Ekanayaka E. M. M. C*and Sathananthan S*

SESSION 4: ZOOLOGY

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Authors	*Nazra M. W. F. A* and Devadasan C. G*

In-vitro Antibacterial Activity of Locally Available Medicinal Plants Against Pathogenic Bacteria

Abhayarathne, A. H. Y. G.[1*] and Mahendranathan, C.[1]

Abstract. Plants are playing a significant role in maintaining human health and improving the wealth of human life and are a better alternative to synthetic drugs that display negative side effects, such as sensitization reactions, and disruption of the metabolic processes in the body via interaction with the body system. The main objective of this study was to evaluate the *in-vitro* antibacterial activity of selected Green Leafy Vegetables (GLVs), namely *Sesbania grandiflora* and *Boerhavia diffusa*. Fully matured fresh leaf samples were collected from different localities of western province, Sri Lanka. The acetone, ethanol and aqueous extracts of leaf samples were tested for antibacterial activity against *Escherichia coli* (*E. coli*) and *Staphylococcus aureus* (*S. aureus*), by using agar well diffusion method at the test concentrations of 25,50 and 75mg/100µl. The maximum inhibitory effect was observed in the ethanol extracts of leaf samples against both bacterial strains at 75mg/100µl concentration. Ethanol extract of *S. grandiflora* showed the maximum inhibition effect (20.8±0.5mm) against *S. aureus* and it was the most susceptible bacteria than *E. coli* in both plant extracts of all three solvents. All three extracts of *S. grandiflora* showed most effective antibacterial activity against both bacterial strains, tested. The MIC values obtained from plants exhibited antibacterial activity ranged between 6.25 and 25mg/100µl. The lowest MIC values were given by the ethanol extracts. So, the ethanol extracts of these two plants were the most effective plants which exhibited strong antimicrobial activity on both bacterial strains. Presence of bio active compounds in plant extracts may be a reason to indicate high antibacterial activity of these plant leaves.

Key words. *Sesbania grandiflora, Boerhavia diffusa, antibacterial activity, Escherichia coli, Staphylococcus aureus*

[1]Department of Botany, Faculty of Science, Eastern University, Sri Lanka
***Corresponding author.** yohangayasri100@gmail.com

Consumption Pattern and Determination of Vitamin C, Total Phenol and Antioxidant Content of Selected Wild Edible Green Weeds of Commelinaceae Family

De Silva, N. C. I.[1*] and Mathiventhan, U.[1]

Abstract. Essential nutrients found in wild edible plants (WEPs) which are necessary for healthy life. The present study aimed to determine the consumption pattern, vitamin C content, total phenol content (TPC) and total antioxidant activity (TAA) of selected wild edible green weeds (WEGWs) of Commelinaceae family. Weeds of Commelinacea family, *Commelina benghalensis* (Diya Meneriya-S) and *Commelina diffusa* (Gira pala-S) were selected by preliminary investigation of wild edible plants in Sri Lanka. Based on an investigation and observation, both selected species considered as weeds in most parts of Sri Lanka. The information of consumption pattern of WEGWs was collected by means of semi structured questionnaires from three different localities in Matara District where these weeds are consumed as leafy vegetable. The fresh leaf samples were used for analyzing and vitamin C, TPC were determined using spectrophotometric method. TAA was measured using Ferric Reducing Antioxidant Power (FRAP) assay. Questionnaire survey revealed that only 32% consumed both weeds as leafy vegetables and 56% of them consumed either *C. benghalensis* or *C. diffusa* as edible. The mode of consumption was cooked form. The vitamin C content of WEGWs ranged from 26.23± 3.35mg/100g for *C. diffusa* to 46.37±2.25 mg/100g ww for C. *benghalensis*. Total phenolic content was in the range of 38.4±19.7mgTAE/100g ww for *C. diffusa* and 256.5±79.9 mgTAE/100g ww for *C. benghalensis*. TAA of WEGWs ranged from 6.46±0.26 µmol FeSO4/g ww for *C. diffusa* to 33.64±0.49 µmol FeSO4/g ww for *C. benghalensis*. Vitamin C and TAA of both plants varied in different locations ($P<0.05\%$). This may be due to changes of soil content in three different locations. The results indicate that the consumption of these WEGWs could provide essential natural antioxidants and if consumed in sufficient amount would provide adequate protection against chronic diseases caused by dietary changes. *C. benghalensis* was the richest ($P<0.05$) source of vitamin C, TPC and TAA.

Key words. *Edible weeds, Vitamin C, phenols, antioxidants*

[1]Department of Botany, Faculty of Science, Eastern University, Sri Lanka
***Corresponding author**. ishuudesilva@gmail.com

Composition of the Phytoplankton as Bio Indicators with Relevant to Seasonal and Water Quality Variations in Selected Locations of Batticaloa Lagoon

Ekanayaka, E. M. M. C.[1*] and Sathananthan, S.[1]

Abstract. The main purpose of this study was to study how the phytoplankton act as bio indicators. In order to determine it, the abundance and distribution of phytoplankton and physiochemical water quality parameters were studied in different seasons at four locations of Batticaloa lagoon which were selected based on the different anthropogenic influences, land use practices, fishing area and mixing point at the ocean such as Onthachimadam, Palameenmadu, Sathrukondan and Pankudaveli. The study was conducted routinely at once a month from October 2019 to February 2020 over the rainy and dry seasons. All water quality parameters of Water temperature, Salinity, Electric conductivity, pH, Dissolved oxygen, Nitrate, Phosphate, iron, total hardness and chloride were measured in standard methods and distribution and abundance of phytoplankton also were analyzed. In the present study, Water temperature, Salinity, Electric conductivity, pH, Dissolved oxygen, total hardness, and Nitrate. of Batticaloa lagoon showed significant seasonal variation ($P < 0.05$) while Phosphate, iron and chloride showed there was no any significant seasonal variation ($P > 0.05$). A total of 122 species of phytoplankton belongs to seven divisions were identified in selected four locations in Batticaloa lagoon throughout the study period. Among them Bacillariophyceae is most diverse division. Abundance and distribution of phytoplankton were higher in the months of January and February than the October, November and December. During this study phytoplankton abundance were negatively correlated with salinity ($r = -0.220$), conductivity($r=-0.115$), iron ($r=-0.184$ and chloride ion ($r=-0.123$) while positively correlated with water temperature($r=0.129$), pH($r=0.361$), DO($r=0.253$), Nitrate($r=0.203$), Phosphate($p=0.195$) and total hardness($r=0.040$) at 95% confidence level. Among them water temperature only significantly correlated with phytoplankton abundance at 95% significant level while other parameters were not at significant level. The presence of bioindicators such as *Navicuala* sp., *Nitzschia* sp., *Scenedesmus* sp., *Closterium* sp., cyanophyceae and euglenoids in Batticaloa lagoon specially in Pankudaveli area evidenced that the lagoon subjected to organically polluted. *Navicuala* sp., *Nitzschia* sp., C*oscinodiscus* sp., *Cyclotella* sp., *Cylindrotheca* sp., *Chorella* sp., *Oscillatoria* sp., *Nostoc* sp. *and Stephanodiscus* sp. lack of seasonality in this study. The information and observation in this study will be very useful in formulating management policies for the future conservation and management of the Batticaloa lagoon.

Key words. *Bioindicators, phytoplankton, water quality, seasonal variation, Batticaloa Lagoon*

[1]Department of Botany, Faculty of Science, Eastern University, Sri Lanka
[*]Corresponding author. maleeekanayake222@gmail.com

Extraction of Natural Dye from *Coscinium fenestratum* and Dyeing of Cotton Fabric by Using Various Mordanting Techniques

Kishoba, K.[1] , Dushyantha, L., Sithambaresan, M.[1]*, Premkumar, S.[1]

Abstract. At present, a higher demand is put towards the use of natural dyes due to increased awareness of the environmental and health hazards associated with the synthesis and use of synthetic dyes. The dye extracted from *Coscinium fenestratum* was subjected to TLC and column chromatographic analysis. IR spectral analysis and comparison with data from literature revealed that the compound isolated from c.fenestratum eluted with CH_3OH maybe berberine or jatrorrhizine or palmitine. Further, comparison of the TLC data of commercial sample (Rf=0.65) of berberine confirms the identity of the isolated compound (Rf=0.66). The confirmed functional groups are related to the three tentative structures (berberine, palmitine and jatrorrhizine). This study also investigated the effect of tannic acid and metallic mordants on the dyeing properties of natural dye extracted from *Coscinium fenestratum*. The methanolic extract of the dye was applied on the bleached cotton fabric. Seven pre-treatment methods (tannic acid alone; aluminium acetate alone; ferrous sulphate alone; copper sulphate alone; tannic acid and aluminium acetate; tannic acid and ferrous sulphate; tannic acid and copper sulphate) were performed. The dyeing of pre-mordanted cotton fabrics has presented a highest dye uptake when compared with un-mordanted cotton fabrics. The colours obtained with the dyes vary in their tone due to the fact that when the dye extracts are combined with metallic mordants to form dye-metal complexes, different shades are then attained. The wash fastness tests show that the mordanted (tannin with metallic salt) fabrics have good colour fastness.

Key words. *Berberine, Coscinium fenestratum, pre-mordanted, mordant, tannic acid, natural dyes, cotton.*

[1] Department of Chemistry, Faculty of Science, Eastern University, Sri Lanka
*Corresponding author. msithambaresan@gmail.com

Synthesize and Characterization of Eco-friendly Bio Lubricants from Plant-based Oils

Chamika, P. G. T.[1], Arasaretnam, S.[1*] and Premkumar, S.[1]

Abstract. Nowadays petroleum oil lubricants are most commonly use lubricant in motor vehicles and industrial machines. But those petroleum base lubricants create major problems to the marine and terrestrial environment. Therefore, researchers are trying to find new substances which are chemically modified for the substitution for petroleum base lubricant. Therefore, in this research four different types of bio lubricants were prepared by chemical modification of plant base oils like coconut oil, Palm oil, Neem oil and Waste palm oil. The method for the production of bio lubricant consists esterification and trans- esterification process. In trans-esterification there are two steps, Synthesizing the methyl ester of the plant oil is the first step and the second step is trans-esterifying the methyl ester to synthesize the bio lubricant using Monoethylene glycol. The bio lubricant was characterized by using GC-MS analysis. And also Flash point, density at 15 °C, 40 °C and 100 °C, viscosities at 40°C and 100°C, viscosity index, acid value, yield percentage and cost of product of samples were analyzed. All the properties of the bio lubricant produced were compared with the mineral oil lubricants and ISO VG 46.

Key words. *Chemical modification, Mineral oil lubricants, trans-esterification, GC-MS analysis*

[1]Department of Chemistry, Faculty of Science, Eastern University, Sri Lanka
*Corresponding author. s_arasaretnam@yahoo.co.uk

Preparation of Activated Carbon for the Adsorption of Metal Ions and Antimicrobial activity

Achini A. W.[1], Koneswaran, M.[1*] and Umaramani, M.[2]

Abstract. The aim of this research was to produce the activated carbon from rice husk as an alternative to the commercially available activated carbon. This work was also focusing on the study of adsorption capacity of this activated carbon on the Cd (II) ions and Cr (III) ions present in the water samples. Moreover, the antimicrobial activity of this synthesized activated was studied against the harmful pathogens such as *Staphylococcus aureus* and *Escherichia coli*. In this work, the carbon was prepared from rice husk through a pyrolysis method and was activated by phosphoric acid using the physico-chemical method. The activated carbon was characterized using various analytical techniques such as Fourier-Transform Infrared (FT-IR) Spectroscopy and UV-Vis Absorption Spectroscopy. The adsorption of Cd (II) ions and Cr (III) ions by the activated carbon were studied using the Atomic Absorption Spectroscopy (AAS). The studies on adsorption isotherm were performed using the Langmuir adsorption isotherm and Freundlich adsorption isotherm. These studies revealed that the Langmuir adsorption isotherm gives better fit for both Cr (III) ions and Cd (II) ions than the Freundlich adsorption isotherm. The adsorption of Cd (II) ions and Cr (III) ions by the activated carbon were calculated and they were 6.9881mgg^{-1} and 2.6274 mgg^{-1} respectively. The antimicrobial activity of this material was performed and compared with commercially available antimicrobial agent (amoxicillin). This activated carbon shown better antibacterial activity against the *Escherichia coli* than the *Staphylococcus aureus*.

Key words. *Rice husk, activated carbon, pyrolysis, adsorption isotherm, antibacterial activity*

[1]Department of Chemistry, Faculty of Science, Eastern University, Sri Lanka
[2]Department of Botany, Faculty of Science, Eastern University, Sri Lanka
*Corresponding author. koneswaran@esn.ac.lk

Comparative Study on the Adsorption of Metal Ions on Activated Biochars Produced from Fruits Peels

Anushka, I. G.[1], Koneswaran, M.[1*]and Premkumar, S.[1]

Abstract. Cadmium (Cd^{2+}) ions and Chromium (Cr^{3+}) ions are the most common pollutants found in industrial effluents which generally affect the ecosystem and the human health. Therefore, it is important to develop cost-effective and environmentally friendly adsorbents to remove these Cd^{2+} ions and Cr^{3+} ions from the aquatic system. Hence, this work aims to synthesize biochar using the waste plant materials to adsorb the Cd^{2+} ions and Cr^{3+} ions from the aquatic medium. This study mainly focused on the synthesis of biochar from the mango peel and lemon peel at various pyrolysis temperatures (400, 500, 600 and 700 °C) with two different heating times (1 h and 2 h). The prepared biochar was activated using an alkaline solution of 2.5 M of NaOH and was characterized using Fourier Transform Infrared Spectroscopy and UV Visible Absorption Spectroscopy. The adsorption capacity of the activated biochar against Cd^{2+} ions and Cr^{3+} ions were evaluated using an Atomic Absorption Spectroscopy. The adsorption isotherm studies were performed using Langmuir isotherm and Freundlich isotherm models. Equilibrium experiments of Cd and Cr adsorption on biochar were performed. The optimum adsorption capacity of activated biochar produced from mano peel for Cd^{2+} ions and Cr^{3+} ions were 3.1918 mg/g and 2.2920 mg/g respectively, whereas biochar produced from lemon peel for Cd^{2+} ions and Cr^{3+} ions were 21.1416 mg/g and 3.3710 mg/g respectively. Moreover, the biochar produced from this method could be used as low-cost alternative adsorbents material for the removal of Cd^{2+} ions and Cr^{3+} ions from the wastewater.

Key words. *Biochar, cadmium ions, chromium ions, adsorption isothermal, mango peel, lemon peel*

[1]Department of Chemistry, Faculty of Science, Eastern University, Sri Lanka
*Corresponding author. koneswaran@esn.ac.lk

Extraction of Natural Dye from C*asuarina Equisetifolia* and Dying of Cotton Fabric Using Different Mordant

Radshaki, K.[1], Dushyantha, L.[1], Sithambaresan, M.[1]* and Premkumar, S.[1]

Abstract. The excessive production and application of synthetic dyes caused serious health hazards and environmental impact. In the view of health concern and environmental awareness the use of natural dyes again become more popular in recent years. Present study efforts were made to use of natural dye from *Casuarina equisetifolia* for dyeing of cotton fabric. The *Casuarina equisetifolia* was collected from the coastal zone of Kallady, Batticaloa, Sri Lanka. TLC analysis revealed that three different compounds are responsible for the colour of the dye. Characterization of the dye using UV spectroscopy confirmed the presence of conjugated phenolic compounds. IR spectroscopy confirmed the presence of phenol, alcohol, ester, alkane and alkene functional groups in the dye. Phytochemical analysis confirmed generally that the dye solution contains phenolic compounds and specifically tannin and flavonoids are present in the dye. The aqueous extract produces different shades of colour on cotton fabric with different chemical and natural mordants. The wash and light fastness properties of the dyed cotton fabric were evaluated and good fastness grades were obtained. pH values of the dye bath have a considerable effect on the shades. Acidic medium of the dye bath produces darker shades and better fastness properties than alkaline medium of the dye bath.

Key words. *Natural dyes, dyeing, mordants, fastness properties*

[1]Department of Chemistry, Faculty of Science, Eastern University, Sri Lanka
*Corresponding author. msithambaresan@gmail.com

Hypergeometric Equation in Modelling Charged Relativistic Stars

Saparamadu, D. I. N.[1]* and Thirukkanesh, S.[1]

Abstract. We model charged compact stars in static spherically symmetric space-time by solving Einstein- Maxwell system of field equation by choosing a physically reasonable form for the metric potential g_{rr} and the electric field. This is achieved by transforming the condition for pressure isotropy to a Gaussian type hypergeometric equation. The solutions are given in simple form that is a desirable requisite to study the behavior of relativistic compact stars in detail. We regain well-known physically reasonable models in the limit of vanishing electric field. The generated interior metrics match smoothly with the exterior Reissner-Nordstrom metric. A physical analysis indicates that our models satisfy all the major requirements of a realistic star. Moreover, the stability of the model has been checked by means of the relativistic adiabatic index.

Key words. *Einstein-Maxwell system, hypergeometric equation, exact solutions, isotropic matter*

[1]Department of Mathematics, Faculty of Science, Eastern University, Sri Lanka.
*Corresponding author. ishara.saparamadu@gmail.com

New Linearizing Invertible Point Transformations for a Nonlinear Third-order Ordinary Differential Equation

Saparamadu, D. I. A.[1*] and Johnpillai, A. G.[1]

Abstract. We construct new linearizing invertible point transformations for a nonlinear third-order ordinary differential equation (ODE) considered in literature in the context of invertible point transformations and linearization. We utilize the direct approach which gives, in terms of the coefficients of the given class of nonlinear third-order ODEs, the necessary and sufficient conditions for its linearizability and the determining equations to find the linearizing point transformations. Furthermore, we show how the linearizing point transformations can be used effectively to reduce the underlying nonlinear ODE to the Laguerre-Forsyth canonical form. These invertible point transformations have not been reported in previous studies and are thus new.

Key words. *Linearization conditions, Nonlinear third-order ordinary differential equations, Point transformations*

[1]Department of Mathematics, Faculty of Science, Eastern University, Sri Lanka
*Corresponding author. imasha.saparamadu@gmail.com

On Regular Locally Closed Sets

Wijerathne, J. M. U. D.[1]* and Elango, P.[1]

Abstract. A new class of locally closed sets namely regular locally closed sets, (briefly, *RL*-closed sets) were introduced in the topological spaces by using the regular open sets and the closed sets. A subset *A* of a topological space *X* is called a *RL*-closed set if *A* is a union of a regular open set and a closed set in a topological space. The locally closed sets, the generalized locally closed sets and the regular generalized locally closed sets were defined with the same terminology, so that the *RL*-closed sets were compared with these closed sets. It was shown that the intersection of a *RL*-closed set with either a closed set or a regular open set again become a *RL*-closed set.

Key words. *Regular open sets, locally closed sets, RL-closed sets.*

[1]Department of Mathematics, Faculty of Science, Eastern University, Sri Lanka.
* Corresponding author. wijerathneumesha0527@gmail.com

Ip-Closed Maps in Ideal Topological Spaces

Rakshana, S.[1*] and Elango, P.[1]

Abstract. We introduced a new class of generalized closed maps in ideal topological spaces namely, *Ip*-closed maps by using the *Ip*-closed sets. We established their connections with some of the other generalized closed maps such as *Ig*-closed maps, *Irg*-closed maps and *αIg*-closed maps which have definitions similar to *Ip*-closed maps in ideal topological spaces. We also focused on some of their most important characteristics. In this order, we showed that the composition of two closed maps is an *Ip*-closed map and also the composition of a closed map and an *Ip*-closed map is again an *Ip*-closed map. Also, we considered the association with *Ip*-continuous map and *Ip*-homeomorphism and proved that a bijective *Ip*-continuous map is an *Ip*-homeomorphism if and only if it is an *Ip*-closed map.

Key words. *Ideals, closed maps, Ip-closed maps, Ip-homeomorphism*

[1]Department of Mathematics, Faculty of Science, Eastern University, Sri Lanka.
*Corresponding author. rakshana1994@gmail.com

Ergasilid Copepod Infestation on Some Widely Consumed Fish Species in Valaichchenai lagoon, Batticaloa District

Sarmila, I.[1]*, Harris, J. M.[1] and Vinobaba, P.[1]

Abstract. The present study was undertaken to find out the ergasilid copepod infestation on widely consumed fish species along three different locations in Valaichchenai lagoon during the Northeast monsoonal period from November 2019 to February 2020. The ergasilid copepod species namely *Dermoergasilus amplectens*, *Ergasilus sieboldi*, *Ergasilus parvitergum* and *Sinergasilus major* were recorded in the widely consumed fish species such as *Etroplus suratensis*, *Mugil cephalus* and *Leiognathus fasciatus* of Valaichchenai lagoon. The results revealed that the prevalence and mean intensity in different gender of fish species for each ergasilid parasite in each location of the lagoon. *Ergasilus parvitergum* showed maximum prevalence of 28.57%, 53.33% and 26.67% in each sampling locations of L1, L2 and L3 respectively. The highest mean intensity (14.5) was recorded in sampling location L1 for *Ergasilus parvitergum* which indicated that E. *parvitergum* is more adapted to their fish hosts when compared to other ergasilid copepod parasites available in Valaichchenai lagoon. Invasion of *Sinergasilus major* was recorded at polyhaline water (L1) in the present study. As stated in the statistical analysis, spatial variation exists in parasitic prevalence of *Sinergasilus major* (P = 0.00) and E. *parvitergum* (P = 0.044) between sampling locations of the lagoon. However, spatial variations not exist in parasitic prevalence of *Ergasilus sieboldi* (P = 0.124) and *Dermoergasilus amplectens* (P = 0.749) between the sampling locations of the lagoon. Furthermore, the overall prevalence of parasites in the host fish values were 66.67% and 33.77% in females and males respectively which shows significant different each other. From the present study it can be infer that gender influence the degree of ergasilid parasitic infestation in fish during the northeast monsoonal period.

Key words. *Fish, parasites, prevalence, Valaichchenai lagoon, water quality*

[1]Department of Zoology, Faculty of Science, Eastern University, Sri Lanka.
* Corresponding author. sharmilailyasin@gmail.com

Prevalence and Bioassay for Major Dengue Vectors *Aedes* sp in Selected Locations of Batticaloa District

Dilushi, J.[1*], Vinobaba, M.[1] and Surendran, S. N.[2]

Abstract. Dengue has become the major vector borne disease in Sri Lanka. Control of the vectors *Aedes aegypti* and *Aedes albopictus* through elimination of breeding habitats and application of insecticides are considered as the most effective ways to suppress the dengue epidemic. The survey was carried out to examine the occurrence of potential breeding site of dengue vectors in indoor and outdoor premises of the houses in urban, suburban and rural areas such as Oddamavadi, Eravur, and Vantharumoolai respectively in Batticaloa district and to assess the resistance status of dengue vectors to some commonly used insecticides. Findings of the container survey and larval survey revealed that the three study locations are abundant with wet containers that are potential for the dengue mosquito breeding. There was a significant difference ($p = 0.001$) in the abundance of indoor containers in all three locations. The number of indoor containers were highest in Oddamavadi and lowest in Vantharumoolai. But there is no significant difference ($p = 0.697$) in the abundance of outdoor containers in all three locations. The results also indicated that both species can breed in urban, suburban, and rural areas. But *Ae.albopictus* prefers mostly rural and outdoor premises where there is dense vegetation. *Ae.aegypti* was the dominant species in all three locations. The larval indices have showed that Oddamavadi and Eravur were at high dengue epidemic risk and Vantharumoolai was at moderate risk. Results of insecticide bioassay revealed that both of the species were susceptible to deltamethrin and both were resistance to DDT and carbamate. It has also been found that both of the species were possibly resistance to malathion. From this result we can conclude that deltamethrin can be effectively used for space spraying programmes during the outbreak of Dengue in Sri Lanka.

Key words. *Bioassay, resistance, larval indices, dengue vectors*

[1]Department of zoology, Faculty of Science, Eastern University, Sri Lanka
[2]Department of Zoology, Faculty of Science, University of Jaffna, Sri Lanka
[*]Corresponding author. e-mail: j.dilushi18@gmail.com

Characterization of Micro-plastics in Batticaloa Lagoon at Kattankudy

Jahan, A. S. S.[1*], Vinobaba, P.[1] and Harris, J. M.[1]

Abstract. Micro-plastics (MPs) are a globally ubiquitous contaminant, the occurrence and accumulation of micro-plastics in the aquatic environment is nowadays an undeniable fact. To date, our understanding of micro-plastics pollution is limited. Therefore, this study intends to address morphological characterization and quantification of micro-plastics at Kattankudy municipal dumping sites of Batticaloa lagoon during September 2019 to February 2020. Normal one-liter buckets and Ekman grab sampler were utilized to collect water samples and sediments, respectively. Density separation was carried out using NaCl solution and all floating solids were subject to a wet peroxidation method and observed under stereomicroscope. All the recovered micro-plastics were sorted into categories based on the size (1 mm, 1-2 mm, 2-4 mm) shape (Film, fragment, filament, foam, pellet, microbeads) and colour. Kattankudy sample stations generally have great abundance and it consists of 1638.83 ±71.69 MPs/Kg dry weight in sediment and 1028.33 ± 73.73 MPs/L in surface water. Overall abundance of micro-plastics was statistically significant ($p<0.05$) among the study sites. Fragments were the most abundant particle shape found within the sediments (~33%) and a greater number of films were overwhelmed in surface water (~47%). Less than 1 mm size fraction was the most common in sediments while somewhat larger sizes 2-4 mm were dominant in surface water. The MPs collected from both surface water and sediment came in a variety of colors, with 51% of the MPs on the lagoon-shore being white and 27% of the MPs inside the lagoon being transparent. Overall, this study offers evidence of micro-plastic pollution present in Kattankudy stations by municipal dumping and some anthropogenic activities. This calls urgently for precautionary measures to mitigate this pollution. Further research is expected to address real impacts of these micro-contaminants on the lagoon environment in future.

Keywords. *Abundance, lagoon, sediment, surface water*

[1]Department of Zoology, Faculty of Science, Eastern University, Sri Lanka
*Corresponding author. samroothsaleem@gmail.com

Nutritional Composition of Three Brackish Water Fish Species Recorded from Batticaloa Lagoon

Nazra, M. W. F. A.[1*] and Devadasan, C. G.[1]

Abstract. Fish is a high-quality animal-source food in the nourishment of millions worldwide. The most edible part of the fish is the muscle and which provide a proper balance of proximate and non-proximate nutrition and have a relatively low caloric value than other meats. This present study aimed to fill the gaps in the nutritional profile of three brackish water fishes (*Arius maculatus*, *Mugil cephalus* and *Oreochromis niloticus*) sourced from Batticaloa lagoon. The survey was conducted during the period from November 2019 to February 2020. The fortnight sampling of the fresh lagoon fishes was done in Kallady, Kattankudy and Arayampathy fish markets. The nutritional compositions such as moisture content, protein content, fat content and ash content of epaxial muscles of selected fishes were analyzed with the suitable standard method of the Association of Official Analytical Chemists, 2005. When comparing nutrition compositions of fishes, the moisture content was the most dominant component in the fish muscles. The protein content of the fish muscles ranged from 13.7 ± 1.55% to 15.36 ± 1.62 %. Amidst the selected fishes, *Oreochromis niloticus* is lean fish while *Arius maculatus* and *Mugil cephalus* are low-fat fishes based on the muscle lipid content. The ash content of the analyzed fish species is ranged between 1.22 ± 0.15% to 1.77 ± 0.45%. All the interested nutrition composition means were significantly differed (P-value < 0.05%) between documented fish species. The results of this study revealed that the *Arius maculatus* containing highest value of lipid and ash content while *Oreochromis niloticus* containing peak value of moisture content. The *Mugil cephalus* can be consider as a good source of animal protein than other examined fish species. Several factors such as biological characters, spawning period, environmental conditions, anthropogenic activities, and water quality parameters determine the nutritional composition level of each fish muscle. The selected fish muscles are highly recommended for human consumption since these fishes are highly enriched with proximate nutrient composition and support to beat the food insecurity by boosting our general health.

Key words. *Fish, lagoon, nutrition*

[1]Department of Zoology, Faculty of Science, Eastern University, Sri Lanka.
*Corresponding author. anazrawazeer60@gmail.com

Designing and Fabrication of Low-cost Coconut Husk Removing Machine

Yunestharan, M.[1], Rizvi, M. F. M.[1], Vikneswaran, T.[1], Siriwardhana, M. G. H.[1], Ketawala, K. M. U. M.[1], Aynharan, S.[1], Tharshanth, H. A.[1], Sumantha, S.[1] and Fernando, P. R.[1]*

Abstract. De-husking with traditional hand tools like machete or a spike depends on the skill of worker and involves training. Nowadays there is shortage of such skilled Workers. These affect the production rate of de-husking the coconut also more hazardous and harmful to user. To overcome the limitations and problems in the present methods a manual or automated machine should be design and fabricate. This research project is to design and fabricate a low-cost coconut husk removing machine. The main purpose of this machine is to eliminate problems and limitations involved in de-husking process and to promote some small-scale industries and self-employment especially for women. The machine with manual loading and unloading of coconuts will yield productivity higher than the existing process with less man power. Also, the machine can accommodate different sizes of the coconut that are cultivated anywhere in Sri Lanka. Also, various experiments have been conducted on both dry and mature coconuts in order to determine the force required to de-husk the coconut. The main aim of this research project is to reduce the human efforts and to increase the rate of de-husking the coconut. This machine takes into consideration the dangers, hazards and risks involved in de-husking the coconut which will be efficient, productive, environmentally friendly, less labors, easy to use and most importantly cost effective in production, maintenance and repair. Test result and assessment of the present manual machine in both laboratory and field conditions are also reported. Safety aspects are incorporated. The unit can de-husk about 70 coconuts per hour compared with about 40 nuts per hour from a skilled worker using the spike method. It can be operated by unskilled laborers. Cost benefit analysis indicates that it should be commercially viable.

Key words. *Coconut husk remover, de-husking, environmentally friendly, manual machine, self-employment*

[1]Department of Physics, Faculty of Science, Eastern University, Sri Lanka.
*Corresponding author. rodneyp@esn.ac.lk